FINANCIAL ANALYSIS AND FACTORS DETERMINING THE PROFITABILITY OF BORO RICE FARMING IN DINAJPUR DISTRICT

MD. AHASANUL MONTAKIM

DEPARTMENT OF AGRIBUSINESS AND MARKETING

SHER-E-BANGLA AGRICULTURAL UNIVERSITY

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BY

MD. AHASANUL MONTAKIM

Reg. No.13-05711

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APPROVED BY:

Sharmin Afrin
Associate Professor
Department of Agribusiness and Marketing
Sher-e-Bangla Agricultural University

Sauda Afrin Anny
Assistant Professor
Department of Agribusiness and Marketing
Sher-e-Bangla Agricultural University

Md. Rashidul Hasan
Chairman
Associate Professor
Department of Agribusiness and Marketing
Sher-e-Bangla Agricultural University
Dhaka-1207

DEPARTMENT OF AGRIBUSINESS AND MARKETING

Sher-e-Bangla Agricultural University

Sher-e-Bangla Nagar

Dhaka-1207

CERTIFICATE

This is to certify that the thesis entitled '**FINANCIAL ANALYSIS AND FACTORS DETERMINING THE PROFITABILITY OF BORO RICE FARMING IN DINAJPUR DISTRICT'** submitted to the Faculty of Agribusiness Management, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **Master of Science in Agribusiness and Marketing,** embodies the result of a piece of bona fide research work carried out by **MD. AHASANUL MONTAKIM**, Registration Number: 13-05711, under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

Additionally, I confirm that any assistance or information obtained throughout the course of this inquiry has been properly recognized.

Dated:

Dhaka, Bangladesh

....

Sharmin Afrin

Supervisor

Associate Professor

Department of Agribusiness and Marketing

Sher-e-Bangla Agricultural University

Dhaka-1207

Dedicated to My beloved parents

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The Author

ABSTRACT

The study is an attempt to determine the profitability of boro rice production and to identify the factors affecting the profitability of boro rice production in parbatipur and phulbari upazila of Dinajpur district. 100 farmers from the research region were interviewed for primary data. A purposive sampling strategy was used to choose the sample farms. The study's primary results established that boro rice farming was lucrative. Cobb-douglas stochastic frontier production function was utilized to determine the variables affecting the profitability of boro rice production. Variable cost, fixed cost and gross return of production of boro rice were BDT 81803, BDT 39092 and BDT 139256 respectively. Benefit Cost Ratio (BCR) was found to be 1.15, which implies that one taka investment in boro rice production would generate BDT 1.15. The inputs like cost of land preparation, fertilizer and manure and irrigation were found to be positive and significant at 5% level of significance. Additionally, the research revealed many significant issues for boro rice producers, including low prices for output, expensive prices for high-quality seed, fertilizers, and irrigation, capital shortages, inadequate storage facilities, and insufficient extension service. Following an analysis of the challenges encountered by farmers, many proposals such as reduced input rice, flexible lending facilities, and price stability have been made in order to enhance the farmers' overall economic position via boro rice production.

CONTENTS

SL. No.	Title	Page

LIST OF TABLES

SL. No.	Title	Page

LIST OF FIGURES

SL. No.	Title	Page

ABBREVIATION

Agril.	=	Agricultural
BRRI	=	Bangladesh Rice Research Institute
BDT	=	Bangladeshi Taka
BADC	=	Bangladesh Agricultural Development Corporation
BARI	=	Bangladesh Agricultural Research Institute
BBS	=	Bangladesh Bureau of Statistics
BER		Bangladesh Economic Review
BCR	=	Benefit Cost Ratio
DAE	=	Department of Agriculture Extension
DAM	=	Department of Agricultural Marketing
GDP	=	Gross Domestic Product
FAO	=	Food and Agriculture Organization
FY	=	Fiscal Year
Ha	=	Hectare
HYV	=	High Yielding Variety
Kg	=	Kilogram
M	=	million
MoA	=	Ministry of Agriculture
MS	=	Master of Science
Mt	=	Metric tons
NGO	=	Non-Government Organization
No.	=	Number
ILO	=	International Labor Organization
SAARC	=	South Asian Association of Regional Co-Operation
SAU	=	Sher-e-Bangla Agricultural University
SD	=	Standard Deviation
%	=	Percent
UAO	=	Upazila Agricultural Officer

