PROFITABILITY AND TECHNICAL EFFICIENCY OF BORO RICE PRODUCTION IN SOME SELECTED AREAS OF PANCHAGARH DISTRICT IN BANGLADESH

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*This is to certify that thesis entitled, **"PROFITABILITY AND TECHNICAL EFFICIENCY OF BORO RICE PRODUCTION IN SOME SELECTED AREAS OF PANCHAGARH DISTRICT IN BANGLADESH**"submitted to the Faculty of Agribusiness Management, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE IN AGRICULTURAL ECONOMICS,** embodies the result of a piece of bona fide research work carried out by **Kazi Faysal Ahmed**, Registration No. **12-04903** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.*

I further certify that such help or source of information, as has been availed of during the course of this investigation has duly been acknowledged.

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TO

MY BELOVED PARENTS

ABSTRACT

Boro is the most important and single largest crop in Bangladesh in respect of volume of production. It has been persistently contributing to higher rice production in last successive years. Present study was designed to measure the profitability and technical efficiency of Boro farmers in selected areas of three upazillas namely Sadar, Tetulia and Debigonj under Panchghar district. Primary data were collected from randomly selected total70 farmers from the study area. Both tabular and functional analyses were applied in this study. The major findings of the study revealed that Boro production is profitable. Total cost of production of Boro was Tk. 86473.85 per hectare. Gross return of Boro was Tk. 106114 per hectare and that of net return was Tk. 19640.15 per hectare, respectively. Benefit Cost Ratio (BCR) was found to be 1.23 which implies that one-taka investment in Boro production generated return Tk.1.23. The Cobb-Douglas stochastic frontier production function was used for this study to measure technical efficiency of Boro farmers. The coefficients of parameters like human labor, TSP and insecticide was negative. Where seed, urea and irrigation was found positive and significant at 1, 5 and 10 percent level of significant respectively. The study revealed that a considerable improvement took place to increase household income of the farmers in the study area and to improve the socioeconomic conditions with the introduction of large-scale commercial Boro production. The study also identified some problems and constraints faced by the Boro farmers and suggested some recommendations to improve the present production situation so that yield of Boro would possibly be increased.

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Kazi Faysal Ahmed

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ABBREVIATIONS AND ACRONYMS

BRRI	: Bangladesh Rice Research Institute
BBS	: Bangladesh Bureau of Statistic
BCR	: Benefit Cost Ratio
BDT	: Bangladeshi Taka
BER	: Bangladesh Economic Review
DAE	: Department of Agricultural Extension
et al.	: and others (at elli)
GR	: Gross Return
gm	: Gram
ha	: Hectare
HIES	: Household Income and Expenditure Survey
HYV	: High Yielding Variety
IOC	: Interest on Operating Capital
kg	: Kilogram
MoP	: Muriate of Potash
Mt	: Metric Ton
NGO	: Non-Government Organization
SRC	: Spices Research Center
T	: Ton
TC	: Total Cost
TFC	: Total Fixed Cost
Tk.	: Taka
TSP	: Triple Super Phosphate
TVC	: Total Variable Cost
US	: United States
USDA	: United States Department of Agriculture
$	: Dollar

CHAPTER 1

INTRODUCTION

1.1 General Background

Agriculture is the largest employment sector in Bangladesh. The performance of this sector has an overwhelming impact on major macroeconomic objectives like employment generation, poverty alleviation, human resources development, food security, etc. A plurality of Bangladeshis earns their living from agriculture. Rice can be grown and harvested three times a year in many areas. Among them boro is the highest yielding production season. Rice production in the immediate past boro season shot up to a new high of 1.95 crore tons, pulling the total output of the staple to 3.62 crore tons in the immediate past fiscal year, enough to meet domestic demand. The latest production estimate of boro is 8.67 percent higher than 1.80 crore tones harvested in 2016-17, according to the Bangladesh Bureau of Statistics. “Based on the production figures, should have a surplus of about 30 lakh tons,” by Bangladesh Rice Research Institute (BRRI, 2018), the state agency responsible for developing improved rice varieties.

The BRRI estimates that the country's annual demand for rice stands at 3.30 crore tons. The area for plantation increased in the last boro season. There is also improvement in the yield. Farmers grew rice on 48.59 lakh hectares of land in the last boro season, up 8.58 percent from a year ago. Areas dedicated to the previous two crops – aus and aman – had also risen amid farmers' enthusiasm to cultivate rice on the back of higher prices prevailing in the domestic market for more than a year. Rice production in the aus season shot up 27 percent year-on-year to 27.09 lakh tones in 2017-18. Aman output rose 2.46 percent to 1.39 crore tones in the just concluded fiscal year 2017-18. The boro season starts in December-February and ends in April-May. Planting of aus starts in April-May and the harvesting takes place in July-August, while the aman season begins in April-May and ends in November-December. (Parvez, August 02, 2018).

1.2 Present Status of Bangladesh Agriculture

Bangladesh is predominantly an agricultural country where agriculture sector plays a vital role in accelerating the economic growth. It is therefore important to have a profitable, sustainable and environment-friendly agricultural system in order to ensure long-term food security for people. Broad agriculture sector has been given the highest priority in order to make Bangladesh self-sufficient in food. The Government determined to develop the overall agriculture sector keeping in view of the goals set out in the Seventh Five Year Plan and National Agriculture Policy. Over the last few years, there has been an increasing trend in food production. Agriculture sector plays an important role in overall economic development of Bangladesh. The agricultural sector (crops, animal farming, forests and fishing) contributes 14.10 percent to the country's GDP (BBS, 2018), provides employment about 39 percent of the labour force according to Quarterly Labour Force Survey (2016-17). Moreover, agriculture is the source of wide range of consumer demanded agricultural commodity markets, especially in rural areas. GDP from Agriculture in Bangladesh increased to 10739.10 BDT Million in 2019 from 10468.80 BDT Million in 2018. GDP From Agriculture in Bangladesh averaged 9012.60 BDT Million from 2006 until 2019, reaching an all-time high of 10739.10 BDT Million in 2019 and a record low of 7017.10 BDT Million in 2006.(BBS, 2018).

According to the final estimate of BBS, the volume of food grains production in FY2015-16 stood at 388.17 lakh MT of which Aus accounted for 22.89 lakh MT, Aman 134.83 lakh MT, Boro 189.38 lakh MT, wheat 13.48 lakh MT and maize 27.59 lakh MT. In FY2016-17 food grains production stood at 388.14 lakh MT of which Aus accounted for 21.33 lakh MT, Aman 136.56 lakh MT, Boro 180.24 lakh MT, wheat 14.23 lakh MT and maize 35.78 lakh MT. Table 7.1 shows the food grains production status during the period from FY2008-09 to FY2016-17.

Table 1.1: Food Grains Production(In lakh MT.)

Food Grains	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
Aus	21	22.18	21.33	23.33	21.58	23.26	23.28	22.89	21.33
Aman	122.25	126.6	127.91	127.98	128.97	130.23	131.9	134.83	136.56
Boro	182.87	185.25	186.17	187.59	187.78	190.07	191.9	189.38	180.24
Total Rice	326.12	333.71	335.41	338.9	338.33	343.56	347.1	347.1	338.13
Wheat	9.58	10.39	9.72	9.95	12.55	13.02	13.48	13.48	14.23
Maize	11.37	13.7	15.52	19.54	21.78	25.16	23.61	27.59	35.78
Total	347.07	358.12	360.65	368.39	372.66	381.74	384.2	388.17	388.14

Source: Bangladesh Bureau of Statistics (BBS) and DAE, 2019

1.3 Importance of Boro Rice

Rice is the amazing food grain that shapes the diets, culture, economy and the way of life in Bangladesh. Keeping this in mind, since the independence all the successive governments have given high priority for attaining self-sufficiency in food production. The development of high yielding modern grain varieties of rice which are highly responsive to inorganic fertilizer and insecticides, effective soil management and water control helped the country to meet the increasing food grain (Hayami and Ruttan, 1985). Among the high yielding varieties boro rice varieties have maximum share to the total rice production which is more or less stable over the last decades. Rice is the staple food for the general people of Bangladesh.

Accordingly, the demand for rice is constantly rising and 2.3 million people being added each year to its total population. Rice constitutes about 70 percent of total calorie intake for the people particularly for hard working people. Rice covers an area of about 11.53 million hectares and is by far the most important provider of rural employment. The area, production and yield rate of rice, in general and boro, in particular, for different years were shown in Table 1.2.

Table 1.2: Area and Production of Rice and Boro Rice by Different Years

Year	Production ('000' MT)		
	Rice	**Boro Rice**	**% of Boro Rice**
2001-02	25085	11766	46.90
2002-03	23834	12222	51.28
2003-04	25187	12838	50.97
2004-05	25157	13837	55.00
2005-06	27520	13975	50.78
2006-07	27319	14965	54.78
2007-08	28931	17762	61.39
2008-09	31317	13084	41.78
2009-10	31975	18059	56.48
2010-11	33542	18617	55.50
2011-12	33988	18759	55.19
2012-13	33826	18778	55.51
2013-14	34356	19007	55.32
2014-15	34710	19192	55.29
2015-16	34701	18937	54.57
2016-17	33804	18014	53.29

Source: BBS, 2018

1.4 Boro Production in Panchagarh

Panchagarh farmers have started Boro cultivation with a target of bringing 46,500 hectares of land under its cultivation this year. Department of Agriculture Extension (DAE) sources said a total of 46,500 hectares of arable land have been brought under the Boro cultivation in all five upazilas of the district with the production target of 3,27,000 metric tons of fresh Boro rice (Boro Cultivation begins in Panchagarh, 2019, February 12). The department has given training on modern technology to the farmers to achieve the production target. The Bangladesh Agriculture Development Corporation (BADC) distributed high quality Boro seed to the farmers of the district at fair price.

Table 1.3: Yearly Boro Production in Panchagarh

Years	Acres	Production(M.T)
2015-16	85802	134516
2016-17	78473	126834
2017-18	114855	324589

Source: BBS, 2018

1.5 Nutritive and Medicinal Value of Boro Rice

Rice is the staple food of over half the world’s population. It is the predominant dietary energy source for 17 countries in Asia and the Pacific, 9 countries in North and South America and 8 countries in Africa. Rice provides 20% of the world’s dietary energy supply, while wheat supplies 19% and maize (corn) 5% (International Food Research center). A detailed analysis of nutrient content of rice suggests that the nutrition value of rice varies based on a number of factors. It depends on the strain of rice, that is between white, brown, red, and black (or purple) varieties of rice, each prevalent in different parts of the world. It also depends on nutrient quality of the soil rice is grown in, whether and how the rice is polished or processed, the manner it is enriched, and how it is prepared before consumption.

About 40 percent of the world’s population derives most of their calories from rice. Almost 90 percent of the population of Bangladesh, Myanmar, Sri Lanka, Vietnam and Kampuchea are rice eaters.

Table 1.4: Nutrients from Per 100 gm Rice

Composition	Rice
Calories (k. calorie)	325
Moisture content (percent)	13.3
Carbohydrate (percent)	79
Protein (gm)	6.4
Fat (gm)	0.4
B-carotine (µg)	0
Vitamin B (mg)	0
Thiamin	0.21
Riboflovine	0.09
Vitamin C (mg)	0
Calcium (Ca) (mg)	9
Iron (Fe) (mg)	1

Source: Bose and Som, 1986; Wahed and Anjan, 2008

The Food Department of the Government of Bangladesh recommends 410 gm of rice/head/day. The opportunity cost of food imports may be high in terms of lower investment and consequently reduced rate of economic growth (Ghatak and Ingersent, 1984). The overall performance of the economy is, therefore, yet intricately linked to the performance of the agricultural sector. Hence, it is evident that Bangladesh should develop its agricultural sector to attain economic development.

