# PROFITABILITY AND TECHNICAL EFFICIENCY OF BORO RICE CULTIVATION IN SOME SELECTED AREAS OF NETROKONA DISTRICT

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## CERTIFICATE

This is to certify that the thesis entitled **"PROFITABILITY AND TECHNICAL EFFICIENCY OF BORO RICE CULTIVATION IN SOME SELECTED AREAS OF NETROKONA DISTRICT"** submitted to the Department of Agricultural Economics, 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 bonafide research work carried out by **MARJIA AKTER RONY**, Registration Number: **15-06857** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

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

**…...…………………………………..**

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*Dedicated*

*To*

*My Beloved Parents*

# ABSTRACT

Bangladesh is predominantly an agricultural country. The dominant food crop in Bangladesh is rice, accounting 75 percent of agricultural land use. The purpose of the study was to describe the socio-economic characteristics; to examine the profitability and technical efficiency and to identify problem faced by the farmers in boro rice production in the study area. Primary data were collected from randomly selected 60 farmers from six villages under Durgapur upazila of Netrokona district. Both tabular and statistical analyses were applied in this study. The study revealed that boro rice production is profitable. The cost of production of boro rice was Tk. 112725.01 per hectare. Gross return of boro rice was Tk. 138000 per hectare, gross margin of boro rice was Tk.58619.39 per hectare and that of net return was Tk. 25274.99 per hectare. Benefit Cost Ratio (BCR) was 1.22 which implies that a boro rice producer could earn Tk 1.22 with the investment of Tk 1.00. The Cobb-Douglas stochastic frontier production function was used for this study to measure technical efficiency of boro rice producers. The coefficients of parameters like hired labor, urea and insecticide were negative, where family labor, machinery and MoP were found positive. The study also identified some problems and constraints faced by the boro rice farmers and suggested some recommendations to improve the present production situation so that yield of boro rice would possibly be increased.

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***December, 2021*** ***The Author***

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## ABBREVIATIONS AND ACRONYMS

BBS: Bangladesh Bureau of Statistics

BCR: Benefit Cost Ratio

BER: Bangladesh Economic Review

BRRI: Bangladesh Rice Research Institute

DAE: Department of Agricultural Extension

DTW: Deep Tube Well

et al.: and others (at elli)

GDP: Gross Domestic Product

gm: Gram

ha: Hectare

HIES: Household Income and Expenditure Survey

IOC: Interest on Operating Capital

MoA: Ministry of Agriculture

MoP: Muriate of Potash

MT: Metric Ton

STW: Shallow Tube Well

TC: Total Cost

TFC: Total Fixed Cost

TSP: Triple Super Phosphate

TVC: Total Variable Cost

USDA: United States Department of Agriculture

# CHAPTER I
# INTRODUCTION

## 1.1 General background

Bangladesh is an agriculture based country. Agriculture sector plays an important role in overall economic development of the country. Agriculture has historically been Bangladesh's major industry, as it has been in numerous other emerging nations. Around 40.6 percent of the population is engaged in this industry, while around 70% of the population relies on agriculture for a living (BER, 2021). Agriculture is the primary source of income and employment for a sizable number of the impoverished. Agriculture's indirect dependency is evident in employment in agro-based services and rural companies.

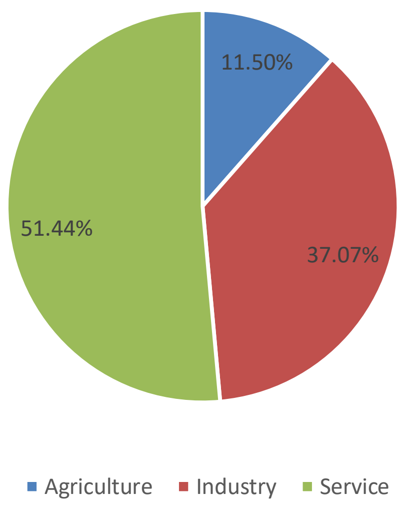
The boro season starts in December-February and ends in April- May. Planting of aus starts in April-May and the harvesting takes place in July- August, while the aman season begins in April-May and ends in November- December. (Parvez, 2018). Among these, boro rice produces the largest yields throughout the growing season.

The highest ever Boro rice production of 20.7 million tons in 2021 is a big step towards a resilient rice system in Bangladesh (MOA, 2021). When the first lock-down in March 2020 was imposed countrywide, Boro rice was at the flowering stage. A deep uncertainty spread over the successful harvest of the main rice. However, farmers in Bangladesh presented a good harvest braving the pandemic, lock-down, and disaster (DAE, 2020). With a good Boro rice production in 2020, Bangladesh graduated to 3rd position in the rice world, sitting next to China and India (USDA, 2020). However, the Aus and Aman rice in 2020 faced usual monsoon flooding, and the production target was not achieved.

## 1.2 Present status of Bangladesh agriculture

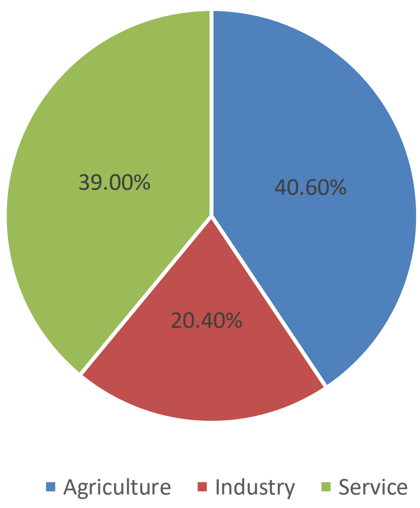
Bangladesh is predominantly an agricultural country where agriculture sector plays a vital role in accelerating the economic growth. It is therefore important to have a profitable, sustainable and environment-friendly agricultural system in order to ensure long-term food security for people. Broad agriculture sector has been given the highest priority in order to make Bangladesh self-sufficient in food. The Government is committed to developing agriculture as a whole in accordance with the objectives outlined in the Eighth Five Year Plan and National Agriculture Policy. Food output has been expanding in recent years. Agriculture is critical to Bangladesh's overall economic growth. According to the Economic Review, agriculture (crops, animal husbandry, forestry, and fisheries) contributes 11.50 percent to the country's GDP and employs around 40.6 percent of the labor force (BBS, 2021). Additionally, agriculture generates a diverse array of consumer-demanded agricultural commodities markets, particularly in rural regions. GDP from agriculture in Bangladesh increased to 11540.50 BDT Million in 2021 from 11242.30 BDT Million in 2020. Figure 1.1

shows the share of GDP by different major sectors and figure 1.2 shows the employment generation by different major sectors.




Source: BER, 2021

**Figure 1.1: Share of GDP by different major sectors**




Source: BER, 2021

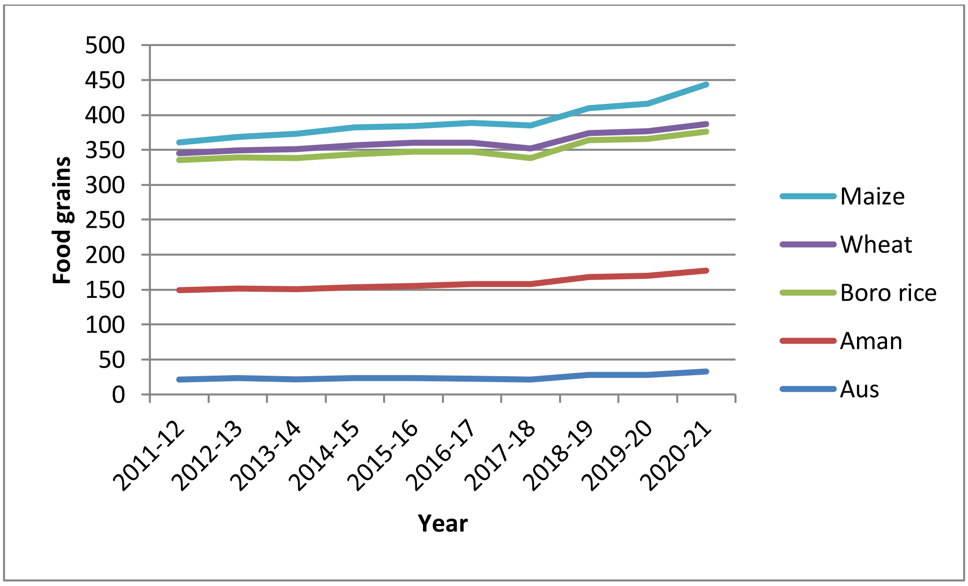
**Figure 1.2: Employment generation by different major sectors**

According to BBS, food grains production totaled 443.56 lakh MT in FY 2020-21, with Aus accounting for 32.85 lakh MT, aman accounting for 144.38 lakh MT, boro rice accounting for 198.85 lakh MT, wheat accounting for 10.85 lakh MT, and maize accounting for 56.63 lakh MT. Table 1.1 and figure 1.3 summarizes the state of food grain output from fiscal years 2011-12 to 2020-21.

**Table 1.1: Food grains production (In lakh MT)**

| **Food grains** | **2011-12** | **2012-13** | **2013-14** | **2014-15** | **2015-16** | **2016-17** | **2017-18** | **2018-19** | **2019-20** | **2020-21** |
|---|---|---|---|---|---|---|---|---|---|---|
| Aus | 21.33 | 23.33 | 21.58 | 23.26 | 23.28 | 22.89 | 21.33 | 27.75 | 27.55 | 32.85 |
| Aman | 127.91 | 127.98 | 128.97 | 130.23 | 131.90 | 134.83 | 136.56 | 140.54 | 142.03 | 144.38 |
| Boro rice | 186.17 | 187.59 | 187.78 | 190.07 | 191.92 | 189.38 | 180.24 | 195.60 | 196.45 | 198.85 |
| **Total Rice** | **335.41** | **338.90** | **338.33** | **343.56** | **347.10** | **347.10** | **338.13** | **363.89** | **366.03** | **376.08** |
| Wheat | 9.72 | 9.95 | 12.55 | 13.02 | 13.48 | 13.48 | 14.23 | 10.16 | 10.29 | 10.85 |
| Maize | 15.52 | 19.54 | 21.78 | 25.16 | 23.61 | 27.59 | 32.88 | 35.69 | 40.15 | 56.63 |
| **Total** | **360.65** | **368.39** | **372.66** | **381.74** | **384.2** | **388.17** | **388.14** | **409.74** | **416.47** | **443.56** |

Source: BBS, 2021




Source: BBS, 2021

**Figure 1.3: Food grains production (In lakh MT)**

### 1.3 Importance of boro rice

Bangladesh has an agrarian economy in which rice is the dominant crop. Rice plays a pivotal role in all spheres of life in Bangladesh and when it comes to food security of the rural farmers it is the most important commodity in terms of livelihood and food.