CHAPTER I

INTRODUCTION

1.1 General background

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 (ERB, 2020). 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. It is a sector that Bangladesh benefits from strategically, considering its position as Asia's biggest and most populous delta. Despite the fact that rice is the predominant crop. In many regions, rice may be planted and harvested three times a year. Among these, boro rice produces the largest yields throughout the growing season. During the 2018-19 harvest season, the country's farmers produced a record 1.95 crore tonnes of Boro rice (DAE, 2019). Boro rice output per hectare was likewise estimated at 4.08 tonnes, with production exceeding the objective as a result of increased cultivated land (DAE, 2019).

Farmers cultivated boro rice on more than 49 lakh hectares of land, above the government's aim of 48 lakh hectares. Growers produced 1.96 crore tonnes of boro rice last year on 48.42 lakh hectares of land (BBS, 2021).

According to BBS (2021), areas devoted to the previous two harvests – aus and aman – had also increased due to farmers' excitement to plant rice after more than a year of higher prices in the domestic market. Rice production was 27.55 lakh tonnes in the aus season of 2019-20. Aman production increased to 1.42 crore tonnes in 2019-20, a 1.06 percent increase over the previous year.

1.2 Present agricultural status of Bangladesh

Bangladesh is mostly an agricultural nation, with agriculture contributing significantly to economic development. To maintain long-term food security for humans, it is critical to establish a lucrative, sustainable, and environmentally friendly agricultural system. The broad agricultural sector has been prioritized in order to ensure Bangladesh's food self-sufficiency. 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 13.35 percent to the country's GDP and employs around 40.6 percent of the labor force (2020). Additionally, agriculture generates a diverse array of consumer-demanded agricultural commodities markets, particularly in rural regions. Agriculture contributed 10739.10 BDT Million to Bangladesh's GDP in 2019, up from 10468.80 BDT Million in 2018. From 2006 to 2019, Bangladesh's GDP From Agriculture averaged 9012.60 BDT Million, hitting an all-time high of 10739.10 BDT Million in 2019 and a record low of 7017.10 BDT Million in 2006. (BBS, 2019).

According to BBS, food grains production totaled 416.47 lakh MT in FY 2019-20, with Aus accounting for 27.55 lakh MT, aman accounting for 142.03 lakh MT, boro rice accounting for 196.45 lakh MT, wheat accounting for 10.29 lakh MT, and maize accounting for 40.15 lakh MT. Table 1.1 summarizes the state of food grain output from fiscal years 2011-12 to 2029-20.

Table 1.1Food 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
Aus	21.33	23.33	21.58	23.26	23.28	22.89	21.33	27.75	27.55
Aman	127.91	127.98	128.97	130.23	131.9	134.83	136.56	140.54	142.03
Boro rice	186.17	187.59	187.78	190.07	191.92	189.38	180.24	195.60	196.45
Total Rice	**335.41**	**338.9**	**338.33**	**343.56**	**347.1**	**347.1**	**338.13**	**363.89**	**366.03**
Wheat	9.72	9.95	12.55	13.02	13.48	13.48	14.23	10.16	10.29
Maize	15.52	19.54	21.78	25.16	23.61	27.59	32.88	35.69	40.15
Total	360.65	368.39	372.66	381.74	384.2	388.17	388.14	409.74	416.47

Source: BBS, 2021

1.3 Importance of boro rice

Rice is an extraordinary food grain that has shaped Bangladesh's foods, culture, economy, and way of life. It is the primary source of nutrition for 155.8 million individuals. Keeping this in mind, all subsequent administrations have placed a high premium on food self-sufficiency since independence. The development of high-yielding contemporary grain rice varieties that are highly sensitive to inorganic fertilizer and pesticides, as well as excellent soil management and water management, has aided the nation in meeting the country's growing food grain demand (Hayami and Ruttan, 1985). Among high-yielding varieties, boro rice types account for the largest proportion of overall rice output, which has been relatively consistent over the previous decades.