The total area of Bangladesh is about 14.845 million hectares of which 53.89 percent is cultivable, 3.16 percent is current fallow land and rest 42.95 percent is covered by homesteads, rivers, tidal creeks, lakes, ponds, roads, etc. So there is a little scope left to increase agricultural output by bringing new land under cultivation. Increase in agricultural output could be attained, however, by using High Yielding Varieties (HYV) and adopting improved cultural and management practices. In the past, growth of agriculture in Bangladesh has centered on food grain production rice alone comprises over 90 percent of that growth. Massive increase in rice production led to the decline in area of tubers, pulses, spices, oilseeds, roots, and other minor crops. Thus Bangladesh has to import spices at the cost of its hard earned foreign currency.

Realizing the importance of minor crops for the improvement of nutritional status of the people, the government of Bangladesh has taken a Crop Diversification Program (CDP) in the Sixth Five-Year Plan (2011-2015). Under the CDP strategy, emphasis was placed to increase production and consumption of those nutrient rich foods. The diversification has not yet taken place adequately within the crop sector, which is still dominated by the production of cereals.

1.6 Justification of the Study

Rice is the staple food of about 135 million people of Bangladesh. It provides nearly 48% of rural employment, about two-third of total calorie supply and about one-half of the total protein intakes of an average person in the country. Rice sector contributes one-half of the agricultural GDP and one-sixth of the national income in Bangladesh. Almost all of the 13 million farm families of the country grow rice. Rice is grown on about 10.5 million hectares which has remained almost stable over the past three decades. About 75% of the total cropped area and over 80% of the total irrigated area is planted to rice. Thus, rice plays a vital role in the livelihood of the people of Bangladesh.

Total rice production in Bangladesh was about 10.59 million tons in the year 1971 when the country's population was only about 70.88 millions. However, the country is now producing about 35.7 million tons to feed her 167.4 million people. This indicates that the growth of rice production was much faster than the growth of population. This increased rice production has been possible largely due to the adoption of modern rice varieties on around 66% of the rice land which contributes to about 73% of the country's total rice production. However, there is no reason to be complacent. The population of Bangladesh is still growing by two million every year and may increase by another 30 million over the next 20 years. Thus, Bangladesh will require about 27.26 million tons of rice for the year 2020. During this time total rice area will also shrink to 10.28 million hectares (MIS&M, 2019).

Rice yield therefore, needs to be increased from the present 2.74 to 3.74 t/ha. The weather condition for boro cultivation was favorable in the growing stage this year. But due to flash flood in some northern districts (boro) crop under 40,198 hectares of land was fully damaged for FY 2015-16 (Source: Bangladesh Rice Knowledge Bank). In a subjective manner, farmers were interviewed on some points relating to management system of seed, fertilizer and rural electricity supply. They opined that proper management and timely distribution of seed, fertilizer and stable supply of electricity led to higher yield of boro this year.

1.7 Specific Objectives of the Study

In view of the problem as stated above, the following specific objectives were formulated for giving proper direction to the study:

a) To determinate the socio-economic profile of the Boro growers;

b) To determine the profitability of Boro production;

c) To analyze technical efficiency of Boro growers; and

d) To draw conclusions and formulate some suggestions for necessary interventions with a view to increasing production of Boro.

CHAPTER 2
REVIEW OF LITERATURE

In this chapter, an attempt has been made to review of pertinent literature keeping in view the problem entitled, “**Profitability and technical efficiency of Boro production in some selected areas of Panchagarh District in Bangladesh.”** Again, some of these studies may not entirely relevant to the present study, but their findings, methodology of analysis and suggestions have a great influence on the present study. Review of some research works relevant to the present study, which have been conducted in the recent past, are discussed below.

Rahman et al. (2013) conducted a study to estimate the technical efficiency of boro production in Bangladesh. The study used activity budgeting technique to calculate profitability and stochastic frontier production function model to measure the efficiency of boro farming. It showed that the farmers’ age, education and training had positive significant impact on efficient boro production.

Akter (2011) studied on profitability and resource use efficiency of BRRI Dhan29 in old Brahmaputra floodplain area of Tangail district with a sample of 60 farmers using Cobb-Douglas production function and found that total return of BRRI Dhan29 was higher than total cost.

Banu (2011) studied on economic analysis of BR-28, BR-29 and Hybrid Hira rice production in Kurigram district with a sample of 90 farmers considering Cobb-Douglas production function and found that Hybrid Hira was more profitable than BR-28 and BR-29 rice as the net return was much higher than BR-28 and BR-29.

Kamruzzaman (2011) studied on economic potential of BRRI Dhan-51 and BR-11 rice production in Rangpur district with a sample of 60 farmers considering Cobb Douglas production function and found that BRRI Dhan-51 had higher gross return than BR-11.

Hanifa (2009) studied on economic analysis of BR-29 and Hybrid Hira rice production in Netrokona district with a sample of 80 farmers using Cobb-Douglas production function and found that total returns from Hybrid Hira rice per hectare was higher than BR-29.

Siddiqui (2008) studied on economic profitability of BRRI Dhan33 and BR-11 rice production in Kurigram district with 60 farmers using Cobb-Douglas production function and found that gross return for BRRI Dhan33 was higher than BR-11.

Ullah (2008) studied on comparative profitability and technical efficiency of aromatic and non-aromatic aman rice production in Dinajpur district with a sample of 60 farmers using stochastic frontier analysis and found that profitability of BRRI Dhan 34 (aromatic) was much higher than BR-11 rice (non-aromatic) as the total return from BRRI Dhan 34 was higher than BR-11.

Islam *et al.* (2007) carried out a study to examine the income and price elasticities of demand for different types of rice in Bangladesh. The total budget for cereal field allocated to aromatic, fine, course rice and wheat was 4.0%, 23.3%, 65.2% and 7.5% respectively. The estimated expenditure elasticities of demand for those types of cereal were 0.85, 0.79, 0.29 and 0.55 respectively.

Majid and Haque (2007) conducted a study on Monga mitigation for employment and food security increase through early aman rice production and crop diversification in greater Rangpur region of Bangladesh. Introducing of cash crop in potato growing time (early to late November) contributed more productivity (32.4-39.3 MT/ha) than Rice-Non-Rice system as Rice-Rice (13.2 MT/ha). The highest rice equivalent yield associated with early Aman Rice-Potato-Mungbean (37.4 MT/ha) and Early Aman Rice-Potato-Rice (Bolan/older seedling of BRRI Dhan-33) (32.4-32.6 MT/ha). However, early Aman Rice-Potato-Mungbean gave lower productivity than Rice-Potato-Relay Maize/Maize but Mungbean added some biomass in the soil for soil health.

Anik (2003) studied on economic and financial profitability of aromatic and fine rice production in Dinajpur and Sherpur district with a sample of 70 farmers using Cobb-Douglas production function and found that aromatic rice was more profitable than fine rice as the net return was higher than fine rice.

Thakur (2003) studied on local boro and hybrid boro rice production in Brahmanbaria district with a sample of 60 farmers considering Cobb-Douglas production function and found that the net return of hybrid Boro rice was 15.04% higher than local boro rice.

Quazi and Paul (2002) conducted a study on comparative advantages of crop production in Bangladesh. In their study, the economic profitability analysis demonstrates that Bangladesh has a comparative advantage in domestic production of rice for import substitution. However, at the export parity price, economic profitability of rice is generally less than economic profitability of many non-rice crops, implying that Bangladesh has more profitable options other than production for rice export. Several non-cereal crops, including vegetables, potatoes and onions have financial and economic returns that are as high as or higher than those of High Yielding Variety (HYV) rice.

Rahman *et al.* (2002)attempted to measure the technical efficiencies obtained by owner operated farming and share cropping for boro, aus and aman rice were 86 percent, 93 percent and 80 percent, respectively whereas mean technical efficiencies obtained by sharecroppers for boro, aus and aman rice were respectively 73 percent, 76 percent and 72 percent. The study reveals that owner operators were technically more efficient than sharecroppers in the production of all the rice crops. To reduce the difference of technical efficiencies between owner operator and sharecropper a perfect leasing system is inevitable.

Akter (2001) conducted a study on relative profitability of alternate cropping patterns under irrigation condition in some selected area of Barguna district. The relative profitability of 5 dominant cropping patterns in two villages of Barguna district Bangladesh was assessed. The cropping patterns considered were (1) T. Aus Rice-T. Aman rice-HYV Boro rice; (2) T. Aus rice-T. Aman rice-wheat; (3) T. Aman rice-Jute-HYV Boro rice; (4) T. Aman rice -chilli-fallow; and (5) T. Aman Rice-Jute-potato. Data were obtained through interviews with 60 farmers 10 farmers from each cropping pattern during June-August 2000. Cropping pattern 1 had the highest per hectare gross margin (Tk. 43312) and net return (Tk. 27643). While cropping pattern 4 had the lowest gross margin (Tk. 29575) and net return (Tk. 19000). The inclusion of HYV boro rice as a third crop in the cropping pattern increased bom income and employment.

Islam (2001) studied on economic potential of Bina-6 rice production in Mymensingh district with a sample of 55 farmers considering Cobb-Douglas production function and found that BINA-6 rice production was profitable because the total return was much higher than total cost of production.

Ali (2000) attempted to measure and compare resource use and land productivity within tenure groups. Total gross cost for producing aman, boro and aus were the highest in owner farms and the lowest in tenant farms. It observed that owner operators used higher level of inputs than owner-cum-tenant and tenant operators. Rice owner-cum-tenant operators obtained higher yield in Aman and Aus production then owner and tenant operators. In Boro paddy production tenant operators obtained maximum net return than owner operators and owner-cum- tenant operators in owner land. Finally, it was concluded that tenancy affects positively on resource use and production in a predictable fashion even in small scale peasant agriculture.

Hasan (2000)studied on the economic potential of alok hybrid rice and found that per hectare total cost for hybrid alok was Tk. 36,276.33 per hectare variable cost was calculated as Tk. 2,927.05 and per hectare yield was 6,557.07 kg. The price of alok paddy was Tk. 7.81/kg. Taking the by product into account the gross return of hybrid alok per hectare was Tk. 5,465.02. The net return per hectare was Tk. 18,375.50 and the gross margin was Tk. 26,409.97.

Mustafi and Azad (2000)conducted a study on adoption of modern rice varieties in Bangladesh. They examined the comparative profitability of BR-28 and BR-29 and found that the average yields 5,980 kg and 6,670 kg per hectare respectively. The gross margin was higher for BR-29 which was Tk. 27,717.02 per hectare. The farm level data also showed that the unit cost of BR-29 and BR-28 were Tk. 4.70 and Tk. 5.12 per kg. They also compared to BR-28 return from BR-29 is higher by Tk. 3,759 per hectare

Research Gaps

The above-mentioned opinions evidently show that only a few studies were conducted on boro rice production. As far from the knowledge of the researcher, no profitability and technical efficiency study on boro rice production was conducted in my study area. The present study was, therefore, undertaken to determine the profitability and resource use efficiency of boro rice production and thereby to facilitate farmers and policy maker's decision making by providing information on boro rice production.

CHAPTER 3
METHODOLOGY

3.1. Introduction

Farm management research depends on the proper methodology of the study. Proper methodology is a prerequisite of a good research. The design of any survey is predominantly determined by the nature, aims, and objectives of the study. It also depends on the availability of necessary resources, materials and time. There are several methods of collecting data for farm management research. A farm business study usually involves collection of information from individual farmers; collection of data for farm business analysis involves judgment of the analyst in the selection of data collection methods within the limits imposed by the resources available for the work (Dillon and Hardaker 1993). In this study, “survey method" was employed mainly due to two reasons:

i. Survey enables quick investigations of large number of cases; and

ii. Its results have wider applicability.