It is the staple food for entire 163.7 million people of Bangladesh (BER, 2020). On the other hand, the annual growth rate for rice consumption in the Asia-Pacific Region over a period of 45 years (1950 to 1995) has kept pace with the demand, more through yield increase rather than area expansion (Papademetriou, 2000). Within 2030 our world population will be increased by 8.27 billion and we can ensure enough rice for the increasing population (Kubo and Purevdorj, 2004).

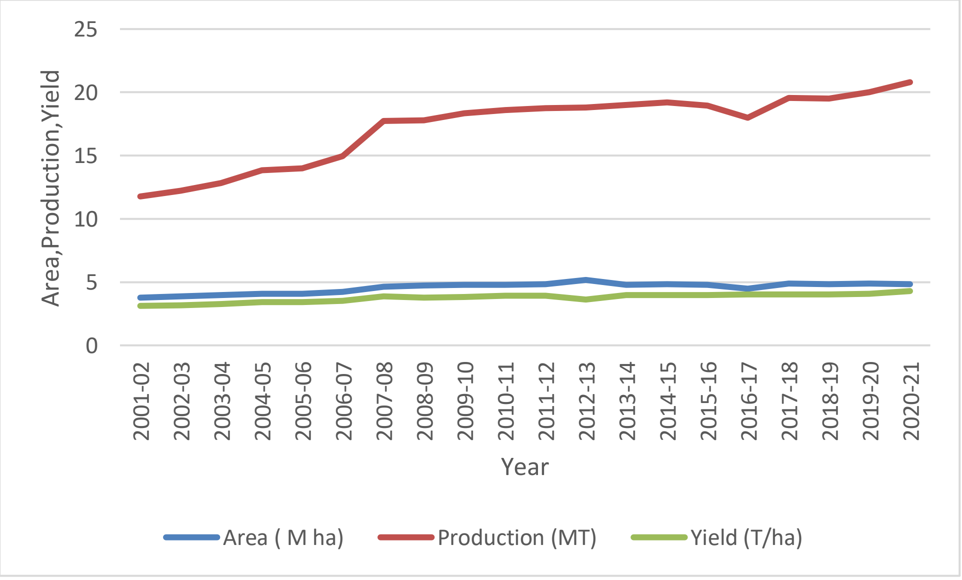
Keeping this in cognizance, since the independence all the successive governments have given high priority for attaining self-sufficiency in food production particularly in rice production. Accordingly, the demand for paddy is constantly rising and 1.37 percent new population are being added each year to its total population. The development of high yielding modern rice 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 almost stable over the last decades. Rice continuously provides 73 percent of total calorie intake for the people particularly for hard working people or day labor. The rice production is by far the most important provider of rural employment (HIES, 2016). The rice area is about 11.55 million hectares (BBS, 2021). Table 1.2 and figure 1.4 summarize area, production and yield of boro rice from fiscal years 2001-02 to 2020-21.

**Table 1.2 Area, production and yield of boro rice by different years**

| Year | Area ( M ha) | Production (MT) | Yield (T/ha) |
|---|---|---|---|
| 2001-02 | 3.77 | 11.77 | 3.12 |
| 2002-03 | 3.85 | 12.22 | 3.17 |
| 2003-04 | 3.95 | 12.84 | 3.25 |
| 2004-05 | 4.06 | 13.84 | 3.41 |
| 2005-06 | 4.07 | 13.98 | 3.43 |
| 2006-07 | 4.25 | 14.97 | 3.52 |
| 2007-08 | 4.61 | 17.76 | 3.85 |
| 2008-09 | 4.72 | 17.81 | 3.77 |
| 2009-10 | 4.78 | 18.34 | 3.84 |
| 2010-11 | 4.77 | 18.62 | 3.90 |
| 2011-12 | 4.81 | 18.76 | 3.90 |
| 2012-13 | 5.17 | 18.78 | 3.63 |
| 2013-14 | 4.79 | 19.01 | 3.97 |
| 2014-15 | 4.84 | 19.19 | 3.96 |
| 2015-16 | 4.77 | 18.94 | 3.97 |
| 2016-17 | 4.48 | 18.01 | 4.02 |
| 2017-18 | 4.86 | 19.58 | 4.03 |
| 2018-19 | 4.85 | 19.50 | 4.02 |
| 2019-20 | 4.90 | 20.00 | 4.08 |
| 2020-21 | 4.85 | 20.80 | 4.29 |

Source: BBS, 2020; MoA, 2021




Source: BBS, 2020; MoA, 2021

**Figure 1.4: Area, production and yield of boro rice by different years**

### 1.4 Boro rice production in Netrokona district

Boro rice cultivation in Netrokona has exceeded this year’s target with bringing additional 253 hectors of land under cultivation. Now farmers are putting in their best efforts in nursing the growing rice plants across the district. Officials of the Department of Agriculture Extension (DAE) Netrokona said, the DAE has designed a target for producing 7.70 lakh tones of clean boro rice from 1,84,575 hectors of land in ten upazilas of the district.

**Table 1.3: Area, production and yield of boro rice in Netrokona district by different years**

| Year | Area (ha) | Production (MT) | Yield (MT/ha) |
|---|---|---|---|
| 2014-15 | 177744 | 702751 | 3.954 |
| 2015-16 | 179707 | 722996 | 4.023 |
| 2016-17 | 140812 | 563439 | 4.001 |
| 2017-18 | 171875 | 714290 | 4.156 |
| 2018-19 | 182698 | 722000.2 | 3.952 |
| 2019-20 | 182891 | 811917 | 4.439 |
| 2020-21 | 181878 | 74990 | 4.123 |

Source: BBS, 2021

### 1.5 Nutritive and medicinal value of rice

Rice is the world single most important food stuff, the staple food for over the billion people in most of the countries and it is an important and nutritionally indispensable food commodity that feeds more than half of the world’s population. Rice is such an important food in some countries that “to eat means” means “to eat rice”. Without rice, or something to take the place of rice, many people would go hungry. Being a part of a balance diet, more and more populations are using rice in their diet because it plays a vital role.

In 17 countries across Asia and the Pacific, nine countries throughout North and South America, and eight countries throughout Africa, it is the principal source of nutritious energy. Rice supplies 20% of the world's dietary energy, whereas wheat offers 19% and maize (corn) provides 5% (Wahed and Anjan, 2008). A thorough assessment of rice's nutrient composition reveals that rice's nutritional value varies according to a range of factors. It varies by rice variety, which includes white, brown, red, and black (or purple) rice varieties cultivated in different parts of the world. Additionally, it is reliant on the nutritional content of the soil in which rice is grown, the way by which the rice is polished or processed, how it is improved, and how it is cooked before to consumption.

The nutritional value of rice makes its good for digestion in stomach, diarrhea, dysentery, nausea, skin disorders and high blood pressure. Health benefits of rice includes managing fast and instant energy, stabilizing blood sugar levels and being a source of vitamin B1 to human body. Other benefits include skin care, resistance to high blood pressure, dysentery and heart diseases.

Rice is primarily known as a high-energy or high calory food and has high biological value of proteins. Around 40% of the world's population get the majority of their calories from rice. Rice is consumed by about 90% of the population of Bangladesh, Myanmar, Sri Lanka, Vietnam, and Kampuchea. Rice is inextricably linked to Bengali culture. The government of Bangladesh's food department advises 410 grams of rice per person each day.

**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 (mg) | 0.09 |
| Vitamin C (mg) | 0 |
| Calcium Ca (mg) | 9 |
| Iron Fe (mg) | 1 |

Source: Bose and Som1986; Wahed and Anjan, 2008

**1.6 Justification of the study**

The researcher was interested to identify whether boro rice farmers utilize their full capacity in production processes or not, and to find ways of improving their productivity, in case they were less efficient. This study is designed to help find solutions which would promote increases in boro rice productivity as well as overall output. Therefore, this study will have important benefits to the researcher, boro rice producers, policy makers in government and to contribution to the body of knowledge in production economics and finally to come up with policy proposals to address the constraints. Identifying inefficiency in boro rice production helps rice producers to use their inputs efficiently thereby helping in minimizing the already scarce resources in the country. It is important that farmers use resources efficiently to achieve the maximum yield. That is, if boro rice farmers can increase productivity with the same input quantities under efficient allocation and management of resources at the farm level; this will have great implication for overall national development and food security.

Additionally, results of this study will help policy makers to design policies to target interventions according to the identified needs and constraints of boro rice producers. Moreover, the results from this study will contribute to the already existing body of knowledge in production economics and efficiency studies in particular. The efforts here could provoke efficiency studies on other crops in the Bangladesh.

As it was also investigated that boro rice productivity in farmer fields are often below what will be possible with improved management. A good understanding can enable us to identify progress in boro rice farmer fields and also help us identify the extent to which increased cost can be justified to raise yields or reduce yield losses.

Identifying the productivity gaps also enables the major yield limiting factors (e.g. drought, flooding, fertilizer deficiencies, extreme temperature etc.) and yield reducing factors(e.g. pests, diseases etc.) to be identified.

Productivity gaps occur in low-input systems with irrigation control and relatively poor input management, but often also in high-input systems with good irrigation control that allows for more suitable management practices. Rice plants growth and development can be severely hampered by drought or floods. Absence or late availability of critical inputs may also undermine farmer’s ability to make management decision and undertake farm operations on time.

However, adoption of increasing agricultural new technology can be an important option for the farmers to get rid of hunger and food insecurity by improving crop productivity, reducing food price and making more food accessible for the poor households. Further, promoting the adoption of improved crop varieties in a sustainable manner helps to improve welfare of the households (Asfaw et al, 2012).

By considering all of aspects the present study will help to find the fundamental problems and develop our consideration on the boro rice cultivation and decision making in production of boro rice. Further, the study will help in affording a picture of the benefits and costs of these initiatives, which will help individual researchers who will conduct further studies of the similar nature and encourage in conducting more comprehensive and detailed investigation in this particular field of the study.

Finally, the study will be helpful for the individual farmers for effective operation and management of their farms through pointing the drawbacks and for the planners for proper planning and policy making. The study may be helpful to the extension workers to learn about various problems related to boro rice cultivation and to suggest the farmers for copying with those problems.

## 1.7 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 explore socio-demographic profile of boro rice producers.
b) To calculate profitability of boro rice production.
c) To assess technical efficiency of boro rice production.
d) To identify the problems of boro rice production.

## 1.8 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.

## 1.9 Organization of the study

This thesis contains a total of eight chapters which have been organized in the following sequence. Chapter 1 includes introduction. The review of literature is presented in Chapter 2. Methodology of the relevant study is discussed in Chapter 3. Chapter 4 contains the socio- demographic profile of the boro rice producing farmers. Chapter 5 deals with the profitability of boro rice cultivation. Chapter 6 describes the technical efficiency of boro rice cultivation. Chapter 7 presents problems of boro rice cultivation. Finally, Chapter 8 represents the summary, conclusion and policy recommendations to increase boro rice production.