As a result, demand for rice is always increasing, and the country's overall population is growing by 2.3 million people per year. Rice accounts for around 70% of total calorie consumption for most individuals, but especially for those who work hard. Rice is grown over an area of around 11.53 million hectares and is by far the largest source of rural employment (HIES, 2005). Table 1.2 shows the area, production, and yield rate of rice in general, and boro rice in particular, for various years.

Table 1.2 Area and production of rice and boro rice by different years

Year	Production ('000' MT)	
	Rice	Boro rice
2001-02	25085	11766
2002-03	23834	12222
2003-04	25.187	12838
2004-05	25157	13837
2005-06	27.520	13975
2006-07	27319	14965
2007-08	28931	17762
2008-09	31317	13084
2009-10	31975	18059
20010-11	33542	18617
2011-12	33988	18759
2012-13	33826	18778
2013-14	34356	19007
2014-15	34710	19192
2015-16	34701	18937
2016-17	33804	18014
2018-19	36389	19560
2019-20	36603	19645

Source: BBS, 2021

1.4 Nutritive and medicinal value of these crops

More over half of the world's population relies on rice as their major food source. 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%. 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.

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 1.3 Nutrients from per 100 gm rice

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

Source: Bose and Som, 1986

1.5 Justification of the study

Bangladesh's approximately 160 million residents eat mostly rice. It employs over 48% of rural workers, provides for over two-thirds of total calorie supply, and accounts for around half of an average person's total protein intake in the country (DAE, 2019). Rice accounts for more than half of agricultural GDP and one-sixth of national income in Bangladesh. Almost all of the 13 million agricultural families in the nation cultivate rice. Around 10.5 million hectares are devoted to rice farming, a number that has been almost steady for the previous three decades. Rice accounts for around 75% of arable land and more than 80% of irrigated land. Rice is so vital to the Bangladeshi people's livelihood.

Bangladesh produced around 10.59 million tons of rice in 1971, when the nation had a population of approximately 70.88 million. This reveals that rice production grew at a pace far greater than population growth. This rise in rice output is mostly due to the adoption of modern rice varieties on around 66% of rice acreage, which accounts for approximately 73% of total rice production in the country. There is no need to be complacent, though. Bangladesh's population is still growing at a pace of two million people per year and is predicted to double in the next two decades. This year's planting season brought favorable weather conditions for growing boro rice.

However, owing to flash flooding in many northern districts (boro rice), the crop on less than 40,198 hectares of land was completely destroyed in FY 2015-16. Farmers were questioned subjectively about several aspects of their seed, fertilizer, and rural power management systems. They said that effective management, timely delivery of seed and fertilizer, and a reliable supply of energy contributed to this year's increased output of boro rice.

The study's results may also be relevant in other parts of Bangladesh with comparable environmental, cultural, and socioeconomic characteristics. Thus, the research may benefit policymakers, planners, extension employees, and field workers in terms of effective planning to enhance profitability and variables impacting profitability in boro rice production.

1.6 Specific objectives of the study

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

i. to describe some selected characteristics of the boro rice cultivators
ii. to determine the profitability of boro rice production
iii. to identify the factors affecting the profitability of boro rice production
iv. to identify the problems associated with boro rice production

1.9 Assumptions of the study

While conducting the study, the researcher prioritized these assumptions:

a. The respondents included in the sample were really representative of the targeted demographic.
b. The respondents included in the study's sample were adequately competent of responding to the questions and expressing their thoughts.
c. The respondents' responses were significant and trustworthy.
d. The researcher, the interviewer, was socially and culturally acclimated to the study location. The responses were objective.