The major disadvantage of the survey method is that the investigator has to rely upon the memory of the farmers. To overcome this problem, repeated visits were made to collect data in the study area and in the case of any omission or contradiction the farmers were revisited to obtain the `missing and/or correct information. The design of the survey for the present study involved the following steps.

3.2. Selection of the Study Area

Selection of the study area is an important step for farm management study. The selection of an area fulfilled the particular purpose which was set for the study and also the possible cooperation from the farmer. Although Boro is grown all over Bangladesh, the district Panchagarh and most of the northern area of Bangladesh are the important districts where it is grown quite extensively.

So, on the basis of higher concentration of boro production, 3big upazila namely Sadar,Tetulia and Debigonj, under of Panchagragh district were purposively selected for the study. The main reasons in selecting the study area were as follows:

a) Availability of a large number of Boro growers in the study area;

b) These villages had some identical physical characteristics like topography, soil and climatic conditions for producing boro.

c) Easy accessibility and good communication facilities in these villages; and

d) Co-operation from the respondents was expected to be high so that the reliable data would be obtained.

3.3. Sampling Technique and Sample Size

In selecting samples for a study two factors need to be taken into consideration. The sample size should be as large as to allow for adequate degrees of freedom in the statistical analysis. On the other hand, administration of field research, processing and analysis of data should be manageable within the limitation imposed by physical, human and financial resources (Mannan 2001). However, because of diversity in the technical and human environment, it is necessary to sample several numbers of the population before any conclusion can be drawn. Therefore, the purpose of sampling is to select a sub-set of the population that is representative of the population (Rahman 2000).

It was not possible to include all the farmers of the study area due to limitation of time, money and personnel. In total 70 farmers were randomly selected. A purposive random sampling technique was followed in the present study for minimizing cost, time and to achieve the ultimate objectives of the study.

3.4 Data Collection

As data collection has a noteworthy impact on the quality of survey results, it is treated as a significant part of a survey. Considering its importance, the following measures were taken during the preparation of questionnaire as the tool of data collection:

3.4.1. Questionnaire Design

A questionnaire is a powerful evaluation tool that allows the collection of data through the use of multi-dimensional questions. A questionnaire written without a clear goal and purpose is inevitably going to overlook important issues and waste enumerators' as well as respondents' time by asking and responding useless questions. All these matters were addressed to the extent possible for developing the questionnaire of survey.

3.4.2. Pre-testing the questionnaire

The questionnaire was pre-tested to examine the time necessary to complete the interview, test the reliability i.e. whether it captured the information desired, and also investigated the consistency whether the information gathered by it was related to the whole purpose of the survey. The test had also targeted to check the logistics required for successful operation of the survey. In order to ensure the best performance of the questionnaire in respect of data collection, processing and analyzing, the pre-testing was carried out during the month of December 2018 and January 2019 prior to the survey at rural area of Sadar,Tetulia and Debigonj, under of Panchagragh District. Myself chosen some of the farmers at random as the respondents.

3.4.3. Finalization of the questionnaire &method of data collection

After addressing all the changes following the recommendations evolved from the pre-test, the questionnaire was placed to my supervisor. My supervisor also put notable contribution to the questionnaire. Eventually, the questionnaire had been finalized with the approval. Face to face interview had been carried out following questionnaire.

3.4.4. Data editing and coding data editing and coding

Data Editing and Coding Data editing and coding were other vital phases of the survey, which were indispensable for data processing. It should be completed before data processing. In case of this survey coding had been done along with questionnaire development so that the enumerator could easily and accurately mark the right answers. Data editing referred to the activity of checking and cleaning data that had already been collected from the field.

3.5. Data processing

Data processing involved many steps that were very important because it affected survey results according to the involved steps. During data processing following steps had been taken.

- Data entry
- Appending and Merging files
- Data validation (further computer checking, editing, and imputation)
- Final decision on errors
- Completion of data processing and generation of data files
- Final documentations
- Conversion of data files to another software.
- Storage of all files.

3.6. Processing, Tabulation and Analysis of Data

The collected data were manually edited and coded. Then all the collected data were summarized and scrutinized carefully. Moreover, data entry was made in computer and analyses were done using the concerned software Microsoft Excel and STATA. It may be noted here that information was collected initially in local units. After necessary checking it was converted into standard international units.

3.7 Analytical Techniques

Data were analyzed with a view to achieving the objectives of the study. Several analytical methods were employed in the present study. Tabular method was used for a substantial part of data analysis. This technique is intensively used for its inherent quality of purporting the true picture of the farm economy in the simplest form. Relatively simple statistical techniques such as percentage and arithmetic mean or average were employed to analyze data and to describe socioeconomic characteristics of boro growers, input use, costs and returns of boro production and to calculate undiscounted benefit cost ratio (BCR).

In order to estimate the level of technical efficiency in a manner consistent with the theory of production function, Cobb-Douglas type stochastic frontier production function was used in the present study.

3.7.1 Profitability Analysis

The net returns of boro were estimated using the set of financial prices. The financial prices were market prices actually received by farmers for outputs and paid for purchased inputs during the period under consideration in this study. The cost items identified for the study were as follows-

- ✓ Land preparation
- ✓ Human labor
- ✓ Seedlings
- ✓ Urea
- ✓ TSP
- ✓ MoP
- ✓ Insecticide
- ✓ Irrigation
- ✓ Interest on operating capital
- ✓ Land use

The returns from the crops were estimated based on the value of main and by product. In this study variable cost, fixed cost and total cost had been described. Total variable cost (TVC) included land preparation, human labor, seedlings, organic manure, urea, TSP, MoP, insecticides and irrigation. Fixed cost (FC) included rental value of landand interest on operating capital. Total cost (TC) included total variable cost and fixed cost.

Cost of Land Preparation

Land preparation considered one of the most important components in the production process. Land preparation for boro production included ploughing, laddering and other activities needed to make the soil suitable for planting seedling. It was revealed that the number of ploughing varied from farm to farm and location to location.

Cost of Human Labor

Human labor cost was considered one of the major cost components in the production process. It is generally required for different operations such as land preparation, sowing and transplanting, weeding, fertilizer and insecticides application, irrigation, harvesting and carrying, threshing, cleaning, drying, storing etc. In order to calculate human labor cost, the recorded man-days per hectare were multiplied by the wage per man-day for a particular operation.

Cost of Seed

Cost of seed varied widely depending on its quality and availability. Market prices of seeds of respected boro were used to compute cost of seed. The total quantity of seed needed per hectare was multiplied by the market price of seed to calculate the cost of seeds for the study areas.

Cost of Urea

Urea was one of the important fertilizers in boro production. The cost of urea was computed on the basis of market price. In order to calculate cost of urea the recorded unit of urea per hectare were multiplied by the market price of urea.

Cost of TSP

The cost of TSP was also computed on the basis of market price. In order to calculate cost of TSP the recorded unit of TSP per hectare were multiplied by the market price of TSP.

Cost of MoP

Among the three main fertilizers used in boro production, MoP was one of them. To calculate the cost of MoP per hectare, the market price of MoP was multiplied by per unit of that input per hectare for a particular operation.

Cost of Insecticides

Farmers used different kinds of insecticides for 5-7 times to keep their crop free from pests and diseases. Cost of insecticides was calculated based on the market price of the insecticides which was used in the study areas per hectare.

Cost of Irrigation

Water management helps to increase boro production. Cost of irrigation varies from farmers to farmers. It was calculated based on how many times irrigation was needed per hectare and what was its cost.

Interest on Operating Capital

The operating capital actually represented the average operating cost over the period because all costs were not incurred at the beginning or at any single point of time. The cost was incurred throughout the whole production period;

Hence, at the rate of 12 percent per annum interest on operating capital for four months was computed for boro. Interest on operating capital was calculated by using the following formula:

IOC= AI*i*t

Where,

IOC= Interest on operating capital

i= Rate of interest

AI= Total investment / 2

t = Total time period of a cycle

Land Use Costs

Land use cost was calculated on the basis of opportunity cost of the use of land per hectare for the cropping period of four months. So, cash rental value of land has been used for cost of land use.

Calculation of Returns

Gross Return

Per hectare gross return was calculated by multiplying the total amount of product and by-product by their respective per unit prices.

Gross Return= Quantity of the product * Average price of the product + Value of by-product.

Gross Margin

Gross margin is defined as the difference between gross return and variable costs. Generally, farmers want maximum return over variable cost of production. The argument for using the gross margin analysis is that the farmers are interested to get returns over variable cost. Gross margin was calculated on TVC basis.

Per hectare gross margin was obtained by subtracting variable costs from gross return. That is,

Gross margin = Gross return – Variable cost

Net Return

Net return or profit was calculated by deducting the total production cost from the total return or gross return. That is,

Net return = Total return – Total production cost.

Undiscounted Benefit Cost Ratio (BCR)

Average return to each taka spent on production is an important criterion for measuring profitability. Undiscounted BCR was estimated as the ratio of total return to total cost per hectare.

BCR = Total return (Gross return)/ Total cost

3.7.2 Technical Efficiency Analysis

Technical efficiency refers to the ability of a firm to produce the maximum possible output from a given set of inputs and given technology. A technically efficient farm will operate on its frontier production function. Given the stated relationship the firm is technically efficient if it produces on its outer-bound production function to obtain the maximum possible output which is feasible under the current technology. Putting it differently a firm is considered to be technically efficient if it operates at a point on an isoquant rather than interior to the isoquant. The homogeneity of inputs is a vital factor for achieving technically efficient output.

No one would dispute that the output produced from given inputs is a genuine measure of efficiency, but there is room for doubt whether, in a particular application, the inputs of a given firm are really the same as those represented by the corresponding point on the efficient isoquant. But it is important to note that mere heterogeneity of factors will not matter, as long as it is spread evenly over firms, it is when there are differences between firms in the average quality (or more strictly, in the distribution of qualities) of a factor, that a firm's technical efficiency will reflect the quality of its inputs as well as the efficiency of its management.

3.7.2.1 The Stochastic Frontier Models

The most widely discussed, theoretically reasonable and empirically competent method of measuring efficiency is the stochastic frontier model. It is an improvement on the traditional average production function and on all types of deterministic frontiers in the sense that it introduces in addition to one-sided error component a symmetric error term to the model. This permits random variation of the frontier across farms, and captures the effects of measurement error, other statistical noise arid random shocks outside the firm's control. A one-sided component captures the effects of inefficiency relative to the stochastic frontier. The stochastic frontier model is also called the 'composed error' model introduced by Aigner, Lovell and Schmidt (1977). It was later extended and elaborated by Jondrow *et al*. (1982).

The notion of a deterministic frontier shared by all farms ignores the very real possibility that a farm’s performance may be affected by factors entirely outside its control (such as poor machine performance, bad weather, input supply breakdowns, and so on), as well as by factors under its control (inefficiency). But stochastic frontiers consider all the factors while estimating the model and accordingly it separates firm- specific efficiency and random error effect. Thus the efficiency measurements as well as the estimated parameters are unbiased.

3.7.2.2 The Stochastic Frontier with Cobb-Douglas Production Function

The Cobb-Douglas production function is probably the most widely used form for fitting agricultural production data, because of its mathematical properties, ease of interpretation and computational simplicity (Heady and Dillion, 1969; Fuss and Mcfadden, 1978). The Cobb-Douglas function has convex isoquants, but as it has unitary elasticity of substitution; it does not allow for technically independent or competitive factors, nor does it allow for Stages I and III along with Stage II. That is, MPP and APP are monotonically decreasing functions for all X- the entire factor-factor space is Stage II-given $0 < b < 1$, which is the usual case.

However, the Cobb-Douglas may be good approximation for the production processes for which factors are imperfect substitutes over the entire range of input values. Also, the Cobb-Douglas is relatively easy to estimate because in logarithmic form it is linear in parameters; it is parsimonious in parameters (Beattie and Taylor, 1985).