# CHAPTER II
# REVIEW OF LITERATURE

The main purpose of this chapter is to review some related studies in connection with the present study. Only a few studies have so far conducted related to profitability and technical efficiency of Boro rice cultivation in Bangladesh. Bangladesh has made remarkable progress in food production and achieving its food security. Since independence in 1971, production and consumption of food grains grew substantially over time.

Even though, there were ups and downs, production of food grains generally experienced an upward trend. At present, agriculture as a whole accounts for 11.50 of Gross Domestic Product (GDP) (BBS, 2021) and 40.6% of labor employment (BER, 2021).Although the contribution of agriculture sector to GDP has gradually been declining in recent years but still it is playing a major role in the economy of Bangladesh. Again, some of these studies may not wholly 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 studies, which have been conducted in the recent past are discussed below.

**Rahman *et* al. (2021)** conducted a study on cost efficiency of boro rice production in Dinajpur district of Bangladesh. The results of the study is shown a broad range of cost efficiency scores between 56.65 to 96.40% for the worse to the best rice-growing farmer, respectively with an average efficiency of 84.01%. The finding is also shown that the mean cost efficiency level of small, medium and large farmers was 83.30, 85.58, and 94.43% respectively. The land rental fees, human labor wages, irrigation prices, and pesticide prices are the key factors that contribute to the productivity of the rice cultivation. The relatively higher level of cost efficiency among large farmers obviously demonstrates the notion that only large farmers in the study region are investing efficiently in rice growing. Irrespective of the farm size, the cost efficiency drivers found out that more efficient were the farmers who had more experience in farming, obtained training on rice production techniques, and better access to institutional credit.

**Mainuddin *et* al. (2021)** performed a study on yield, profitability, and prospects of irrigated boro rice cultivation in the north-west region of Bangladesh. The results shown that there were significant ($p<0.05$) variations in rice yield between sites, irrigation pump types, and rice varieties, with Hybrid rice and BRRIdhan29 producing highest yields (6.0-7.5 t/ha) Due to different pricing systems, the cost of irrigation water varied from site to site and from year to year, but always comprised the highest input cost (20-25% of the total production). The total paid- out cost, gross benefit, and gross income of rice significantly ($p<0.05$) differed between sites, type of irrigation pumps, rice varieties, transplanting dates, and two cropping years. The variations in observed yield and profitability reveal considerable scope to improve the rice production systems. Market variation in the price of rice affected overall profitability significantly. Probability and risk analysis results shown that Minikit and BRRI dhan29 are the most stable varieties for yield and profitability. Hybrid rice, which has the maximum attainable yield among the cultivated rice varieties, also has the risk of negative net income.

**Hoque *et* al. (2020)** examined a study on profit efficiency and technology adoption of boro rice production in Bangladesh. The findings showed that the profit efficiency of the farmer varied between 23% and 97% with a mean of 76% which implied as 24% of the profit is lost due to a combination of technical and allocative inefficiencies in boro rice cultivation in the study area. The inefficiency model revealed that the education level of the farmer, farm size, variety of seed, and training & extension service influence the profit inefficiency significantly. The study also explained that the level of technology adoption index affects profit efficiency. The technology adoption in boro rice cultivation is influenced by the education level of the farmer, farm size, and farm capital.

**Kamruzzaman and Uddin (2020)** evaluated the economic viability of boro rice production in haor ecosystem of Kishoreganj district. The study revealed that boro rice production was profitable and productivity index was very high. It also indicated that power tiller and insecticides cost had a significant impact on profitability of boro rice production. Lower price of output, early flash flood inundation and lack of short-duration and high yielding variety were found the major constraints faced by the farmers.

**Akhter *et* al. (2019)** did a research on the factors that affect the profitability of rice growing in Bangladesh. They found that the cost-benefit ratio of boro rice was 1.37 and that hired labor, fertilizer, and power tiller expenses all have a negative impact on profitability.

**Rasha *et* al. (2018)** examined a study on financial profitability and resource use efficiency of boro rice production in some selected areas of Mymensingh district in Bangladesh. Benefit cost ratio was to be 1.29 for boro rice production. They found that boro rice production was profitable. Among the variables quantity of seed, animal labor and power tiller cost, no.of human labor, quantity of fertilizer, cost of irrigation had a positive and significant effect on the gross yield of boro rice production, except for cost of manure and cost of pesticides had an insignificant effect on the gross yield of rice production.

**Islam (2017)** examined a study to compare the profitability of boro rice and jute in Rajoirupazila of Madaripur district in Bangladesh and found that jute was more profitable than boro rice in the study area as the (BCR) of jute was 1.52 which was higher than boro rice 1.10.

**Sujan *et* al. (2017)** conducted a study on financial profitability and resource use efficiency of boro rice cultivation in some selected area of Bangladesh. Result based on Farm Budgeting model showed that per hectare variable cost and total cost of production was BDT (Bangladeshi Taka) 57,583 and BDT 71,208 respectively. Average yield was found 4.112 ton which was more than the previous year's national average yield of 3.965 ton. The average gross return, gross margin, and net return were BDT 86,548, BDT 28,965 and BDT 15,340 respectively. Benefit-Cost ratio (BCR) was found 1.22 and 1.50 on full cost and variable cost basis. Cobb- Douglas production function analysis showed that the key production factors, that is, human labor, irrigation, insecticide, seed and fertilizer had statistically significant effect on yield. MVP and MFC ratio analysis showed that growers allocated most of their resources in the rational stage of production.

**Hasan *et* al. (2016)** performed a study on the technical efficiency of boro rice production in Jhenaidah district of Bangladesh. This study indicated that the level of technical efficiency in the study area was high (0.92). It also found that cost labor, irrigation, seed and ploughing are the important factors which affect increasing efficiency of boro rice production. Farm size, age, education, training and credit facility are the significant factors which are negatively related to technical inefficiency of boro rice production.

**Rahman *et* al. (2016)** studied on profitability and technical efficiency of boro rice (BRRIdhan29) cultivation in Dinajpur and Bogra of Bangladesh. Benefit cost ratio of rice implied that rice (BRRIdhan29) cultivation Dinajpur was more profitable than Bogra region. The empirical results indicated that the coefficient of human labor, seed cost, MP, gypsum, and irrigation cost were positive and significant which implied that an increase in the magnitudes of these variables would result the positive impacts on rice production in Dinajpur region. On the other hand, some coefficients were positive (human labor, seed, and urea) and some were negative (land preparation and gypsum), but had significant effect on the yield of rice in Bogra region.

**Rahman *et al.* (2015)** shown that although rice cultivation is a successful agricultural practice in Bangladesh, profitability varies by region owing to widespread adoption of modern rice technology, input availability, and soil fertility. Excessive fertilizer and pesticide usage, along with climate change, is also contributing to the loss of biodiversity, soil fertility, and extensive arsenic pollution of groundwater.

**Hasnain *et al*. (2015)** conducted the technical efficiency of boro rice production using data from boro rice farmers of Meherpur district in Bangladesh and found that technical efficiency of boro rice farms in Meherpur district is 89.5% and labor, fertilizer, pesticide, seed and irrigation are significant factors that affect the level of technical efficiency.

**Akter (2011)** studied on profitability and resource use efficiency of BRRIDhan29 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 BRRIDhan-51 and BR-11 rice production in Rangpur district with a sample of 60 farmers considering Cobb Douglas production function and found that BRRIDhan-51 had higher gross margin than BR-11.

**Kana (2011)** studied on economic analysis of salt tolerant Binadhan-8 and HYV BRRI Dhan28 rice production in Satkhira district with a sample of 60 respondents using Cobb Douglas production function and found that total return of Binadhan-8 was more than total return of BR-28.

**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 BRRIDhan33 and BR-11 rice production in Kurigram district with 60 farmers using cobb-douglas production function and found that gross margin taking BRRIDhan33 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 gross margin from BRRI Dhan 34 was higher than BR-11.

**Rahman *et* al. (2007)** conducted a study on measuring the costs of production, based on sizes of farm operation on rice farmers in Jassore district of Bangladesh study. The objectives of the study were to measure the differences in the cost of production of Boro rice farmers on the basis of land. They included three types of rice farmers such as small, medium &large. They found that although there were no significant differences in the quantity of inputs used for all categories of farmers, the unit cost of some inputs significantly varied between small-large medium-large, thus affecting the cost of production. The reason is that most of the small medium farmers purchased inputs on credit, spending comparatively more than cash &they paid higher interest on borrowed money. They showed that for that reason rice production increased regardless of the land operation size but small &medium farmers still have a serious problem especially the increasing cost involved in the production.

**Abedullah and Mushtaq (2007)** carried out the study and employed a Stochastic Frontier Production approach to determine the future investment strategies that can enhance the production of rice. The results of stochastic production function indicated that coefficient of pesticide was not significant probably due to heavy pest infestation while fertilizer found to have negative impact on rice production mainly because of improper combination of N, P, and K nutrients. The improper combination of input use indicates poor dissemination of extension services. The results of inefficiency model suggested that investment on tractor (mechanization) could significantly contribute to improve farmer’s technical efficiency, implying that the role of agricultural credit supply institutes (such as banks) needs to be redefined. Rice farmers were 9 percent technically inefficient, implying that little potential existed that could be explored through improvement in resource use efficiency.

The literature review revealed that there has been little research on boro rice farming in the study region. The result of these studies varies widely in different reasons as well different regions. The present study aims to gather information on profitability of boro rice cultivation and the level of technical efficiency and inefficiencies of rice farmers. Additional study on boro rice production in the study area may assist in identifying particular difficulties and determining the activities that need to be taken to boost the farmers’ productivity and profitability. The study would help researchers, related farmers, extension workers and policy makers in taking necessary steps for increasing rice production in our country.