1.10 Organization of the thesis

This report will be organized based on seven chapters. The first chapter will describe the introduction including background, present status, and importance of boro rice, research questions, objectives, scope, assumptions and limitations of the study. The second chapter will represent a review of previous studies. Chapter three will explain the research methodology. Chapter four will demonstrate the demographic characteristics of boro rice producers. Chapter five will demonstrate the financial analysis of boro rice production. Chapter six will identify factors influencing boro rice profitability. Finally, chapter seven will present various problems, conclusion and recommendation.

1.11 Limitations of the study

Several limitations were noted throughout the research period, including the following:

- ✓ To begin, this investigation was geographically confined.
- ✓ Second, the researcher was forced to deal with tiny sample sizes due to time and other resource restrictions.
- ✓ Thirdly, due to time and cost constraints, all data and other relevant information were gathered as quickly as feasible.
- ✓ Fourthly, a significant weakness of the study was that the researcher had to rely entirely on the producers' recollection for the essential information since they did not retain written records of their on-farm operations throughout production and selling. As a result, growers were probed within the confines of their memory in order to recall the right responses to the queries posed.
- ✓ Additionally, certain challenges were encountered during data collection in getting responses from a number of boro rice producers. At first, individuals are hesitant to provide accurate facts. They were eventually persuaded to report the facts.

Throughout the research period, numerous restrictions were addressed with deliberate attention in order to reduce any voice faults.

CHAPTER II

REVIEW OF LITERATURE

On this chapter makes an effort to evaluate significant literature in light of the issue mentioned, **“Financial analysis and factors determining the profiability of Boro rice farming in Dinajpur District.”**Again, although some of these studies are not totally relevant to the current investigation, their results, analytical methods, and recommendations all had a significant effect on the current study. Below is a review of several recent research papers that are related to the current investigations.

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

Lucky *et al.* (2018) found poorer access to extension service, good quality seed, phosphorous fertilizer, pesticides and power supply were the main barrier to achieve potential performance of rice cultivars and expected level of returns in Bangladesh.

Islam (2017) examined a study to compare the profitability of boro rice and jute in Rajoir upazila 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.

Hasan *et al.* (2016) performed a study on the technical efficiency of boro rice farms and discovered that many characteristics such as farm size, age, education, training, and loan availability are important predictors of technical efficiency in boro rice production.

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) examined the profitability and resource use efficiency of BRRI Dhan 29 in the old Brahmaputra floodplain region of Tangail district using a cobb-douglas production function on a sample of 60 farmers and found that the overall return on BRRI Dhan 29 was more than the total cost.

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

Kana (2011) conducted a study 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 greater than total return of BR-28.

Hanifa (2009) conducted a study 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.

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

Majid and Haque (2007)examined a study on Monga mitigation for employment and food security increase through early aman rice production and crop diversification in greater Rangpur region of Bangladesh. The introduction of cash crops during the boro rice growing season (early to late November) increased productivity (32.4-39.3 MT/ha) compared to the Rice-Non-Rice system (13.2 MT/ha). The greatest rice equivalent yields were obtained from early aman rice-boro rice-mung bean (37.3 MT/ha) and early aman rice-boro rice (Bolan/older seedling of BRRI Dhan-33) (32.4-32.6 MT/ha). However, early aman rice-boro rice-mung bean combination produced less than rice-boro rice-Relay maize/maize combination, but mung bean supplied biomass to the soil, which was beneficial for soil health.

Anik (2003) conducted a study on economic and financial profitability of aromatic and fine rice production in Dinajpur and Sherpur district with a sample of 100 farmers using cobb-douglas production function and found that aromatic rice was more profitable than fine rice as the net return was higher than fine rice.