A stochastic Cobb-Douglas production frontier model may be written as

$Y_i = f\ (Xi,\beta)\ \exp.(V_i\text{-}U_i)\ i = 1, 2, 3, \ldots\ldots\ldots, N$

Where the stochastic production frontier is f(Xi,β)exp.(Vi), Vi having some symmetric distribution to capture the random effects of measurement error and exogenous shocks which cause the placement of the deterministic kernel f(Xi,β) to vary across firms.

The technical inefficiency relative to the stochastic production frontier is then captured by the one-sided error component Ui > 0.

The explicit form of the stochastic Cobb-Douglas production frontier is given by

$$Y_i = \alpha X_{1i}^{\beta 1}\ X_{2i}^{\beta 2} X_{3i}^{\beta 3} X_{4i}^{\beta 4} X_{5i}^{\beta 5}\ X_{6i}^{\beta 6} e^{ui}$$

Where Y is the frontier output, X is physical input, b the elasticity of Y with respect to X, a is intercept and Ɛ = V-U is a composed error term as defined earlier. For simplicity, we have ignored the subscript.

3.7.2.3 Specification of Production Model

We have specified the Cobb-Douglas Stochastic Frontier Production Function in order to estimate the level of technical efficiency. The functional form of stochastic frontier is as follows:

$Y = \beta_0 X_1 \beta_1\ X_2 \beta_2\ \ldots\ldots\ldots X_6 \beta_6\ eV_i\text{-}U_i$

The above function is linearized double-log form:

$\ln Y = \ln\beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + V_i\text{-}U_i$

Where,

Y = Revenue (Tk/ha)

X_1 = Human labour cost (Tk/ha)

X_2 = Seed Cost (Tk/ha),

X_3= Urea cost (Tk/ha)

X_4= TSP cost (Tk/ha)

X_5 = Cost of insecticide cost (Tk/ha)

X_6 = Irrigation cost (Tk/ha).

The model of the technical inefficiency effects in the stochastic production frontier equation is defined by

$U_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + + W_i$

Where,

Z_1…….. Z_5 are explanatory variables.

The equation can be written as:

$Ui = \delta_0 + \delta_1$Boro farming experience + δ_2 Farm size + δ_3 Extension service + δ_4 Training + δ_5Taking loan + W_i

V is two-sided uniform random variable beyond the control of farmer having N (0, σ 2) distribution, U is one-sided technical inefficiency effect under the control of farmer having a positive half normal distribution {Ui~|N (0, σu2)|} and W_i is two-sided uniform random variable. W is unobservable random variable having a positive half normal distribution. The model was estimated simultaneously using STATA and MS excel.

CHAPTER 4
DESCRIPTION OF THE STUDY AREA

4.1 Introduction

This chapter presents a brief description of the study area. Knowledge of the study area is very essential to understand the location, physical features and topography, soil type, temperature, rainfall, agricultural and economic condition, population, education and other socioeconomic infrastructure available in the area. This chapter aims at present the above-mentioned characteristics of the study area.

4.2 Location

The study was conducted on some villages of three Upazila namely Sadar Upazila, Tetulia Upazila, Debigonj Upazila of Panchagarh district. Tetulia Upazila, Debigong Upazila are 43 km and 27.5 km respectively from the Panchagarh sadar.

Panchagarh is bounded on the north by Darjeeling District of West Bengal State of India, east by Jalpaiguri District and Coochbihar District of West Bengal State of India and Nilphamari District, south by Dinajpur District and Thakurgaon District and west by West Dinajpur District and Purnia District of West Bengal State of India and Thakurgaon District. It lies between 26º00' and 26º38' north latitudes and between 88º19' and 88º49' east longitudes. The total area of the district is 1404.62 sq. km. (542.00 sq. miles). The location of the study area is shown in Map 4.1.

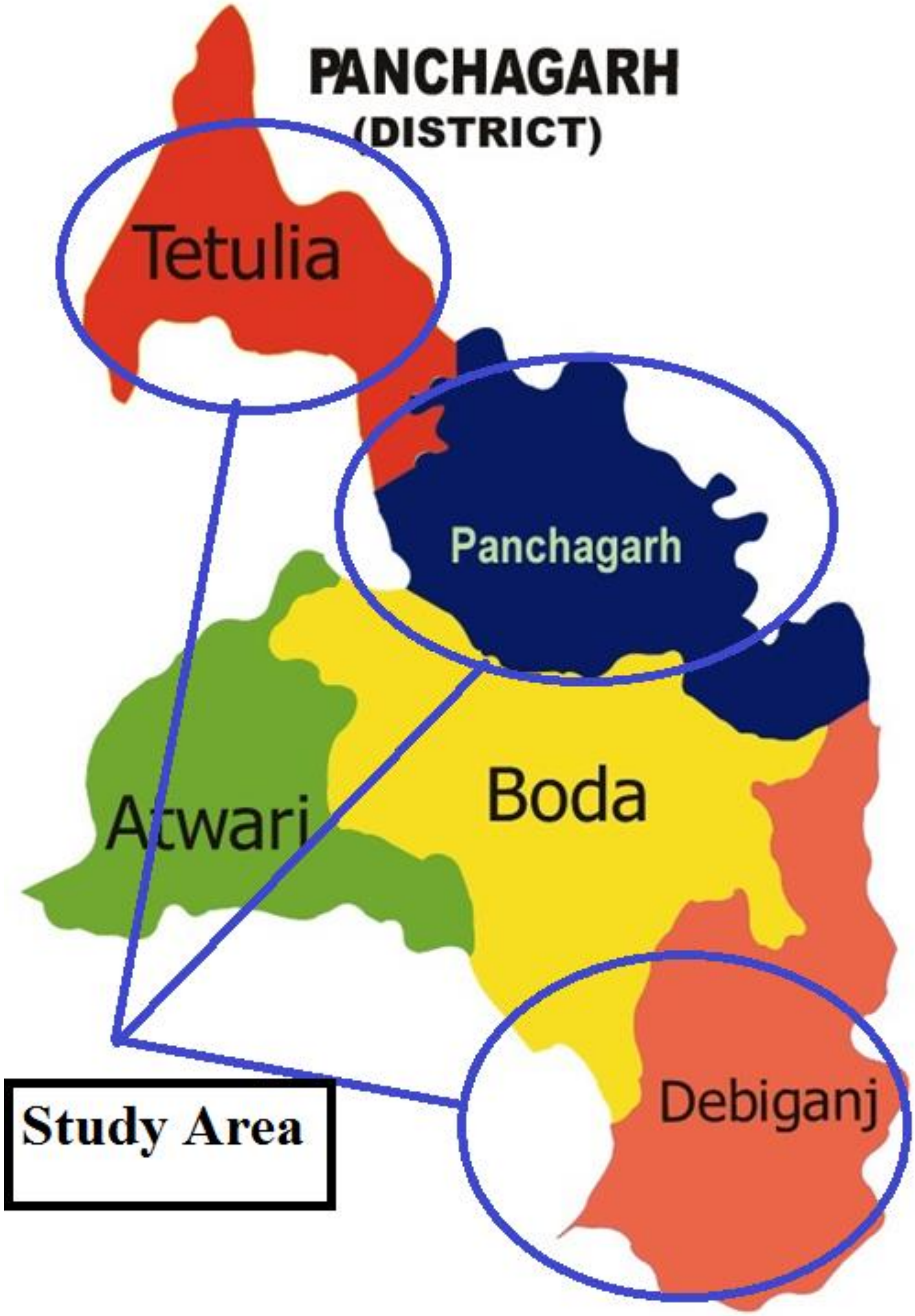

Figure 4. 1: Map of Panchgarh district

4.3 General Information of study area

Table 4.1: Broad classification of Study area(In sq. km.)

Upazila	Total area	Land area
Panchagarh Sadar	347.09	337.05
Tetulia	189.10	178.41
Debigonj	309.02	263.63

Table 4.2: Number of household, population and density of study area

Upazila	House hold	Population			Sex ratio (M/F)	Average size of household	Density per sq. km
		Male	Female	Total			
Panchagarh Sadar	60115	136850	134857	271707	101	4.49	783
Tetulia	27908	63463	61991	125454	102	4.48	663
Debigonj	52411	113120	111589	224709	101	4.28	727

Table 4.3: Population and literacy rate of study area

Upazila	Population			Literacy rate (%)		
	2001	2011	2018	2001	2011	2018
Panchagarh Sadar	193198	229237	271707	34.7	45.7	53.2
Tetulia	86760	105368	86760	25.5	39.0	47.3
Debigonj	159902	185960	159902	24.8	41.1	47.7

4.4 Climate

The annual average temperature of the district varies from maximum 30.2°C to minimum 10.1°C and the average rainfall of the district is 1955 mm. The soil of this district is basically sandy, alluvial and bears close affinity with the soil of the old Himalayan basin. On the northern part of the district there exists underground layer of pebbles.

Table 4.4: Temperature, rainfall, humidity

Years	Temperature (centigrade		Rainfall (millimeter)	Humidity (%)
	Maximum	Minimum		
2016	34.1	9.9	1787	77.0
2016	33.0	12.1	1994	74.0
2017	33.5	8.5	1453	60.3
2018	20.8	3.6	1632	75.8

Source: Bangladesh Meteorological Department

4.5 Agriculture and Economic Condition

Agriculture work signifies all activities of holder and his/her labour force doing planning, management, and operation of a holding.

Main Crops: The major agricultural crops of Panchagarh Zila are paddy, jute, wheat, potato and sugarcane. Extinct and nearly extinct crops are barley, aus paddy and kaun.

Main Fruits: The common fruits found in this zila are mango, wood apple, jackfruit, black berry,guava, banana, tamarind, etc.

Industry: Tea, sugar, rice mill, ice factory, oil mill, and Saw mill.

Banglabandha land port is located in about 10 acres (40,000 m^2) of acquired land at the north-western tip of Bangladesh in Tetulia under Panchagarh district on the Bangladesh-India highway.The port is situated 60 km from Panchagarh Town. The place is of international character and used for Nepal transit traffic passing through a small corridor of India. It is about 22 meter away from the Bangladesh-Indian borderline.

The growing tea sector in Panchagarh has ushered in a new hope for further enhancing the standard of socio-economic life and women empowerment, they said.

The female workers are yet to get their just wages from the garden-owners as the growing tea-farming sector in the region has been facing manifold problems including present unfair prices of the tea leaves for the tea farmers. Presently, over 7,000 skilled and unskilled workers, mostly women, have been working in 246 tea gardens, including 18 big estates, 13 medium-size and 215 small-scale gardens set up on more than 1,815 acres (7.35 km^2) of land in Tetulia and its surrounding areas, they said. Of them nearly 2,300 workers, mostly women, are working alone at the giant 'Kazi and Kazi Tea Estate' (KKTE) at Tetulia which has earned reputation in both national and international markets by producing, processing and marketing the famous and most popular 'Kazi & Kazi Organic Tea' and earning foreign exchange. **Panchagarh Sugar Mills Ltd.** is the oldest industry of the district. Panchagarh Sugar Mills was set up by the Government in 1965-69 at a cost of Tk.55.55 million.

4.6 Transportation

Bi-cycle, rickshaw, motor cycle are the main modes of transport for the local people. Regular buses connect the district to their neighboring districts and subdivisions. The road distance from Dhaka (Capital city of Bangladesh) to Panchagarh is 475 km. Road transportation between Dhaka & Panchagarh is a private sector affair operating predominantly in domestic routes. On 10 November 2018 direct train service from Dhaka to Panchagarh has been inaugurated. The railway distance from Dhaka to Panchagarh is 639 km, which is the longest distance travelled by any train in the country. There is no direct air connection from Dhaka to Panchagarh.