# CHAPTER III
# 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

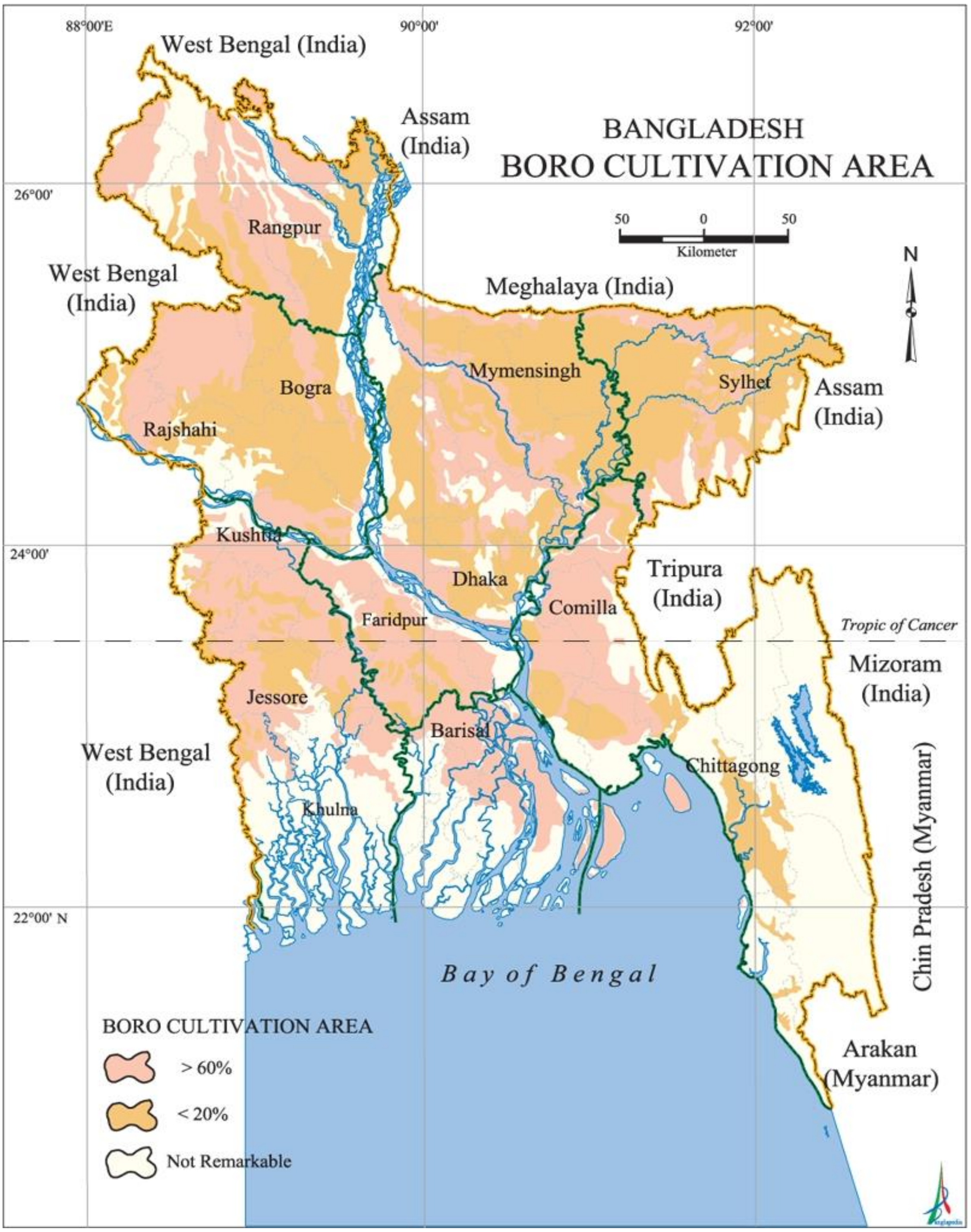
The study area selection is a critical stage in conducting a farm management research. The region chosen suited both the study's specific objective and the possibility of cooperating with the farmer. Although boro is grown all over Bangladesh, the district Netrokona and most of the area of Mymensingh division of Bangladesh are the important region where it is grown quite extensively. So, on the basis of higher concentration of boro production, 60 farmers from 6 villages under Durgapur upazila of Netrokona district were selected. The sample farmers produce various types of boro rice such as BRRI Dhan28, BRRI Dhan29, BRRI hybrid Dhan3, BRRI hybrid Dhan5 etc.

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) The area represented the similar agro-ecological characteristics;
c) These villages had some identical physical characteristics like topography, soil and climatic conditions for producing boro.
d) Easy accessibility and good communication facilities in these villages; and
e) Co-operation from the respondents was expected to be high so that the reliable data would be obtained.

### 3.3 Location of the study area

Netrokona is situated in the northern part of Bangladesh, along the border with the Indian state of Meghalaya. Netrokona occupies 2744.28 square kilometer. It lies between 24°34' and 25°12'north latitudes and between 90°00' and 91°07' East longitudes. Netrokona is bounded by the Garo Hills in Meghalaya, India on the north, Sunamgonj district on the east, Kishoreganj district on the south and Mymensingh district on the west. There are five main rivers in Netrokona: Kangsha, Someshawri, Dhala, Magra, and Teorkhali. It is a part of the Surma-Padma river system. Much of the district becomes a haor during the monsoon. The main town is situated on the bank of the river Magra, 123 kilometres north of Dhaka. It has ten upazila. The major boro rice cultivation areas of Bangladesh are shown in map 3.1 and the map of Netrokona district is shown in Map 3.2.




Source: Banglapedia

**Figure 3.1: Map of major boro rice cultivation area of Bangladesh**


Source: Banglapedia

**Figure 3.2: Map of Netrokona district**

### 3.4 Description of the study area

Durgapur upazila area is 293.42 sq km, located in between 24°57' and 25°12' north latitude and in between 90°28' and 90°47' east longitudes. It is bounded by Meghalaya state of India on the north, Netrokonasadar and Purbadhalaupazilas on the south, Kalmakandaupazila on the east, Dhobauraupazila on the west. The Garo hills and valleys are on the northern part of the upazila. Main water bodies are Kangsha, Someshwari and Old Someshwari.

According to Banglapedia the features of Durgapur upazila are as follows:

Population: total-224873; density-770 per sq km.

Literacy rate: 40.86%

Main sources of income: Agriculture 73.01%, non-agricultural laborer 3.04%, industry 0.47%, commerce 9.83% transport and communication 1.02%, service 3.21%, construction 0.60%, religious service 0.20%, rent and remittance 0.32% and others 8.30%.

Ownership of agricultural land: land owner 57.15%, landless 42.85%; agricultural land owner: urban 35.31% and rural 59.91%.

Main crops: paddy, jute, wheat, mustard, peanut, garlic, corn, cotton.

The map of Durgapur upazila is shown in figure 3.3.


Source: Banglapedia

**Figure 3.3: Map of Durgapur upazila (study area)**

### 3.5 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 60 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.

### 3.6 Data collection procedure

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:

#### 3.6.1. 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.

#### 3.6.2. 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 May 2021 and June 2021 prior to the survey at rural area of Durgapur upazila under Netrokona District. I have chosen some of the farmers at random as the respondents.

#### 3.6.3. Finalization of the questionnaire and 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 co-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.

### 3.7 Data collection techniques

Primary data was collected through conducting field survey, while secondary data was gathered from research related statistical papers and other related publications. Due to the absence of producers' records regarding farm activities, data collection depended on a combination of methods, which rely memory recall for basic information such as labor use, wages, input costs.

#### 3.7.1 Primary data collection technique

As rice farming is seasonal so the researcher must determine to what extent the information for a particular year represents normal or average conditions, particularly for yields, annual production and price level. Farmers generally transplant boro rice from mid-January to mid-February and harvest after three month. Primary data were collected from farm level boro rice producer. Selected respondents were interviewed personally with the help of pre-tested questionnaires. The primary data collected from 60 boro rice producers and it has been used in estimating production function.

#### 3.7.2 Secondary data collection technique

The secondary data was collected from various research documents like thesis paper, articles and other statistical papers. The research materials are collected from the following documents:

- Yearbook of Agricultural Statistics
- Bangladesh Economic Reviews
- Statistical Yearbook of Bangladesh
- The national and international journals, articles and publications
- MS and PhD thesis papers
- Web browsing or Internet

### 3.8 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.

## 3.9 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 was 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 the data files
- Final documentation
- Conversion of data files
- Storage of all files.

## 3.10 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.

## 3.11 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.

### 3.11.1 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-

- Human labor
- Machinery
- Seed
- Urea
- TSP
- MoP
- Insecticides
- 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 human labor, seedlings, urea, TSP, MoP, insecticides and irrigation. Fixed cost (FC) included rental value of land and interest on operating capital. Total cost (TC) included total variable cost and fixed cost.

#### 3.11.1.1 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.

#### 3.11.1.2 Cost of machinery

Machinery cost is considered one of the most important components in the production process. Machinery cost for boro production included ploughing, laddering, harvesting threshing and other activities.

#### 3.11.1.3 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.

#### 3.11.1.4 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.

### 3.11.1.5 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.

### 3.11.1.6 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.

### 3.11.1.7 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.

### 3.11.1.8 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.

### 3.11.1.9 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

### 3.11.1.10 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. So, cash rental value of land was undertaken for cost of land use.

### 3.11.1.11 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.

### 3.11.1.12 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

### 3.11.2 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 iso-quant rather than interior to the iso-quant. 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 iso-quant. 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. If these differences in quality are physically measurable, it may be possible to reduce this effect by defining a large number of relatively homogeneous factors of production, but in practice it is never likely to be possible to completely eliminate it (Farrell 1957).

#### 3.11.2.1 The stochastic frontier model

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.

#### 3.11.2.2 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

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

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

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

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

$$Y_i=\alpha X_{1i}^{\beta1}X_{2i}^{\beta2}X_{3i}^{\beta3}X_{4i}^{\beta4}X_{5i}^{\beta5}X_{6i}^{\beta6}X_{7i}^{\beta7}X_{8i}^{\beta8}X_{9i}^{\beta9}e^{ui}$$

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

**3.11.2.3 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:

$$Y = \beta_0X_1\beta_1X_2\beta_2\ldots\ldots X_9\beta_9eV_i\text{-}U_i$$

The above function is linearized double-log form:

$$\ln Y=\ln\beta_0+\beta_1\ln X_1+\beta_2\ln X_2+\beta_3\ln X_3+\beta_4\ln X_4+\beta_5\ln X_5+\beta_6\ln X_6+\beta_7\ln X_7+\beta_8\ln X_8+\beta_9\ln X_9+Vi-Ui$$

Where,

Y = Revenue (Tk/ha)

$X_1$ = Seedling cost (Tk/ha)

$X_2$ = Family labor cost (Tk/ha)

$X_3$= Hired cost (Tk/ha)

$X_4$= Machinery cost (Tk/ha)

$X_5$ = Cost of urea (Tk/ha)

$X_6$ = Cost of TSP (Tk/ha)

$X_7$=Cost of MoP (Tk/ha)

$X_8$=Irrigation cost (Tk/ha)

$X_9$=Insecticide cost (Tk/ha)

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

$U_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + \delta_6 Z_6 + \delta_7 Z_7 + Wi$

Where,

$Z_1$…….. $Z_7$ are explanatory variables.