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

Quazi and Paul (2002)examined a study on comparative advantages of crop production in Bangladesh. The economic profitability analysis conducted in their research reveals that Bangladesh has a competitive advantage in local rice production for import replacement. However, at export parity prices, rice is often less lucrative than a variety of non-rice commodities, meaning that Bangladesh has more profitable choices other than rice export production. Numerous non-cereal crops, such as vegetables, boro rices, and onions, have financial and economic returns comparable to or greater than those of High Yielding Variety (HYV) rice.

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

Ali (2000) sought to measure and compare resource consumption and land productivity across tenure categories. Owner farms had the greatest total gross cost of production for aman, boro rice, and aus, while tenant farms incurred the lowest total gross cost. It was noted that owner operators used a greater degree of inputs than owner-tenant or tenant operators. Rice owner-cum-tenant operators got a greater yield than owner-tenant operators in aman and aus production. Tenant operators had a higher net return in boro rice paddy output than owner operators and owner-cum-tenant operators on owner property. Finally, it was determined that tenancy had a predicted beneficial effect on resource utilization and productivity, especially in small scale peasant agriculture.

Hasan (2000) did an economic analysis of alok hybrid rice and determined that the overall cost per hectare for hybrid alok was BDT 36,276.33, the variable cost per hectare was BDT 2,927.05, and the yield per hectare was 6,557.07 kg. Alok paddy was priced at BDT 7.81/kg. Taking into consideration the by product, the gross return on hybrid alok was BDT 5,465.02 per hectare. The net return on investment was BDT 18,375.50 per hectare, while the gross margin was BDT 26,409.97 per hectare.

Mustafi and Azad (2000) conducted a research on modern rice variety adoption in Bangladesh. They compared the profitability of BR-28 and BR-29 and discovered that they produce an average of 5,980 kg and 6,670 kg per hectare, respectively. BR-29 had a larger gross margin of BDT 27,717.02 per hectare. Additionally, farm-level statistics indicated that the unit cost of BR-29 and BR-28 was BDT 4.70 and BDT 5.12 per kilogram, respectively. Additionally, as compared to BR-28, the return on BR-29 is BDT 3,759 per hectare greater.

The literature review revealed that there has been little research on boro rice farming in the study region. Additional research on boro rice production in the study region may assist in identifying particular difficulties and determining the activities that need be taken to boost the farmers' productivity and profitability. Thus, the research may benefit policymakers, planners, extension employees, and field workers in terms of effective planning to enhance profitability and variables impacting profitability in boro rice production.

CHAPTER III

METHODOLOGY

3.1 Introduction

This chapter details the methodologies used at various phases of the research. Methodology is a fundamental and necessary component of every study. This chapter discusses the methods used in the research, which includes the selection of the study region, sample selection, creation of a survey schedule, data collecting method, survey duration, data editing and tabulation, and analytic tools. The following techniques and methodologies were utilized and followed throughout the research, taking into account the study's unique objectives:

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 rice is planted across Bangladesh, Rangpur, Nilphamari, Bogura, Nagoan, as well as Dinajpur and the majority of the country's northern region, are significant areas where it is grown abundantly.

Thus, two upazilas in Dinajpur district, Parbatipur and Phulbari, were purposefully chosen for the research due to their significant concentration of boro rice cultivation. The following were the primary reasons for choosing the research area:

a) There were several boro rice producers in the research region;
b) These villages had certain physical features such as topography, soil composition, and meteorological conditions favorable for boro rice production.
c) Accessibility and communication facilities were anticipated to be readily available in these communities; and
d) Respondents' cooperation was expected to be strong in order to acquire trustworthy data.