4.7 NGO Activities

Operationally important NGOs are BRAC, ASA, CARE, RDRS, Annesha, JDS, Parshi, South Bengal Development Society, Social Welfare Organisation, Popular Development Society, CIDA, CIDIP, Palli Unnayan Sangstha, TMSS etc.

4.8 Concluding Remarks

From the above discussions it is found that the location of the study area near to the district. Physical features and topography, soil type, temperature and rainfall are favourable for cultivating boro rice. Therefore, various types of agricultural crops were cultivated in the study area. Communication are good for marketing of agricultural crops.

CHAPTER –5

SOCIO-ECONOMIC PROFILE OF HOUSEHOLDPOPULATION

5.1 Introduction

The point of this part is to present a brief description of the socio-economic characteristics of the growers delivering Boro Rice. Socioeconomic l parts of the growers can be viewed from various perspectives relying on various factors identified with their degree of living, the financial condition where they live and the nature and the degree of the growers ' support in national advancement exercises. It was impractical to gather all the data with respect to the financial attributes of the example growers because of confinement of time and assets. Financial state of the example growers is significant in the event of research arranging in light of the fact that there are various interrelated and constituent qualities describes an individual and significantly impacts advancement of his/her conduct and character. Individuals contrast from each other for the variety of financial perspectives. Nonetheless, for the present research, a couple of the financial qualities have been contemplated for exchange.

5.2 Age

There are 25, 25, 20 samples are collected from three upazila named respectively Sadar,Tetulia and Debiganj represented the total population. In Sadar upazila, 56 percent of the sample populations were 20-40 years, 40 percent were 40-60 years and 4 percent were above 60 years old. In Tetulia upazila, 52 percent of the sample populations were 20-40 years, 48 percent were 40-60 years and have no found sample were above 60 years old. In Debiganj upazila, 70 percent of the sample populations were 20-40 years, 30 percent were 40-60 years and no sample found who were above 60 (Figure 5.1**)**. In this figure we saw most of the people age between 40 to 60 years in every upazila.

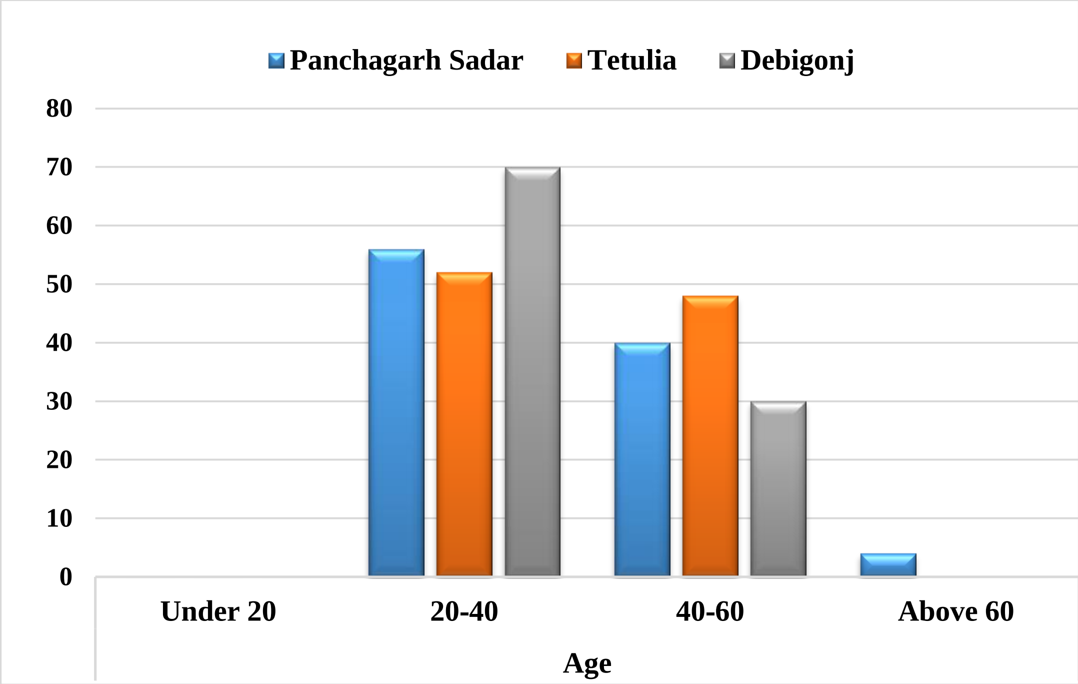

Figure 5.1: Age of the respondent by Study Area

Source: Field survey, 2018

5.3Education

Figure 5.2 showed that, in sadar upazila, about 25 percent of the study population aged 5 years or more were found to have no education and/or read/write, about 10 percent were found to have primary level education, about 45 percent were found to have secondary and/or higher secondary level education and 10 percent people were found to have attained/completed graduation level of education. In Tetulia upazila, about 30 percent of the study population aged 5 years or more were found to have 20 percent education and/or read/write, about 30 percent were found to have primary level education, about 10 percent were found to have secondary and/or higher secondary level education and 10 percent people were found to have attained/completed graduation level of education. In Debiganj upazila, about 20 percent of the study population aged 5 years or more were found to have no education and/or read/write, about 40 percent were found to have secondary and/or higher secondary level education and only 10 percent people were found to have attained/completed graduation level of education.

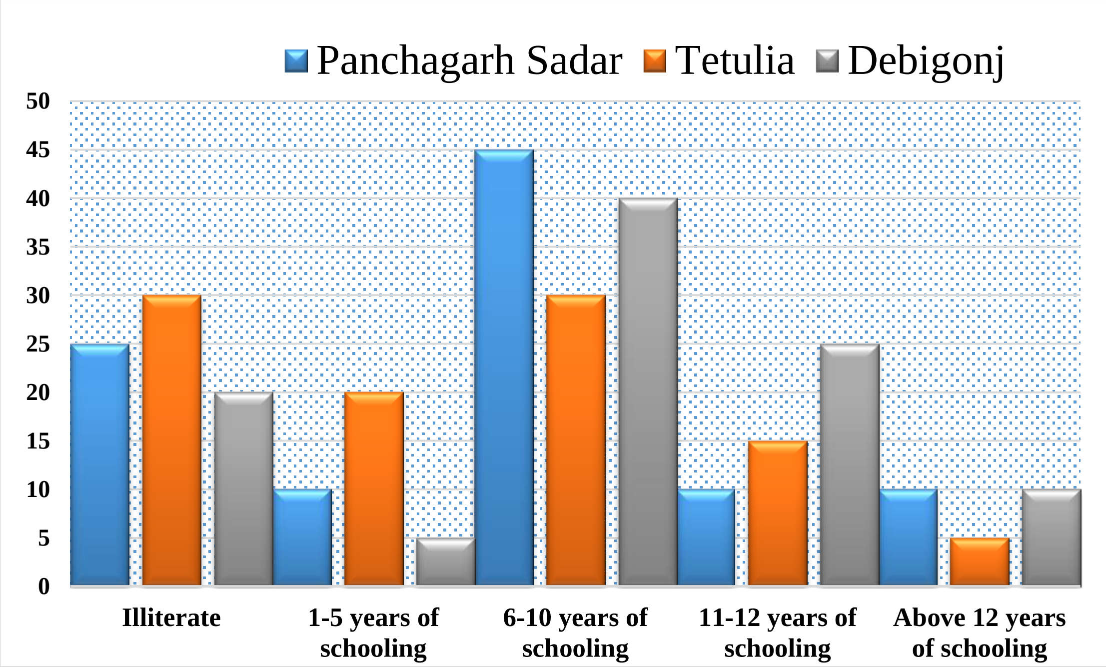

Figure 5.2: Education of the Household Members by Study Area
Source: Field survey, 2018

5.4. Annual Family income

a) Agricultural work

Table 5.1: Agricultural Work

Sector	Average annual Income	Mean
Crops	59837.31	1500275
Poultry	30666.67	
Livestock	26750	
Fisheries	31800	

Crops, poultry, livestock and fisheries are the main agricultural income source of the sample. Most of the framer generates income by agriculture sector. Crop production was the main source of income among them average yearly income from crop production found TK 59837.31. Now a day's poultry has been developed in the study area. Farmer incomes Tk.30666.67 from poultry production per year. The mean value of annual family income by agriculture was Tk1,50,027.5.

b) Non-Agriculture work

Main non agriculture was found day labor, Auto driver, Truck driver, domestic worker, small business, foreign remittance, services. Annual average income by non-agriculture source was found Tk. 1,15,071.4. The total average annual income was found Tk. 2,65,098.9.

5.5. Annual Family Expenditure

Sample farmer, annual average expenditure was found Tk. 2, 25,589.6. Main family expenditure was use for food consumption. Others main cost were child’s education cost, clothing cost, medicine cost transportation, festival cost, entrainment cost etc Average annual family savings was found Tk 39.509.3.

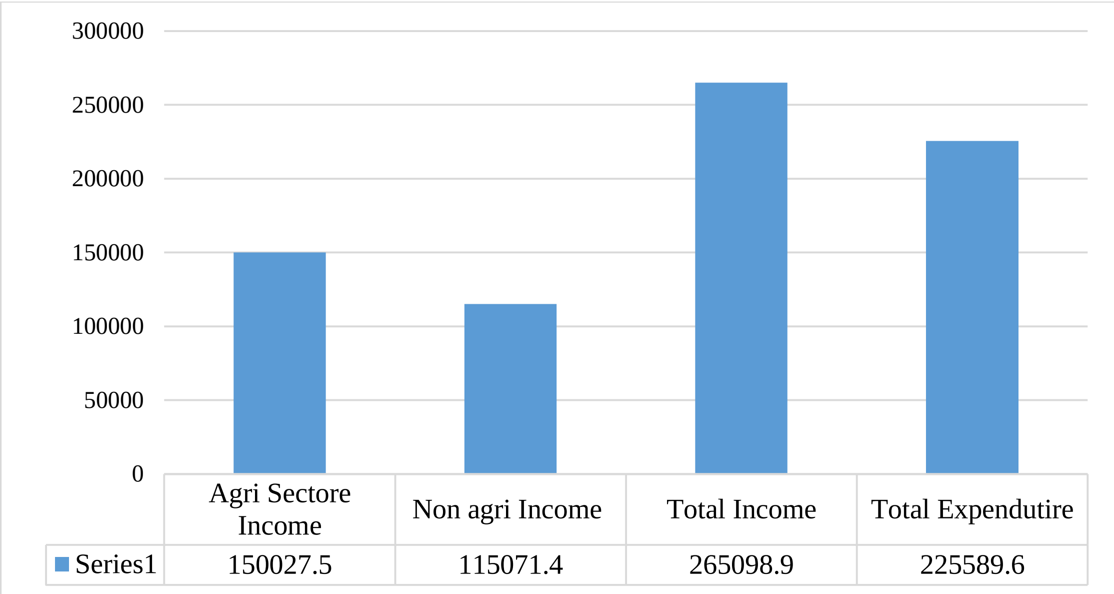

Figure 5.3: Annual Family Income and Expenditure by Study Area
Source: Field survey, 2018

5.6 Composition of the Family Size

Family size is significant in connection to generation of enough nourishment grain for ranch family. In this study family has been characterized as the all-out number of people living respectively and taking meals from a similar kitchen under the influence of one leader of the family. The relatives considered as spouse, children, unmarried little girl, father, mother, sibling and different relatives who live for all time in the family.

Table 5.2: Average Family Size and Distribution of Members According to Sex of the Sample Farmers

Particulars	Sadar Upazila		Tetulia Upazila		DebigonjUpazila		All Farmers		**National Average Family Size**
	No.	%	No.	%	No.	%	No.	%	
Male	2.7	52.94	2.87	53.54	3.24	60	2.94	55.58	4.06
Female	2.4	47.06	2.49	46.46	2.16	40	2.35	44.42	
Total	5.1	100	5.36	100	5.4	100	5.29	100	

Source: Field survey, 2018

5.7 Agricultural Training

Among the respondent farmers in Sadar upazila, only 72 percent farmer's got training of boro rice whereas, 56 percent farmers got training in Tetulia upazila, 65 percent farmers got training in Debigonj upazila (Table 5.3). These training have improved their perceptions of good seed use, use of resistant varieties, application of insecticides and pesticides, water management, and so on.