The equation can be written as:
$Ui = \delta_0 + \delta_1$Age + $\delta_2$Education + $\delta_3$Farm size + $\delta_4$Livestock + $\delta_5$Extension service + $\delta_6$Credit+ $\delta_7$Market distance +$W_i$

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 {$U_i$~|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 IV
# SOCIOECONOMIC PROFILE OF SAMPLE FARMERS

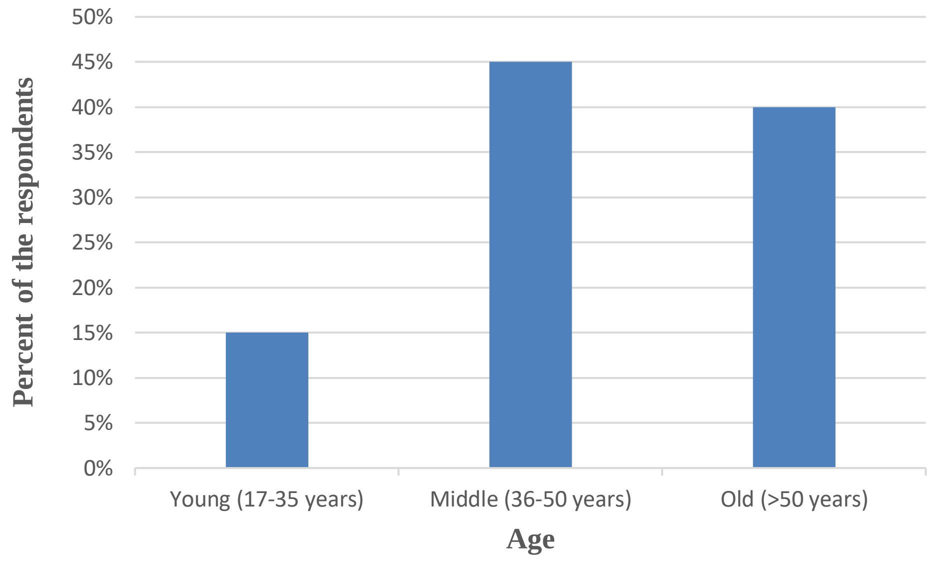
## 4.1 Introduction

The purpose of this chapter is to present a brief description of the socio-economic characteristics of the boro rice farmers. Socioeconomic standpoints of the farmers can be looked upon from different points of view. This activities depend upon a number of variables related to their livelihood status, the socio-economic environment in which they live and the nature and the extent of the farmers participation in national development activities. It was not possible to collect all the information regarding the socio-economic characteristics of the sample boro rice farmers due to limitation of time and relevant resources. Socioeconomic condition of the sample farmers is very important in case of research planning because there are many interrelated and constituent attributes characterizes an individual and profoundly influences development of their behavior and personality. People differ from one another for the variation of socioeconomic aspects. However, for the present research, a few of the socioeconomic characteristics have been taken into consideration for discussion. Data on several types of socio-economic variables were collected to know the socioeconomic profile of the sample boro rice farmers. The general profile of boro rice farmers such as age, educational status, family size, annual income, farm size, farming experience, distance from market, membership on organization, agricultural training, extension service, access to credit, access to TV, having livestock and electricity facility are discussed in this chapter.

## 4.2 Age

Age of the farmers ranged from 21 to 80 years. All the variables were categorized on the basis of their possible scores except age was categorized based on the classification provided by the Ministry of Youth and Sports, Government of the People's Republic of Bangladesh. The distribution of the boro rice farmers according to their age is shown in figure 4.1.

The farmers were classified into three age groups: Young (17-35 years), Middle (36-50 years) and Old (above 50 years). Out of 60 sample farmers of all categories, 15 percent belongs to the age group of 17-35 years, 45 percent belongs to 36-50 years age group and 40 percent belongs to above 50 years age group. These findings imply that the majority of the sample farmers were in the most active age group of 36-50 years indicating that they provided more physical efforts for farming and this age group is supposed to have more energy and risk bearing ability.



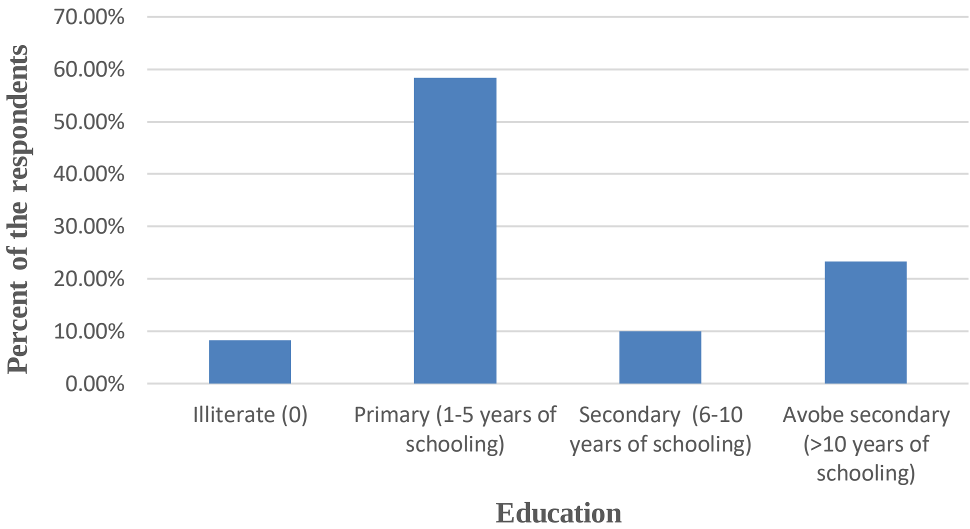

Source: Field survey, 2021; Sarkar *et* al., (2014)

**Figure 4.1: Distribution of the respondents according to their age**

**4.3 Educational status**

The education scores of the sample farmers ranged from 0 to 16. On the basis of their educational scores, the boro rice cultivars were classified into four categories, namely "illiterate (0), primary (1-5 years of schooling), secondary (6-10 years of schooling) and above secondary (above 10 years of schooling). This distribution of the sample farmers according to their education is shown in the figure 4.2.

Literacy plays an important role in accelerating agricultural development of a country in the sense that the literate farmers tend to apply modern technology. Figure 4.2 shows that out of 60 sample farmers of all category 8.33 percent farmers have illiterate level of education, 58.33 percent have primary level, 10 percent have secondary level and 23.34 percent have above secondary level of education. Finding of the study reveals that most of the sample farmers have primary level of education.



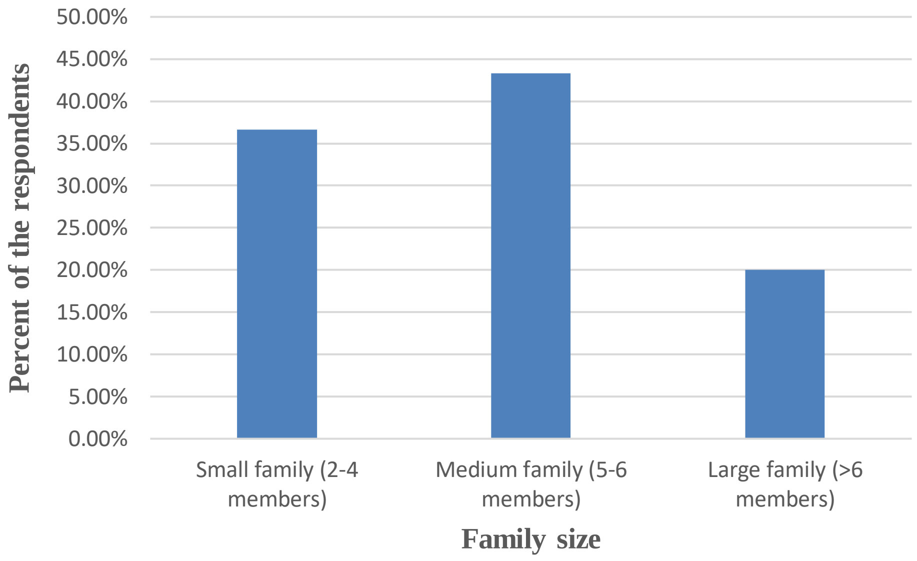

Source: Field survey, 2021

**Figure 4.2: Distribution of the respondents according to their educational status**

### 4.4 Family size

Family size scores of the farmers ranged from 2 to 11. Average family size is 5.3 which is higher than the national average of 4.06 (HEIS, 2016). According to family size, the respondents are classified into three categories as small family (2-4members), medium family (5-6 members) and large family (above 6 members) shown in figure 4.3.

Out of 60 sample farmers, 36.67 percent belonged to the small family of 2-4 members, 43.33 percent belongs to the medium family of 5-6 members and 20 percent belongs to the large family size of above 6 persons (figure 4.3).




Source: Field survey, 2021

**Figure 4.3: Distribution of the respondents according to their family size**

## 4.5 Annual income

Annual household income of the sample farmers included all the incomes from different income sources i. e, crop farming, livestock rearing, fish farming, day labor, service, business and others. In the study area, annual household income of the respondent ranged from 0.3 to 12.14 lakh. Findings of the study that average monthly household income of the respondents (Tk. 21,238) is well above the national average of Tk.15,998 (HEIS, 2016). The boro rice farmers are classified based on their annual household income into low income group, medium income group and high income group. The distribution of the boro rice farmers according to their annual household income is presented in table 4.1.

**Table 4.1: Distribution of the farmers according to their annual income**

| Income group (“000” Tk.) | Farmers | |
|---|---|---|
| | Number | Percent (%) |
| Low income (Up to 120) | 44 | 73.33 |
| Medium income (121 to 250) | 6 | 10 |
| High income (Above 250) | 10 | 16.67 |
| All income group | 60 | 100 |

Source: Field survey, 2021; Sarkar *et* al., (2014) Result shows that out of 60 sample farmers 73.33 percent fell into low income group, 10 percent fell into medium income group and 16.67 percent fell into high income group. Majority of the farmers belongs to low income group.

### 4.6 Farm size

In the study area, household farm size of sample boro rice farmers ranged from 0.06 to 6.11 hectares with an average of 0.67 hectares. Boro rice farmers are classified into five categories according to their farm size as landless (<0.20 ha), marginal (0.21-0.50 ha), small (0.51-1.00 ha), medium (1.01-2.00 ha) and large (>2.00 ha). The distribution of the sample farmers is presented in table 4.2.

**Table 4.2: Distribution of the farmers according to their farm size**

| Farm size (Ha) | Farmers | |
|---|---|---|
| | Numbers | Percent (%) |
| Landless ( < 0.20) | 8 | 13.33 |
| Marginal (0.21-0.50) | 29 | 48.33 |
| Small (0.51-1.00) | 18 | 30 |
| Medium (1.01-2.00) | 4 | 6.67 |
| Large (> 2.00) | 1 | 1.67 |
| All farm size groups | 60 | 100 |

Source: Field survey, 2021; Zaman *et* al., (2010)

The result shows that marginal farm holder constitutes the highest proportion (48.33%) of the respondents. And out of 60 respondents 13.33% belongs to landless group, 48.33% belongs to marginal group, 30% belongs to small group, 6.67% belongs to medium group and 1.67% belongs to large farm group.

### 4.7 Farming experience

Boro rice farming experience of the respondents ranged from 5 to 55 years. Farming experience is classified into three categories as low farming experience group (4-15 years), medium farming experience group (16-30 years) and high farming experience group (>30 years). The distribution the respondents according to their farming experience is presented in the table 4.3.