Table 5.3: Agricultural Training of the respondent by Study Area

Traning Received	**Sadar**		**Tetulia**		**Debigonj**	
	No.	**%**	**No.**	**%**	**No.**	**%**
Yes	18	72	14	56	13	65
No	7	28	11	44	7	35
Total	25	100	25	100	20	100

Source: Field survey, 2018

5.8 Membership of social organization

Among the respondent farmers in Sadar upazila, 80.00 percent boro growers were found to have membership in different NGOs and/or farmers' organizations whereas Tetulia upazila 72 percent of boro grower's farmers had membership in different NGOs and/or farmers' organizations and 55 percent of boro farmers had membership in different social organization in Debigonj upazila (Table 5.4).

Table 5.4: Membership in organization of the respondent by Study Area

Membership in organization	Sadar		Tetulia		Debigonj	
	No.	%	No.	%	No.	%
Yes	20	80	18	72	11	55
No	5	20	7	28	9	45
Total	25	100	25	100	20	100

Source: Field survey, 2018

CHAPTER –6
PROFITABILITY OF BORO RICE PRODUCTION

6.1 Introduction

The main purpose of this chapter is to assess the costs, returns and profitability of growing Boro Rice. Profitability is a major criterion to make decision for producing any crop at farm level. It can be measured based on net return, gross margin and ratio of return to total cost. The costs of all items were calculated to identify the total cost of production. The returns from the crops have been estimated based on the value of main products and by-products.

6.2 Profitability of Boro Rice Production

6.2.1 Variable Costs

6.2.1.1 Cost of Land Preparation

Land preparation is the most important components in the production process. Land preparation included ploughing, laddering and other activities needed to make the soil suitable for Boro Rice cultivation. For land preparation in Boro Rice production, no. of tiller was required 2 with Tk. 1645 per tiller. Thus, the average land preparation cost of boro production was found to be Tk. 3146 per hectare, which was 3.64 percent of total cost (Table 6.1).

6.2.1.2 Cost of Hired Labour

Human labour cost is one of the major cost components in the production process the quantity of human labour used in Boro Rice production was found to be about 68 man-days per hectare and average price of hired labour was Tk. 300 per man-day. Therefore, the total cost of hired human labour was found to be Tk. 20100 representing 23.24 percent of total cost (Table 6.1).

6.2.1.3 Cost of Seed

Cost of seed varied widely depending on its quality and availability. Per hectare total cost of seed for Boro Rice production were estimated to be Tk. 4538.70, which constituted 5.25 percent of the total cost (Table 6.1).

6.2.1.5 Cost of Urea

In the study area, farmers used different types of fertilizers. On an average, farmers used urea 254 kg per hectare. Per hectare cost of urea was Tk. 4572, which represents 5.29 percent of the total cost (Table 6.1).

6.2.1.6 Cost of TSP

Among the different kinds of fertilizers used, the rate of application of TSP was128.5 kg per hectare. The average cost of TSP was Tk. 3212.50 which representing 3.71 percent of the total cost (Table 6.1).

6.2.1.7 Cost of MoP

The application of MoP per hectare was 114.8 kg. Per hectare cost of MoP was Tk. 1951.60, which represents 2.26 percent of the total cost (Table 6.1).

6.2.1.8 Cost of Gypsum

The application of Gypsum per hectare was 45 kg. Per hectare cost of Gypsum was Tk. 540, which represents 0.62 percent of the total cost (Table 6.1).

6.2.1.9 Cost of Insecticides

Farmers used different kinds of insecticides to keep their crop free from pests and diseases. The average cost of insecticides for Boro Rice production was found to be Tk. 1995.33 which was 2.31 percent of the total cost (Table 6.1).

6.2.1.10 Cost of Irrigation

Cost of irrigation is one of the most important costs for Boro Rice production. Production of boro largely depends on irrigation. For Boro Rice production no of irrigation was 11 times with Tk. 1100 per times. The average cost of irrigation was found to be Tk. 12100 per hectare, which represents 13.99 percent of the total cost (Table 6.1).

Table 6.1: Per Hectare profitability of Boro production in Panchagarh district, 2018-19

Cost Items	Quantity (Kg)	Price Per Unit (Tk.)	Costs/Returns (Tk./ha)	% of total
A. Gross Return				
Main product (Kg)	6895	15	103425.00	97.47
By-product (Tk.)			2689.00	1.91
Total return(Tk.)			106114.00	100.00
B. Gross Cost				
C. Variable Cost				
Seedlings			4538.70	5.25
Irrigation	11 times	1100	12100.00	13.99
Power tiller	2 times	1645	3146.00	3.64
Hired labour	67	300	20100.00	23.24
Urea	254	18	4572.00	5.29
TSP	128.5	25	3212.50	3.71
MOP	114.8	17	1951.60	2.26
Gypsum	45	12	540.00	0.62
Fertilizers cost			10276.10	11.88
Manure	200	10	2000.00	2.31
Insecticides			1995.33	2.31
Total Variable cost			**54156.13**	**62.63**
D. Fixed Cost				
Land use cost			18712.00	21.64
Family labour	38	300	11400.00	13.18
Interest on operating capital @ 12%			2205.72	2.55
Total Fixed cost			**32317.72**	**37.37**
E. Total costs			**86473.85**	**100.00**

Source: Field survey, 2018

6.2.1.11 Cost of manure

It was observed in the present study area that farmers used cow dung for producing their enterprises. They bought a large portion of cow dung from the milk producers. The average cost of manure for Boro Rice productionwas found to be Tk. 2000 per hectare, which represents 2.31 percent of total cost (Table 6.1)

6.2.1.12 Total Variable Cost

Therefore, from the above different cost items it was clear that the total variable cost of Boro production was Tk. 54156.13 per hectare, which was 62.63 percent of the total cost (Table 6.1).

6.2.2 Fixed Cost

6.2.2.1 Rental Value of Land

Rental value of land was calculated on the basis of opportunity cost of the use of land per hectare for the cropping period of four months. Cash rental value of land has been used as cost of land use. On the basis of the data collected from the Boro farmers the land use cost was found to be Tk. 18712 per hectare, and it was 21.64 percent of the total cost (Table 6.1).

6.2.2.2 Cost of Family Labour

Boro Rice production was found to be about 37 man-days family labour per hectare and average price of family labour was Tk. 300 per man-day. Therefore, the total cost offaimly human labour was found to be Tk. 11400 representing 13.18 percent of total cost (Table 6.1).

6.2.2.3 Interest on Operating Capital

It may be noted that the interest on operating capital was calculated by taking in to account all the operating costs incurred during the production period of Boro. Interest on operating capital for Boro production was estimated at Tk. 2205.72per hectare, which represents 2.55 percent of the total cost (Table 6.1).

6.2.3 Total Cost (TC) of Boro Production

Total cost was calculated by adding all the cost of variable and fixed inputs. In the present study per hectare total cost of producing Boro was found to be Tk. 86473.85(Table 6.1).

Table 6.2: Per Hectare Cost and Return of Boro Production

Cost Item	Cost/Returns (Tk/ha)
A. Gross Return	106114.00
B. Gross Cost	
C. Variable Cost	54156.13
D. Fixed Cost	32317.72
E. Total costs	86473.85
F. Gross Margin (A-C)	51957.87
G. Net Return (A-E)	19640.15
H. Undiscounted BCR	**1.23**

6.2.4 Return of Boro Production

6.2.4.1 Gross Return

Return per hectare of Boro cultivation is shown in table 6.2. Per hectare gross return was calculated by multiplying the total amount of product with respective per unit price. It is evident from table that the per hectare average yield of Boro was 6895 kg and the average price of Boro was Tk. 20 and the average price of by-product was Tk. 2689 per hectare. Therefore, the gross return was found to be Tk. 106114 per hectare (Table 6.2).

6.2.4.2 Gross Margin

Gross margin is the gross return over variable cost. Gross margin was calculated by deducting the total variable cost from the gross return. On the basis of the data, gross margin was found to be Tk. 51957.87 per hectare (Table 6.2).

6.2.4.3 Net Return

Net return or profit was calculated by deducting the total production cost from the gross return. On the basis of the data the net return was estimated as Tk. 19640.15 per hectare (Table 6.2).

6.2.5 Benefit Cost Ratio (Undiscounted)

Benefit Cost Ratio (BCR) is a relative measure, which is used to compare benefit per unit of cost. Benefit Cost Ratio (BCR) was found to be 1.23 which implies that one taka investment in Boro production generated Tk. 1.23 (Table 6.2). From the above calculation it was found that Boro cultivation is profitable in Bangladesh.

6.3 Concluding Remarks

From the above discussion it is easy to understand about the different cost items and their application doses of farmers, yields and returns per hectare of Boro cultivation. Boro production is a labour intensive enterprise. It is most essential to use modern inputs such as seeds, fertilizers, human labour, power tiller, pesticides and irrigation efficiently. Timely and efficient use of these inputs are the most important to increase production and profitability. On the basis of above discussions it could cautiously be concluded here that cultivation of Boro is a profitable. Cultivation of Boro would help farmers to increase their income earnings.

CHAPTER 7
MAJOR FACTORS AFFECTING AND TECHNICAL EFFICIENCY OF BORO PRODUCTION

7.1 Introduction

The estimation of efficiency with the help of production function has been a popular area of applied econometrics. Technical efficiency reflects the ability of a farmer to obtain the maximum possible output from a given level of inputs and production technology. It is a relative concept, since each farmers production performance is compared to a best-practice input-output relationship or production frontier. A farmer is technically inefficient in the sense that if it fails to produce maximum output from a given level of inputs. Technical inefficiency is then measured as the deviation of a farmer from the best-practice frontier. The main objective of this chapter is to estimate the technical inefficiency as well as frequency distribution of boro farmers through technical efficiency analysis. The technical efficiency in production was estimated by using the stochastic frontier production. The primary advantage of a stochastic frontier production function is that it enables one to estimate U, (non-negative random variable which is under the control of the farmers).

Since the pioneering work on technical efficiency by Farrell in 1957, which drew upon the works of Debreu (1951) and Koopmans (1951), considerable effort has been directed at refining the measurement of technical efficiency. Empirical studies suggest that farmers in developing countries fail to exploit the potential of technology perhaps due to inefficient decision making due to various reasons of which management capacity is important one.

7.2 Interpretation of ML Estimates of the Stochastic Frontier Production Function:

Maximum likelihood estimation begins with writing a mathematical expression known as the Likelihood Function of the sample data. The likelihood of a set of data is the probability of obtaining that particular set of data, given the chosen probability distribution model. This expression contains the unknown model parameters. The values of these parameters that maximize the sample likelihood are known as the Maximum Likelihood Estimates or MLE's. 7.1

The maximum likelihood estimates for parameters of the Cobb-Douglas stochastic frontier production function and technical inefficiency effect model for Boro production for all farmers are presented in Table 7.1.

Table 7.1: ML Estimates for Parameters of Cobb-Douglas Stochastic Frontier Production Function and Technical Inefficiency Model for Boro Farmers.

Variables	**Parameter**	**Coefficients**	**T-ratio**
Stochastic Frontier:			
Constant (X_0)	β_0	4.0214***	4.54
Human Labour (X_1)	β_1	-0.1215***	-6.04
Seed (X_2)	β_2	0.8807***	4.53
Urea(X_3)	β_3	0.2112**	2.36
TSP(X_4)	β_4	-0.0015	-0.04
Insecticide (X_5)	B_5	-0.0213	-0.19
Irrigation (X_6)	B_6	0.0280*	1.78
Inefficiency Model			
Constant	δ_0	-39.0497*	-1.73
Experience (Z_1)	δ_1	-0.1318*	1.90
Farm size (Z_2)	δ_2	-0.0395***	-3.84
Extension service(Z_3)	δ_3	-0.0298	-0.32
Training (Z_4)	δ_4	0.4357	1.78
Credit service (Z_5)	δ_5	-0.0320	-0.80

Note: *, ** and * indicates significant at 1, 5 and 10 percent level respectively**.

Source: Field survey, 2018.

Human Labor (X1)

The regression coefficient of labour cost (X1) of Boro production was negative and significant at 1 percent level of significance, which implied that if the expenditure on labour was increased by 1 percent then the revenue of Boro would be decreased by 0.1215 percent, other factors remaining constant (Table 7.1).

Seed (X2)

The regression coefficient of seed cost (X2) of Boro production was positive and significant at 1 percent level of significance, which implied that if the expenditure on seed was increased by 1 percent then the revenue of Boro would be increased by 0.8807 percent, other factors remaining constant (Table 7.1).

Urea (X3)

The regression coefficient of Urea cost (X3) of Boro production was positive and significant at 5 percent level of significance, which implied that if the expenditure on urea was increased by 1 percent then the revenue of Boro would be increased by 0.2112 percent, other factors remaining constant (Table 7.1).

TSP (X4)

The regression coefficients of TSP cost (X4) were not significant.

Cost of Insecticide (X5)

The regression coefficients of Insecticide cost (X5) were not significant.

Irrigation (X5)

The regression coefficient of irrigation cost (X5) of Boro production was positive and significant at 10 percent level of significance, which implied that if the expenditure on irrigation was increased by 1 percent then the revenue of Boro would be increased by 0.0280 percent, other factors remaining constant (Table 7.1).

7.3 Interpretation of Technical Inefficiency Model

In the technical inefficiency effect model experience, farm size, extension service and credit service have expected (negative) coefficients. The negative and significant (1 percent) coefficient of experience implies that experienced farmers are technically more efficient than non-experienced farmers.

The negative coefficient and significant at10 percent level of significance of farm size implies that large farm households are technically more efficient than small farm households.

The negative coefficient of extension service postulates that farmers having contacts with extension officers are technically more efficient than others. Although this coefficient is not statistically significant.

The negative coefficient of credit service postulates that farmers taking loan for producing Boro are technically more efficient than others. Although this coefficient is not statistically significant. (Table 7.1)

Table 7.2: Frequency Distribution of Technical Efficiency of Boro Farms

Efficiency (%)	**No. of farms**	**Percentage of farms**
0-50	2	2.86
51-70	5	7.14
71-80	12	17.14
81-90	28	40
91-100	23	32.6
Total number of farms	70	100
Minimum	0.10	
Maximum	0.99	
Mean	0.85	
Standard Deviation	*0.157*	

Source: Field survey, 2018

The coefficients of training are positive meaning that these factors have no impact on the technical inefficiency. That is, these factors do not reduce or increase technical inefficiency of producing Boro.

7.4 Technical Efficiency and Its Distribution

Table 7.2 shows frequency distribution of farm-specific technical efficiency for boro farmers. It reveals that average estimated technical efficiencies for boro are 85 percent which indicate that boro production could be increased by 15 percent with the same level of inputs without incurring any further cost. Increase of only managerial skills result a substantial increase of output for boro rice. It was observed that about only 10 percent of sample farmers were found were minimum level efficiency up to 70 percent efficient. Above 50 percent farm are efficient 70 to 90 percent the maximum frontier outputs maintaining the efficiency level. On the other hand, 32 per cent of sample farmers obtained up 90 to 100 percent technical efficiency level. The minimum and maximum technical efficiencies were observed to be 10 and 99 per cent respectively, where standard deviation was maintained at 0.15.

7.5 Concluding Remarks

From the above discussion it is easy to understand about the different cost items and their application doses of farmers, yields and returns per hectare of Boro cultivation. Boro production is a seed, irrigation and labor intensive enterprise. It is most essential to use modern inputs such as seeds, fertilizers, human labour, power tiller, pesticides and irrigation efficiently. Timely and efficient use of these inputs are the most important to increase production and profitability. On the basis of above discussions it could cautiously be concluded here that cultivation of Boro is a profitable. Cultivation of Boro would help farmers to increase their income earnings.

CHAPTER 8
PROBLEMS AND CONSTRAINTS TO BORO RICE PRODUCTION

8.1 Introduction

The focus of this chapter is to identify the extent of problems encountered by the Boro farmers. Farmers faced a lot of problems in producing Boro. The problems were social and cultural, financial and technical. This chapter aims at represent some socioeconomic problems and constraints to producing Boro. The problems and constraints faced by the farmers were identified according to opinions given by them. The major problems and constraints related to Boro cultivation are discussed below:

8.2 Low Price of Output

Most of the farmers had to sell a large portion of their product at the harvesting period to meet various obligations like, household's expenditure and repayment of loan. But harvest time price of Boro remained low because of ample supply. So they could not get reasonable return for their products. It can be seen from Table 8.1 that 97.14 percent Boro growers reported this as high problem.

8.3 High Cost of Irrigation Water

Irrigation is the leading input for crop production. Yield of Boro varies with the application of irrigation water. Most of the farmers had no shallow tube well or deep tube well of their own in the study areas and for this they had to pay a higher amount of money to the water supplier. But farmers reported that they had to pay higher charge for irrigation water. Table 8.1 shows that about 92.86 percent Boro growers reported this as high problem. (Table 8.1).

8.4 High Price of Quality Seed

High price of quality seed was also one of the most important limitations of producing Boro in the study area. From Table 8.1 it is evident that about 85.71 percent Boro growers reported this as high problem.

8.5 Lack of Quality Seed

Lack of quality seed was one of the most important limitations of producing Boro in the study area. From Table 8.1 it is evident that about 84.29 percent Boro growers reported this as high problem. Farmers in both Upazilas told that they were cheated by buying so called hybrid seeds from the local markets and from the seed dealers.

8.6 Attack of Pest and Disease

The growers of Boro were also affected by the problem of attack of pests and diseases. Pests and diseases attack reduce crop yield and increase cost of production. About 80 percent Boro growers reported this as high problem (Table 8.1).

8.7 Inadequate Extension Service

During the investigation some farmers complained that they did not get any extension services regarding improved method of Boro cultivation from the relevant officials of the Department of Agricultural Extension (DAE). As an agricultural extension personnel block supervisor, the main advisor of technical knowledge to the farmers about their farming problems. About 64.29 percent Boro growers reported this as high problem (Table 8.1). Farmers of both areas marked that they hardly ever got help from the block supervisor and Agricultural Extension Officer.

8.8 Lack of Operating Capital

The farmers of the study area had capital constraints. For cultivation of Boro, a huge amount of cash money was needed to purchase various inputs like, human labour, seed, fertilizers, pesticides, etc. About 62.86 percent Boro farmers reported that they did not have sufficient amount of money for purchasing the required quantity of inputs for the relevant enterprises and marked this as high problem. (Table 8.1).

8.9 Natural Calamities

It was found that Boro growers faced some acute problems relating to the nature in their production process. Natural calamities like drought, hailstorm, excessive rainfall, caused substantial damage to the crop in the field. Farmers said that excessive rainfall during the harvesting period reduces both the quantity and storability of Boro. Table 8.1 shows that almost 57.14 percent Boro growers in reported this as high problem.

8.10 Shortage of Human labour

Most of the human labour is being used during seed/seedling plantation and harvesting period of Boro. Boro are labour intensive spices. Non-availability of human labour was found in different stages of production such as planting, intercultural operations and harvesting. Table 8.1 shows that near 57.14 percent of Boro growers reported this as high problem.

8.11 Lack of Scientific Knowledge of Farming

Although modern agricultural technologies have been using in the study area, a large number of farmers have no adequate knowledge of right doses and methods of using modern inputs and technologies of producing their enterprises. Near 50 percent Boro growers were encountered this problem. (Table 8.1).

8.12 Adulteration of Fertilizer, Insecticide, and Pesticide

Chemical fertilizers, insecticides and pesticides are the most important inputs of Boro production. They were being intensively used in Boro production in the study area. Many farmers reported to have been cheated by applying adulterate fertilizers and pesticides in their crop field. It can be seen from Table 8.1 that near 48.57 percent Boro growers faced this problem highly.

8.13 High Price of Fertilizers

Farmers claimed that non-availability of fertilizers at fair price was a problem in the way of producing enterprise. It appears from the table 8.1 that about 45.71 percent Boro growers reported this as high problem.

8.14 Poor Storage Facilities in House

Usually most of the fanners used to store their Boro in their house. Lack of trained manpower was a great deal of spoilage of Boro in the harvest and the post-harvest period. For this, they had to face some losses like losing weight and rotten of Boro. It appears from Table 8.1 that only 40 percent of sample farmers faced the problem of poor storage facilities highly.

Table 8.1 Problems and Constraints of Boro Production by no. of Farmers

Type of Problems	No. of farmers	Percentage of farmers	Rank
Low price of output	68	97.14	1
High cost of irrigation water	65	92.86	2
High price of quality seed	60	85.71	3
Lack of quality seed	59	84.29	4
Attack of pest and disease	56	80.00	5
Inadequate extension service	45	64.29	6
Lack of operating capital	44	62.86	7
Natural calamities	40	57.14	8
Shortage of human labour	40	57.14	9
Lack of scientific knowledge of farming	35	50.00	10
Adulteration of fertilizer, insecticide, and pesticide	34	48.57	11
High price of fertilizers	32	45.71	12
Poor storage facilities in house	28	40.00	13
Lack of quality tillage	25	35.71	14

Source: Field survey, 2018

8.15 Lack of Quality Tillage

Deeply ploughing is essential for successful crop production. Most of the farmers, who use hired power tiller, reported that hired power tiller owners did not till deeply. Never the less, they did not use all the tines when they till others land. Table 8.1 shows that 35.71 percent Boro growers reported this as high problem.

8.16 Concluding Remarks

The above mentioned discussions as well as the results presented in Table 8.1 indicate that Boro growers in the study area have currently been facing some major problems in conducting their Boro farming. These are the major constraints for the producers of Boro in the study area. Public and private initiatives should be taken to reduce or eliminate these problems for the sake of better production of Boro.

CHAPTER-9

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

9.1 Summary

Boro is the most **important** and single largest crop in **Bangladesh** in respect of volume of production. It has been persistently contributing to higher rice production in last successive years. Boro is the predominant crop in the country over decades, accounting for more than 50 per cent of total paddy production. According to the Bangladesh Bureau of Statistics (BBS) data, in 2018-19, Boro accounted for 54 per cent of 36.4 million tons of rice produced in the country, Aman 38 per cent and Aush only 8 per cent. This year, the DAE is expecting 20 million tons of Boro from 4.70 million hectares of land and 3.4 million tons of Aush from around 1.4 million hectares.

In Bangladesh, Boro are grown in almost all districts of the country and the major growing district in terms of production isPanchagragh. The total area under spices is 92769 hectares in the Panchagragh district with a production of 632031 metric tons. Boro is the important vegetable, spice crop of the Panchagragh district with area and production of 41359 hectares and 280312 tons respectively and productivity was 26.77 metric tons (Boro) per hectare during 2017-18.

Boro are grown all over Bangladesh, not only for a huge home market but also for export purposes. Production of Boro plays an important role in improving the economic conditions of farmer’s specially marginal and small farmers and meeting the nutritional requirements of the people of Bangladesh. The present study will give the answers of some of the important questions regarding the aspects like growth of this crop, cost of cultivation, returns from this crop and constraints to its production and marketing. Therefore, a systematic research work was required to carry out for this crop in order to make available complete information to the farmers who want to grow this crop.