**Table 4.3: Distribution of the farmers according to farming experience**

| Farming experience (years) | Farmers | |
|---|---|---|
| | Number | Percent (%) |
| Low (4-15) | 14 | 23.33 |
| Medium (16-30) | 26 | 43.33 |
| High (> 30) | 20 | 33.34 |
| Total group | 60 | 100 |

Source: Field survey, 2021

The result shows that medium farming experience constitutes highest proportion (43.33%) when 23.33 have lower experience and 33.34% have higher experience.

### 4.8 Distance from market

Distance from market of the respondents ranged from 0.25 to 3 km. On the basis of distance from market, the respondents are classified into three categories namely, short, medium and long distance is as shown in Table 4.4.

**Table 4.4: Distribution of the farmers according to market distance**

| Distance (km) | Farmers | |
|---|---|---|
| | Number | Percent (%) |
| Short distance (0.25-1) | 53 | 88.33 |
| Medium distance (1.01-2) | 6 | 10 |
| Long distance (above 2) | 1 | 1.67 |
| Total | 60 | 100 |

Source: Field survey, 2021

Table 4.4 shows that the highest proportion 88.33 percent of the farmers have short distance from market, while 10 percent of the farmers have medium distance from market and 1.67 percent of the farmers have long distance from market.

### 4.9 Membership on organization

The distribution of the sample farmers according to their membership on different organization is shown in table 4.5.

Table 4.8 shows that among the respondent farmers 33.33% of boro rice farmers have membership in different organization and 66.67% of boro rice farmers have no membership in any organization.

**Table 4.5: Distribution of the farmers according to membership on organization**

| Membership on organization | Farmers | |
|---|---|---|
| | Number | Percent (%) |
| Yes | 20 | 33.33 |
| No | 40 | 66.67 |
| Total | 60 | 100 |

Source: Field survey, 2021

### 4.10 Agricultural training

Among the respondent farmers 33.33 percent farmers got training on different agricultural technologies of boro rice farming whereas, 66.67 percent farmers did not get training on different agricultural technologies of boro rice cultivation (Table 4.6). 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 4.6: Distribution of the farmers according to agricultural training**

| Agricultural training | Farmers | |
|---|---|---|
| | Number | Percent (%) |
| Yes | 20 | 33.33 |
| No | 40 | 66.67 |
| Total | 60 | 100 |

Source: Field survey, 2021

### 4.11 Extension service

The distribution of the sample farmers based on receiving extension service is shown in the table 4.7. Among the respondent 11.67% farmers get extension service and rest of the 88.33% farmers do not get any extension service.

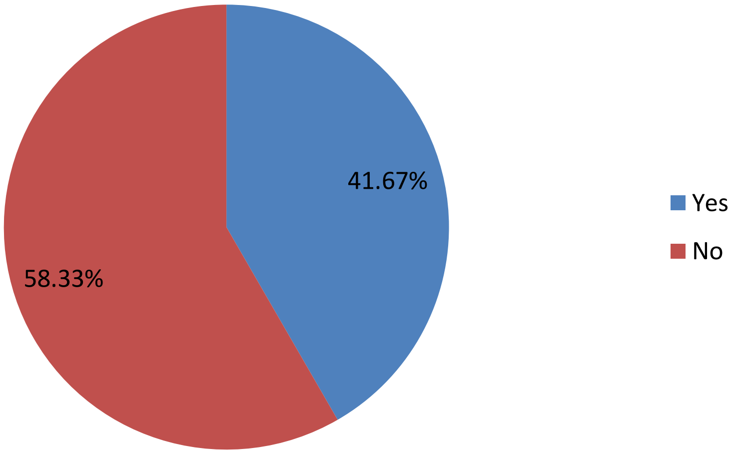
**Table 4.7: Distribution of the farmers according to extension service**

| Receiving extension service | Farmers | |
|---|---|---|
| | Number | Percent (%) |
| Yes | 7 | 11.67 |
| No | 53 | 88.33 |
| Total | 60 | 100 |

Source: Field survey, 2021

### 4.12 Receiving credit

Figure 4.4 shows that among the respondent farmers 41.67% farmers have taken credit for boro rice cultivation and 58.33% farmers did not take credit for boro rice cultivation.




Source: Field survey, 2021

**Figure 4.4: Distribution of the respondents according to receiving credit service**

### 4.13 Livestock

Distribution of the farmers based on having livestock is shown in table 4.8.The table 4.8 shows that 86.67% sample farmers have livestock in their house and rest of 13.33% farmers do not have livestock.

**Table 4.8: Distribution of farmers according to having livestock**

| Having livestock | Farmers | |
|---|---|---|
| | Number | Percent (%) |
| Yes | 52 | 86.67 |
| No | 8 | 13.33 |
| Total | 60 | 100 |

Source: Field survey, 2021

## 4.14 Conclusion

This chapter analyzed the socioeconomic characteristics of the rice farmers. Decision making behavior of an individual is determined by his socio-economic characteristics. There are numerous interrelated and constituent attributes that characterize a person and these profoundly influence development behavior. Socio economic characteristics of the producers affect their production process and technology use. It is, however, not easy task to collect all the relevant information regarding the socio - economic characteristics of the sample farmers due to limitation of time and resources.

# CHAPTER V
# PROFITABILITY OF BORO RICE CULTIVATION

## 5.1 Introduction

The main purpose of this chapter is to assess the costs, returns and profitability of boro rice cultivation. 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. For calculating the costs and returns of boro paddy production, the costs items were classified into two groups; (i) variable cost; and (ii) fixed cost. Variable cost included the cost of all variable factors like hired labor, machinery inputs, seedlings, fertilizer, irrigation and insecticides. On the other hand, fixed cost was calculated for interest on operating capital, land use cost and family labor. The returns from the crops have been estimated based on the value of main product and by-product. Gross return, gross margin, net return, and undiscounted benefit cost ratio (BCR) were determined in this section.

## 5.2 Variable cost

### 5.2.1 Cost of hired labor

Human labor cost is one of the major cost components in the rice production process. It is one of the most important and largely used inputs for producing boro rice. It is generally required for different operations such as land preparation and seed sowing, transplanting, weeding, irrigation, applying fertilizer and applying insecticides, harvesting and carrying, threshing and winding, drying and storing etc. The quantity of human labor used in boro rice cultivation was found to be about 46.87 man-days per hectare and average price of human labor was Tk. 500 per man-day. Therefore, the total cost of human labor was found to be Tk. 23437.04 per hectare which represents 20.79 percent of total cost of production (Table 5.1).

### 5.2.2 Cost of machinery inputs

Cost of machinery inputs is Tk.15416.39 per hectare which represents 13.68 percent of total cost of production (Table 5.1).

### 5.2.3 Cost of seedlings

Seed is the basic input for crop production. Cost of seedlings varied widely depending on seed quality and availability. Per hectare total cost of seedling for boro rice cultivation were estimated to be Tk. 10373.50, which constituted 9.20 percent of the total cost of production (Table 5.1).

### 5.2.4 Cost of urea

In the study area, farmers used urea as one of the main fertilizer for boro rice production. Per hectare cost of urea was Tk. 5591.79, which represents 4.96 percent of the total cost (Table 5.1).

### 5.2.5 Cost of TSP

The average cost of TSP was Tk. 4171.06 per hectare which representing 3.70 percent of the total cost (Table 5.1).

### 5.2.6 Cost of MoP

Per hectare cost of MoP was Tk. 5739.87, which represents 5.09 percent of the total cost (Table 5.1).

### 5.2.7 Cost of irrigation

Rice production needs a huge amount of water. In the study area, farmers had to depend on shallow tube well (STW) and deep tube-well (DTW). These tube-wells were diesel operated and/or electricity operated. The cost of irrigation water was charged at fixed rate for per unit area of irrigated land. All irrigation water charges were paid in cash. The average cost of irrigation was found to be Tk. 11777.22 per hectare, which represents 10.45 percent of the total cost of production (Table 5.1).

### 5.2.8 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. 2873.74 per hectare which was 2.55 percent of the total cost of production (Table 5.1).

### 5.2.9 Total variable cost

Therefore, from the above different cost items it was clear that the total variable cost of boro rice production was Tk. 79380.61 per hectare, which was 70.42 percent of the total cost of production (Table 5.1).

## 5.3 Fixed cost

### 5.3.1 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. 3175.22 per hectare, which represents 2.82 percent of the total cost of production (Table 5.1).

### 5.3.2 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. 10336.73 per hectare, and it was 9.17 percent of the total cost of production (Table 5.1).

**Table 5.1: Per hectare cost of boro rice cultivation**

| SI No. | Items | | Tk/ha | % of total cost |
|---|---|---|---|---|
| A. | Variable cost | | | |
| | Hired labor | | 23437.04 | 20.79 |
| | Machinery inputs | | 15416.39 | 13.68 |
| | Seedlings | | 10373.50 | 9.20 |
| | Fertilizers | Urea | 5591.79 | 4.96 |
| | | TSP | 4171.06 | 3.70 |
| | | MoP | 5739.87 | 5.09 |
| | | Total | 15502.72 | 13.75 |
| | Irrigation | | 11777.22 | 10.45 |
| | Insecticides | | 2873.74 | 2.55 |
| | **Total variable cost** | | 79380.61 | 70.42 |
| B. | Fixed cost | | | |
| | Interest on operating capital | | 3175.22 | 2.82 |
| | Rental value of land | | 10336.73 | 9.17 |
| | Family labor | | 19832.45 | 17.59 |
| | **Total fixed cost** | | 33344.40 | 29.58 |
| C. | **Total cost (A+B)** | | 112725.01 | 100 |

Source: Field survey, 2021

### 5.3.3 Cost of family labor

Boro Rice production was found to be about 39.66 man-days family labor per hectare and average price of family labor was Tk. 500 per man-day. Therefore, the total cost of family labor was found to be Tk. 19832.45 representing 17.59 percent of total cost (Table 5.1).

### 5.3.4 Total fixed cost

Therefore, from the above different cost items it was clear that the total fixed cost of boro rice production was Tk. 33344.4 per hectare, which was 29.58 percent of the total cost of production (Table 5.1).

## 5.4 Total cost

Total cost was calculated by adding all the variable cost and fixed cost. In the present study per hectare total cost of production of boro rice was found Tk. 112725.01 (Table 5.1).

## 5.5 Gross return

Return per hectare of boro cultivation is shown in table 5.2. Per hectare gross return was calculated by multiplying the total amount of product with respective per unit price. It is evident from table that per hectare average yield of Boro was 4500 kg and the average price of Boro was Tk. 25 per kg. The average price of main product (rice) was Tk. 112500 per hectare and the average price of by product (straw) is Tk.25500 per hectare. Therefore, the gross return was found to be Tk. 138000 per hectare (Table 5.2).

**Table 5.2: Per hectare gross return of boro rice cultivation**

| Items | Quantity (kg/ha) | Price per kg | Return (Tk/ha) |
|---|---|---|---|
| Rice | 4500 | 25 | 112500 |
| Straw | | | 25500 |
| **D. Gross return** | | | 138000 |

Source: Field survey, 2021

## 5.6 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. 58619.39 per hectare (Table 5.3).

### 5.7 Net return

Net return or profit from the boro rice was calculated by deducting the total production cost from the gross return. On the basis of the study the net return was estimated as Tk. 25274.99 per hectare (Table 5.3).

**Table 5.3: Per hectare cost and return of boro rice cultivation**

| Items | Cost/Return (Tk/ha) |
|---|---|
| A. Total variable cost | 79380.61 |
| B. Total fixed cost | 33344.40 |
| C. Total cost | 112725.01 |
| D. Gross return | 138000 |
| E. Gross margin (D-A) | 58619.39 |
| F. Net return (D-C) | 25274.99 |
| **G. Undiscounted BCR( D/C)** | **1.22** |

Source: Field survey, 2021

### 5.8 Benefit cost ratio (undiscounted)

Benefit Cost Ratio (BCR) is a relative measure, which is used to compare benefit per unit of cost. The benefit cost ratio (BCR) for the study was 1.22 which implies that one taka investment in boro rice production generated Tk. 1.22. So, from the above calculation it was found that boro rice cultivation is profitable in the study area (Table 5.3).

### 5.9 Conclusion

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 labor intensive enterprise. It is most essential to use modern inputs such as seeds, fertilizers, human labor, 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 vigilantly be concluded here that cultivation of boro is a profitable. Cultivation of boro would help farmers to increase their income earnings.

# CHAPTER VI
# TECHNICAL EFFICIENCY OF BORO RICE CULTIVATION

## 6.1 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 rice 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.

## 6.2 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. 6.1.
The maximum likelihood estimates for parameters of the cobb-douglas stochastic frontier production function and technical inefficiency effect model for boro rice production for the farmers are presented in Table 7.1.

### 6.2.1 Seedling ($X_1$)

The regression coefficient of seedling cost ($X_1$) of boro rice production was positive which implied that if the expenditure on seedling was increased by 1 percent then the revenue of boro rice would be increased by .0215 percent, other factors remaining constant, although the regression coefficient of seedling was non-significant (Table 6.1).

### 6.2.2 Family labor ($X_2$)

The regression coefficient of family labor cost ($X_2$) of boro rice production was positive and significant at 10 percent level of significance, which implied that if the expenditure on family labor was increased by 1 percent then the revenue of boro rice would be increased by 0.0151 percent, other factors remaining constant (Table 6.1).

### 6.2.3 Hired Labor ($X_3$)

The regression coefficient of hired labor cost ($X_3$) of boro rice production was not statistically significant (Table 6.1).

### 6.2.4 Machinery ($X_4$)

The regression coefficient of machinery cost ($X_4$) of boro rice production was positive and significant at 1 percent level of significance, which implied that if the expenditure on machinery was increased by 1 percent then the revenue of boro would be increased by .2572 percent, other factors remaining constant (Table 6.1).

### 6.2.5 Urea ($X_5$)

The regression coefficient of urea cost ($X_5$) of boro rice production was negative and significant at 10 percent level of significance, which implied that if the expenditure on urea was increased by 1 percent then the revenue of boro would be decreased by 0.1004 percent, other factors remaining constant (Table 6.1).

### 6.2.6 TSP ($X_6$)

The regression coefficient of TSP cost ($X_6$) of boro rice production was positive which implied that if the expenditure on TSP was increased by 1 percent then the revenue of boro would be increased by 0.0405 percent, other factors remaining constant. Although the regression coefficient of TSP in non-significant (Table 6.1).

### 6.2.7 MoP ($X_7$)

The regression coefficient of MoP cost ($X_7$) of boro rice production was positive and significant at 10 percent level of significance, which implied that if the expenditure on MoP was increased by 1 percent then the revenue of boro would be increased by 0.1296 percent, other factors remaining constant (Table 6.1).

### 6.2.8 Irrigation ($X_8$)

The regression coefficient of irrigation cost ($X_8$) of boro rice production was positive which implied that if the expenditure on irrigation was increased by 1 percent then the revenue of boro rice would be increased by 0.0500 percent, other factors remaining constant, although the regression coefficient of irrigation was non-significant (Table 6.1).

### 6.2.9 Insecticide ($X_9$)

The regression coefficient of insecticide was not statistically significant (Table 6.1).

**Table 6.1: Parameters of Cobb-Douglas Stochastic Frontier Production Function and Technical Inefficiency Model for Boro Farmers**

| Variables | Parameter | Coefficients | Standard error | P value |
|---|---|---|---|---|
| **Stochastic Frontier** | | | | |
| Constant ($X_0$) | $\beta_0$ | 9.094129*** | .7635307 | 0.000 |
| Seedling ($X_1$) | $\beta_1$ | .0215242 | .0201733 | 0.286 |
| Family labor ($X_2$) | $\beta_2$ | .0151199* | .0084683 | 0.074 |
| Hired labor ($X_3$) | $\beta_3$ | -.0553346 | .0514789 | 0.282 |
| Machinery ($X_4$) | $\beta_4$ | .2571644*** | .0726717 | 0.000 |
| Urea ($X_5$) | $\beta_5$ | -.1004476* | .0599197 | 0.094 |
| TSP ($X_6$) | $\beta_6$ | .0405003 | .0751185 | 0.590 |
| Mop ($X_7$) | $\beta_7$ | .1295516* | .0726612 | 0.075 |
| Irrigation ($X_8$) | $\beta_8$ | .0500296 | .0330552 | 0.130 |
| Insecticide ($X_9$) | $\beta_9$ | -.0233815 | .0271832 | 0.390 |
| **Inefficiency Model** | | | | |
| Constant | $\delta_0$ | -1.857175 | 7.909288 | 0.814 |
| Age ($Z_1$) | $\delta_1$ | -.244025 | .3452778 | 0.480 |
| Education ($Z_2$) | $\delta_2$ | -.2943344 | .1893017 | 0.120 |
| Farm size ($Z_3$) | $\delta_3$ | 2.539571 | 3.011598 | 0.399 |
| Livestock ($Z_4$) | $\delta_4$ | -3.667098* | 1.883751 | 0.052 |
| Extension ($Z_5$) | $\delta_5$ | -6.110633** | 2.763585 | 0.027 |
| Credit ($Z_6$) | $\delta_6$ | -.698889 | 1.731108 | 0.686 |
| Market distance ($Z_7$) | $\delta_7$ | 1.779456 | 1.654329 | 0.282 |

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

Source: Field survey, 2021

### 6.3 Interpretation of technical inefficiency model

In the technical inefficiency effect model age, education, livestock, extension service and credit service are expected (negative) coefficients (Table 6.1).

#### 6.3.1 Age ($Z_1$)

The negative coefficient of age implies that more aged farmers are technically more efficient than less aged farmers although the regression coefficient of age is non-significant (Table 6.1).

#### 6.3.2 Education ($Z_2$)

The negative coefficient of education implies that educated farmers are technically more efficient than non educated farmers, although the regression coefficient of education is non-significant (Table 6.1).

#### 6.3.3 Livestock ($Z_4$)

The negative coefficient and significant at 10 percent level of significance of livestock implies that farmers having livestock are technically more efficient than those who don't have livestock (Table 6.1).

#### 6.3.4 Extension service ($Z_5$)

The negative coefficient and at 5 percent level of significance of extension service postulates that farmers having contacts with extension officers are technically more efficient than those who don't have contacts with extension service (Table 6.1).

#### 6.3.5 Credit service ($Z_6$)

The negative coefficient of credit service postulates that farmers taking loan for producing boro rice are technically more efficient than those who are not taking loan although the regression coefficient credit service is non- significant (Table 6.1).

## 6.4 Distribution of Technical Efficiency

**Table 6.2 Frequency Distribution of Technical Efficiency of Boro Rice Farms**

| Efficiency (%) | No. of Farms | Percentage of Farms |
|---|---|---|
| 0-50 | 0 | 0.00 |
| 51-70 | 2 | 3.33 |
| 71-80 | 1 | 1.67 |
| 81-90 | 7 | 11.67 |
| 91-95 | 7 | 11.67 |
| 96-100 | 43 | 71.66 |
| Total number of farms | 60 | 100 |
| Minimum | 0.56 | |
| Maximum | 0.99 | |
| Mean | 0.95 | |
| Standard Deviation | 0.085 | |

Source: Field survey, 2021

Table 6.2 showed the frequency distribution of farm specific technical efficiency for boro rice farmers. It revealed that average estimated technical efficiencies for boro rice was 95 percent which indicated that boro rice production could be increased by 5 percent with the same level of inputs without incurring any further cost. Increase of only farm management skills result a substantial increase of output of boro rice. It was observed that 71.66 percent of sample farmers were found to have received outputs which were very close to the maximum frontier outputs maintaining the efficiency level more than 96 percent. The minimum and maximum technical efficiencies were observed 56 and 99 percent respectively, where standard deviation maintained at 0.085.

## 6.5 Conclusion

It is easy to understand from the above discussion about the different inputs items and their efficiency level at farmer level. Yields and returns per hectare of boro rice cultivation depends on efficient use of these inputs. On the basis of above discussions it could cautiously be concluded here that cultivation of boro rice is a profitable and there is scope to increase production by reducing farm level technical inefficiencies.

# CHAPTER VII
# PROBLEMS OF BORO RICE CULTIVATION

## 7.1 Introduction

The focus of this chapter is to identify the extent of problems faced by the boro rice 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:

## 7.2 High price of quality seed

High price of quality seed is also one of the most important problems of producing boro in the study area. From Table 7.1 it is marked that about 75% boro growers reported this as high problem and this problem is ranked by 1$^{st}$.

## 7.3 Lack of post-harvest facilities

Usually most of the farmers used to store their boro rice 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. So the products were sold just after harvest at a low price due to lack of proper storage facilities. About 71.67% of the farmers in this study area reported that lack of storage facilities and high charge for storage discouraged them to produce more rice (Table 7.1). In the rank order, problem of lack of storage facility is the 2$^{nd}$ in the study area.

## 7.4 High rent charges of agricultural machinery

Several agricultural machineries (power tiller, tractor, thresher etc) are used at different stage of boro rice cultivation. But rent charges of these machineries are so high. This problem is mentioned by 56.67% of sample farmers in the study area (Table 7.1). This problem is ranked as 3$^{rd}$ in the study area.