The sampling frame for the present study was selected purposively as to select the area where the Boro cultivation was intensive. On the basis of higher concentration of Boro crop production, three upzillas namely Sadar, Tetulia and Debigonj in Panchagragh was selected. A sample size of 60 is generally regarded as the minimum requirement for larger population that will yield a sufficient level of certainty for decision-making (Poate and Daplyn, 1993). In this case, who were cultivating different varieties of Boro in the selected areas were selected as samples. Farmers generally plant Boro from mid- December to January and harvest after three months. Data for the present study have collected during the period of December2018 to January 2019. Primary data were collected from primary producers. Selected respondents were interviewed personally with the help of pre-tested questionnaires. The collected data were checked and verified for the sake of consistency and completeness. Editing and coding were done before putting the data in computer. All the collected data were summarized and scrutinized carefully to eliminate all possible errors. Data entry was made in computer and analysis was done using the concerned software Microsoft Excel and STATA.

Economic profitability is a major criterion to make decision for producing any crop at farm level. It can be measured based on net return, gross margin and ratio of return to total cost. The average land preparation cost of Boro production was found to be Tk. 3146 per hectare. The quantity of human labor used in Boro production was found to be about 105 man-days per hectare and average price of human labor was Tk. 300 per man-day. Therefore, the total cost of human labor was found to be Tk. 20100 representing 23.24 percent of total cost. Per hectare total cost of seed for Boro production was estimated to be Tk. 4538.70. On average, farmers used Urea, TSP, MoP and Gypsum was254 Kg, 128.5 kg, 114.8 kg and 45 kg respectively, per hectare. The average cost of insecticides for Boro production was found to be Tk. 1995.33. Whereas the average cost of irrigation was found to be Tk. 12100 per hectare. The total variable cost of Boro production was Tk. 54156.13 per hectare, which was 62.63 percent of the total cost.

The average yield of Boro per hectare was 6895 kg and total price of Boro was Tk. 103425. The gross return, gross margin and net return were found to be Tk. 106114, Tk. 51957.87 and Tk. 19640.15 per hectare. Benefit Cost Ratio (BCR) was found to be 1.23 which implies that one-taka investment in Boro production generated Tk. 1.23.

Technical efficiency reflects the ability of a farmer to obtain the maximum possible output from a given level of inputs and production technology. Technical efficiency is then measured as the deviation of a farmer from the best-practice frontier. The regression coefficients of Seed (X2), Urea (X3) and Irrigation (X6) were positive but the coefficient of Human labor (X1), TSP (X4) and Insecticide (X5) was found negative. It indicates that if Human labor Seed (X2), Urea (X3) and Irrigation (X6) were increased by one percent, the production of Boro would be increased by 0.8807, 0.2112, 0.0280, percent of sample farmers respectively.

In the technical inefficiency effect model, experience, farm size, extension service and credit service have expected (negative) coefficients. The negative coefficient of experience implies that experienced farmers are technically more efficient than non-experienced farmers. The negative coefficient of farm size implies that large farm households are technically more efficient than small farm households.

The negative coefficient of extension service postulates that farmers having contacts with extension officers are technically more efficient than others. The negative credit service coefficient indicates that taking loan by farmers helps reduce technical inefficiency. The coefficients of training are positive meaning that these factors have no impact on the technical inefficiency. Average estimated technical efficiencies for Boro are 81 percent which indicate that Boro production could be increased by 19 per cent with the same level of inputs without incurring any further cost. Increase of only managerial skills result in a substantial increase of output for Boro.

Farmers faced a lot of problems in producing Boro. The problems were social and cultural, financial and technical. Lack of quality seed was one of the most important limitations of producing Boro in the study area. Lack of operating capital, high price of quality seed, high cost of irrigation water, shortage of human labor and lack of quality tillage were the major problems faced by farmers. These are the major constraints for the producers of Boro in the study area. Public and private initiatives should be taken to reduce or eliminate these problems for the sake of better production of Boro.

9.2 Conclusion

Boro is one of the important cereal crops grown by farmers mainly for market purpose. The study areas have tremendous potential for Boro cultivation. The findings of the present study indicate that Boro production is highly profitable and it would help to improve the socioeconomic condition of sample farmers in the study areas. As Boro is a labour intensive crop, it would help to create employment opportunities. In Bangladesh, it is difficult to increase Boro production by increasing the area of land under cultivation due to the limitation of land. But, there is an opportunity to increase production of Boro by improving the existing production technology. Farmers are relatively inefficient due to land fragmentation, less experience, illiteracy, etc. The present study indicate that farmers are technically efficient that means there is an opportunity to increase production to a large extent using the existing level of agricultural inputs, the agricultural extension services and the available technology.

If the modern inputs could be made available to the farmers in time, production of this crop might be increased which could help them in alleviating rural poverty in many areas. Boro are only produced in winter season. But now the BRRI introduced some verities of summer Boro. However, farmers in the study areas, to some extent have started to produce summer Boro. Farmers were not known about the application of inputs in right time with right dose. Thus, well-planned management training in accordance with their problems, needs, goals and resources base may lead to viable production practices and sustainable income from Boro cultivation.

9.3 Suggestion

On the basis of the finding of the study it was evident that Boro was profitable enterprises and it can generate income earnings and employment opportunity to the rural people of Bangladesh. But some problems and constraints bared to attain the above mentioned objectives. The policy makers should, therefore, take necessary measures. According to the findings of the study; some policy recommendations may be advanced which are likely to be useful for policy formulation. The following specific recommendation may be made for the development of Boro sector.

As most of the Boro farmers are technically efficient at present production technology, improved method of production technology with sufficient storage ability should be introduced.

- As Boro is a profitable enterprise, government and concern institutions should provide adequate extension programme to expand its area and production.
- Boro based cropping pattern should be developed and disseminated to those areas of Bangladesh where their production is suitable.
- Government should take necessary measures to lower the price of inputs which have positive significant impact on yield. It will increase the net benefit of Boro producers.
- Adequate training on recommended fertilizer doses, insecticides, use of good seed, intercultural operations, etc., should be provided to the Boro farmers which will enhance production as well as technical efficiency by improving the technical knowledge of the farmers.
- Boro farmers had to sell their product at low price during harvesting or just after harvest. An appropriate storage scheme should be developed so that the farmers are not forced to sell their product at low price during the harvest period.

9.4 Limitations of the Study

There are some limitations of the study thus are indicated below.

a. Most of the data were collected through interview of the farmers and sometimes they did not well-cooperate with the interviewer.
b. The information were gathered mostly through the memories of the farmers which were not always correct.
c. Due to resource and time constraints, broad based and in-depth study was hampered to some extent.

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Appendix

Department of Agricultural Economics

Sher-e-Bangla Agricultural University

An Interview Schedule on

An Economic Study of Boro Rice Production in Some Selected Areas of Panchagarh District

Sample No…………..

1. Farmers Idntification

a).Name……………………………………. b).Village……………..........

c).Upzilla…………………………………….. d).Zilla…………………….

e).Mobile No:……………………………..

2. Farmers Socio-Economic Characteristics

2.1. General Information

Sl.No	Relation with H .H	Sex	Age	Education	Marital status	Occupation	
						Main	Subsidiary

N.B. Sex=(Male=1,Female=2)

Marital status=(Maried=1,Unmaried=2)

Education (year of schooling)= (write name=1, PSc=2, JSc=3,SSC=4,Graduate=6,Masters=7

Occupation= No work=0,Boro rice cultivar=2,Agriculture=3,Fish culture=4,poultry rearing=5,livestocks=6 ,labour=7 Student=8,business=9.house wife=10,Others=11

3. Farm Size

(Please indicatd the area of your land in your possession)

Types of land	Area(Decimal)
a. Own Land	
b. Boro rice field/ cultivated land	
c. Household land	
d. Gerden	
e.Fellow land	
f. Pond	
g.Rent In	
h.Rent Out	
i.Mortgaged In	
j. Mortgaged Out	
k. Others(..)	
Total=(a+b+c+d+e+f+g+i-h-j)	

5.Farmers Income source

(Please mention the amount of annual income from the followng sources)

a). Agricultural sources

SL. No.	Crop Name	Amount of income (in TK.)/yearly
1.	Boro Rice	
2.	Livestocks rearing	
3.	Poultry rearing	
4.	Fisheries/ Fish culture	
5.	Others crops	
(a)	Jute	
(b).	Maize	
(c).	Potato	
(d).	Mustard	
(e).	Pulse crops	
	Oil crop	
(g).	Spice crop	
(h).	Vegetables	
(i).	Fruits	
Total		

b). Non-Agricultural sources

SL No.	Income sources	Amount of income (in TK.)/yearly
1.	Business	
2.	Services	
3.	Foreign Remittance	
4.	labor	
5.	Ricshawpuller	
6.	Auto driver	
7.	Others income source	
Total		

6.Boro Cultivation Information

(Please mention the following regarding Boro Cultivation)

Management Practices	Boro Cultivatin
Amount of Land (acres)	
Variety	
Seed rate (kg/Acre)	
Number of Irrigation	
Manure & fertilizer	
Weeding	
Number of Inter-cultural operation	

7. Cost and Return

a. Human Labor Requirement (man/day)

(Please mention of your Human Labor requirement)

Name of items	**Boro Rice**			
	No. of labor		**Taka/ labor**	**Total (Tk)**
	own	**Hired**		
Seedbed preparation& Sowing				
Main land Preparation (tillage & laddering)				
Uprooting & transplanting				
Manure & fertilizer				
Weeding				
Irrigation				
Pest management				
Harvesting				
Carrying ,threshing & storing				
Winnowing, sunning & drying				
Total				

b) Cost of animal/ Mechanical powers used

(Please mention your cost of animal or mechanical powers used)

Name of Practices	**Boro Rice**				
	Name of machine/animal	**No of machine/animal**	**Rent (taka/Unite)**	**Cultivated Area(Decimal)**	**total (taka)**
Tillage					
Weeding					
Spraying					
Thrashing					
Total					

c. Materials inputs used

(Please mention about material input used)

Inputs	Unit Price (Tk/unit)	Boro rice	
		Amount (kg/Unite)	Total Taka
Seedling			
Manure			
Fertilizer			
a. Urea			
b. TSP			
c. MP			
d. Gypsum			
e. Zinc			
Pesticides			
Insecticides			
Irrigation			
Others (.................................)			
Total			

8. Amount of Boro rice production and disposal/Return

(Please mention about Boro rice production and disposal)

Rice Variety	Total production (kg)	Unite price(TK /kg)	Total taka	Straw production (kg)	Unite price (Tk/ kg)	Total Taka	Gran d Total taka
1	2	3	4(2*3)	5	6	7(5*6)	4+7

4. Farmer Expenditure

(Please mention you monthly expenditure in following source)

SL.No.	Items	Monthly Expenditure(Taka)	Yearly Expenditure(Taka)
1.	Food		
2.	Energy(Petrol,Gas,Electricity)		
3.	Health Care		
4.	Education		
5.	Clothing		
6.	Transportation		
7.	Festivals & social Economics		
8.	House Rent		
9.	Cell phone expense		
10.	Entertainments		
11.	Others (..........................)		

9. Please mention the problems faced by you in rice cultivation

a)……………………………………………………………………………..

b)……………………………………………………………………………..

c)……………………………………………………………………………..

d)……………………………………………………………………………..

e)……………………………………………………………………………..

10. What are your suggestions to overcome the above problems?

a)……………………………………………………………………………

b)…………………………………………………………………………..

c)…………………………………………………………………………..

d)…………………………………………………………………………..

e)…………………………………………………………………………..

Thank you for kind co-operation

Date…………………………….. **Signature of the interviewer**