## 7.5 High cost of irrigation

Irrigation is the leading input for boro rice production. Yield of boro rice varied with the application of irrigation water. Most of the farmers have no shallow tube well or deep tube well of their own in the study areas. But availability of irrigation water is not a serious problem in the study area because of portable irrigation devices. But farmers reported that they had to pay higher charge for water management. The study showed that 41.67% boro rice growers reported this problem and this problem is ranked as 4th in the study area (Table 7.1).

### 7.6 Low yield and unstable price

The problem of low yield and unstable price is noticed by 36.67% percent of boro rice growers in the study area (Table 7.1). It was a severe problem for rice production and ranked 5th among the problems.

**Table 7.1: Problems of boro rice cultivation**

| Problems | Farmers | Farmers (%) | Rank |
|---|---|---|---|
| High price of quality seed | 45 | 75 | 1st |
| Lack of post-harvest facilities | 43 | 71.67 | 2nd |
| High rent charges of agricultural machinery | 34 | 56.67 | 3rd |
| High cost of irrigation | 25 | 41.67 | 4th |
| Low yield and unstable price | 22 | 36.67 | 5th |
| Attack of pest and disease | 20 | 33.33 | 6th |
| Adulteration of fertilizer | 17 | 28.33 | 7th |
| Natural calamities | 13 | 21.67 | 8th |
| Shortage of human labor at critical stage | 11 | 18.33 | 9th |
| Lack of training | 9 | 15 | 10th |

Source: Field survey, 2021

### 7.7 Attack of pest and disease

Diseases is one of the most severe constrains to produce boro rice. The boro producers were affected by the problem of attack of pests and diseases. Pests and diseases attack and reduce crop yield and increase cost of production. About 33.33% of boro rice producers reported that they were facing this problem (Table 7.1). This problem is ranked 6th for the boro rice producers.

### 7.8 Adulteration of fertilizer

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 7.1 that near 28.33% boro growers faced this problem. This problem is ranked by 7$^{th}$ for the boro rice farmers.

### 7.9 Natural calamities

It was found that boro cultivars faced some severe problems relating to the nature in their production process. Farmers reported that natural hazards, such as: haze weather in sowing or planting period, rainfall and flood during harvesting period hampered proper production and quality. On an average, 21.67% of the farmers in the study area reported that large amount of crops were damaged due to flood (Table 7.1). This problem is ranked by 8$^{th}$ in the study area.

### 7.10 Shortage of human labor at critical stage

Boro rice cultivation is labor intensive activity. Most of the human labor are used during seedbed preparation, seedling transplantation and harvesting period of boro rice. Non-availability of human labor was found in different stages of production such as transplanting, intercultural operations and harvesting. The study found that 18.33% of boro growers reported for this problem (Table 7.1). This problem is ranked by 9$^{th}$ in the study area.

### 7.11 Lack of training

Agricultural training have improved farmers perceptions of good seed use, use of resistant varieties, application of insecticides and pesticides, water management, and so on, 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. Lack of proper training is a major problem in the study area. 15% of the respondent reported for this problem and this problem is ranked by 10$^{th}$ in the study area (Table 7.1).

### 7.12 Conclusion

The above discussions as well as the results presented in Table 7.1 indicated that boro rice producers in the study area have currently been facing some major problems in conducting boro rice cultivation. These are the major constraints for the production of boro rice in the study area. Initiative should be taken to reduce or eliminate these problems for the sake of better production of boro rice. Proper attention need for better distribution of subsidy for the boro rice farmers.

# CHAPTER VIII
# SUMMARY, CONCLUSIONS AND RECOMMENDATION

The present chapter focuses on the summary in the light of the discussions made in the earlier chapters. Conclusion has been made on the basis of study result. Policy recommendations are illustrated for improvement of the existing problems of boro rice production in Bangladesh. The section 8.1 presents a summary of the major findings of the study, conclusion and policy recommendations are given in Section 8.2 and 8.3.

## 8.1 Summary

Bangladesh has an agrarian economy. Agriculture sector plays an important role in overall economic development of the country. Around 70% of the population relies on agriculture for a living (BER, 2021). Agriculture is the primary source of income and employment for a sizable number of the impoverished.

According to the Economic Review, agriculture (crops, animal husbandry, forestry, and fisheries) contributes 11.50 percent to the country's GDP and employs around 40.6 percent of the labor force (2021). Additionally, agriculture generates a diverse array of consumer-demanded agricultural commodities markets, particularly in rural regions. GDP from agriculture in Bangladesh increased to 11540.50 BDT Million in 2021 from 11242.30 BDT Million in 2020. Rice plays a pivotal role in all spheres of life in Bangladesh and when it comes to food security of the rural farmers it is the most important commodity in terms of livelihood and food.

According to BBS, food grains production totaled 443.56 lakh MT in FY 2020-21, with aus accounting for 32.85 lakh MT, aman accounting for 144.38 lakh MT, boro rice accounting for 198.85 lakh MT, wheat accounting for 10.85 lakh MT, and maize accounting for 56.63 lakh MT.

Boro rice are grown all over Bangladesh, not only for a huge home market but also for export purposes. Production of Boro rice 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. Boro rice production is labor intensive, so cultivation of this crop can create more employment opportunity of the rural 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 rice cultivation was intensive. For the study six villages of

Durgapur upazila in Netrokona district were selected for the study. In total 60 farmers for boro rice were randomly selected. Farmers generally plant Boro rice from mid-December to January and harvest after three months. Data for the present study have collected during the period of May 2022 to June 2022. Primary data were collected from randomly selected 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.

Socioeconomic condition of sample household considered age, educational status, family size, annual income, farm size, farming experience, distance from market, membership on organization, agricultural training, extension service, access to credit, access to TV, access to livestock and electricity facility of the sample farmers.

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 quantity of human labor used in boro rice production was found to be about 46.87 man-days per hectare and average price of human labor was Tk. 500 per man-day. Therefore, per hectare cost of human labor was found to be Tk. 23437.04 representing 20.79 percent of total cost. Per hectare cost of machinery for boro rice production is Tk.15416.39 representing 13.68 percent of the total cost. Average cost of seedling for boro production was estimated to be Tk. 10373.50 representing 9.20 percent of the total cost. On average, per hectare cost of Urea, TSP, MoP was Tk.5591.79, Tk.4171.06, Tk. 5739.87 respectively representing 4.96 percent, 3.70 percent and 5.09 percent of total cost respectively. The average cost of irrigation for boro rice production was found to be Tk. 11777.22 representing 10.45 percent of the total cost. Whereas the average cost of insecticide was found to be Tk. 2873.74 per hectare representing 2.55 percent of the total cost. The total variable cost of boro rice production was Tk. 79380.61 per hectare, which was 70.42 percent of the total cost. Interest on operating capital was found to be Tk.3175.22 representing 2.82 percent of total cost. Per hectare rental value of land was Tk.10336.73 representing 9.17 percent of the total cost. Average family labor cost was Tk. 19832.45 representing 17.59 percent of total cost. The total fixed cost was Tk.33344.4 per hectare, which was 29.58 percent of the total cost. The total cost is Tk. 112725.01 per hectare. The average yield of boro rice per hectare was 4500 kg and total price of boro rice was Tk. 112500. The gross return, gross margin and net return were found to be Tk. 138000, Tk. 58619.39 and Tk. 25274.99 per hectare. Benefit Cost Ratio (BCR) was found to be 1.22 which implies that one-taka investment in boro rice production generated Tk. 1.22.

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 seedling ($X_1$), family labor ($X_2$), machinery ($X_4$), TSP ($X_6$), MoP ($X_7$) and irrigation ($X_8$) were positive, although regression coefficient of seedling ($X_1$), TSP ($X_6$) and irrigation ($X_8$) were non-significant. But the coefficient of Human labor ($X_3$), urea ($X_5$) and Insecticide ($X_9$) were found negative. It indicates that if seedling ($X_1$), family labor ($X_2$), machinery ($X_4$), TSP ($X_6$), MoP ($X_7$) and Irrigation ($X_8$) were increased by one percent, the production of boro would be increased by 0.0215, 0.0151, 0.0.2572, 0.0405, 0.1296 and 0.0500 percent of sample farmers respectively.

In the technical inefficiency effect model age, education, livestock, extension service and credit service were expected (negative) coefficients. The negative coefficient of age implies that more aged farmers are technically more efficient than low aged farmers. The negative coefficient of education implies that educated farmers are technically more efficient than non-educated farmers. The negative coefficient of livestock implies that the farmers having livestock are more efficient than the farmers not having livestock. 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 farm size are positive meaning that this factor had no impact on the technical inefficiency.

The boro rice producers faced a lot of problems to produce boro rice. The problems were social and cultural, financial and technical. High price of quality seed was one of the most important problems of producing boro in the study area. Lack of post-harvest facilities, high rent charges of agricultural machinery, high cost of irrigation, low yield and unstable price, attack of pest and diseases, adulteration of fertilizer, natural calamities, shortage of human labor at critical stage and lack of training were the major problems faced by the producers. 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 rice.

### 8.2 Conclusion

Boro rice are extensively cultivated food grain in Durgapur upazila under Netrokona district and it is one of the most important cereal crop grown by farmers mainly for food and market purpose. The results of the present study helps to draw a conclusion that some substantial scope evidently exists in the study area to increase the productivity of boro rice. The economic profitability analysis of the study demonstrates that Bangladesh enjoys low profitability of boro rice cultivation due to some problems.

Due to land scarcity in Bangladesh, it is difficult to expand boro rice output by increasing the area under cultivation. However, there is a possibility to significantly enhance productivity by using current inputs and technology. If modern inputs could be made accessible to farmers in a timely manner, output of this crop might be increased.

However, boro rice cultivation is labor and irrigation intensive enterprise. So cultivation of boro rice increased the production cost of farmers and at the same time can help in increasing farm income through high yield and can create new employment opportunities for other unemployed people. The regulatory management practices of boro rice farms in the study area were not found efficient enough. Farmers were not known about the application of inputs in right time with proper doses. Therefore, they made over or under use of some farm inputs. Thus, proper strategic management training in accordance with boro rice farmer's problems, requirements, objectives and resource base can lead to feasible production practices and sustainable income from boro rice cultivation.

### 8.3 Recommendation

On the basis of the finding of the study it was evident that boro rice was profitable 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 rice production.

- Agricultural labor shortage is becoming a great problem in Bangladesh. So adequate measure should be taken to enhance farm mechanization. And government should also take necessary steps to reduce high rent charges of machineries.
- Government should take required steps to reduce the cost of inputs that have a major beneficial effect on yield. Subsidies on inputs like seed, fertilizer and insecticides should be supplied.
- Adequate training on recommended fertilizer doses, insecticides, use of good seed, intercultural operations etc should be provided to the boro rice farmers which will enhance production as well as technical efficiency by improving the technical knowledge of the farmers.
- Government and concern institutions should provide adequate extension program to increase boro rice production.
- Storage system should be improved through better management.
- Policy should be taken to encourage livestock rearing that enhance boro rice production.

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