3.3 Background of the study area

Dinajpur district is located in northern Bangladesh's Rangpur Division. It is the biggest district of Bangladesh's sixteen northern districts. The district is flanked on the north by Thakurgaon and Panchagarh, on the south by Gaibandha and Joypurhat, on the east by Nilphamari and Rangpur, and on the west by the state of West Bengal, India. The district has a total area of 3,437.98 km^2. Dinajpur has a tropical climate that is hot, damp, and humid. Dinajpur has a tropical wet and dry climate according to the Koppen climate classification. The district has a distinct monsoon season, with an average yearly temperature of 25 °C (77 °F) and monthly mean temperatures ranging from 18 °C (64 °F) in January to 29 °C (84 °F) in August. Dinajpur's economy is mostly dependent on agricultural output. There is a well-known adage about Dinajpur: 'paddy heaped high, cow barns filled with milk'. Dinajpur is well-known for its rice cultivation. 'Katharivog' rice is one of Bangladesh's most widely cultivated varieties. Dinajpur is also a wheat-growing region. Dinajpur's Lychee (fruit) is the finest in Bangladesh. Dinajpur is well-known across the nation for its manufacturing of. A significant portion of the population of Dinajpur is reliant on agricultural goods. Additionally, the primary sector is rice processing mills.

Figure 3.1 Map of Dinajpur district

3.4 Sampling technique and sample size

Two criteria must be considered while choosing samples for a research. The sample size should be as big as possible while yet providing sufficient degrees of freedom for statistical analysis. On the other hand, field research administration, data processing, and analysis should be doable within the constraints of physical, human, and financial resources (Mannan, 2001). However, due to the variety of the technological and human environments, it is required to sample a representative sample of the population before drawing any conclusions. Thus, sampling's objective is to choose a subset of the population that is representative of the whole population (Rahman, 2000).

Due to time, financial, and manpower constraints, it was not feasible to enroll all of the study area's farmers. A total of 100 farmers were purposefully chosen. The current research used a purposeful random sample strategy to save costs and time and to accomplish the study's final aims.

Upazila	**Sample size**
Parbatipur	50
Phulbari	50
Total	100

3.5 Data collection

Due to the enormous influence data collecting has on the quality of survey findings, it is recognized as a crucial component of a survey. Considering its significance, the following procedures were taken during the development of the questionnaire used to gather data:

3.5.1 Questionnaire design

A questionnaire is a very effective assessment instrument that enables the collecting of data through multi-dimensional questions. A questionnaire created without a clear objective and aim would always ignore critical topics and waste the time of both enumerators and respondents by asking and responding to irrelevant questions. All of these points were considered to the degree practicable while constructing the survey questionnaire.

3.5.2 Pre-testing the questionnaire

The questionnaire was pre-tested to determine the length of time required to finish the interview, its reliability, i.e. if it caught the needed information, and also its consistency, i.e. whether the information acquired by it was connected to the survey's overall aim. Additionally, the test was designed to validate the logistics necessary for the survey's proper operation. To guarantee the questionnaire's optimal performance in terms of data collecting, processing, and analysis, pre-testing was conducted prior to the survey in the upazilas of Parbatipur and Phulbari, Dinajpur District, from July 2019 to December 2020. A responder was chosen at random.

3.5.3 Finalization of the questionnaire & method of data collection

After resolving all of the adjustments suggested by the pre-test, the questionnaire was delivered to my supervisor. My supervisor also contributed significantly to the questionnaire. Eventually, the questionnaire received permission. A face-to-face interview was conducted in response to the questionnaire.

3.5.4 Data editing and coding data editing and coding

Coding was completed concurrently with questionnaire creation in order for the enumerator to simply and properly mark the correct responses. The term "data editing" refers to the process of verifying and cleansing previously acquired data from the field.

3.6 Data processing

Data processing included several procedures that were critical since they had an effect on the survey's findings. The following actions were conducted during data processing.

i. Data entry

ii. Appending and merging files

iii. Data validation (further computer checking, editing, and imputation)

iv. Final decision on errors

v. Completion of data processing and generation of data files

vi. Final documentations

vii. Conversion of data files to another software.

viii. Storage of all files.

3.7 Processing, tabulation and analysis of data

Manual editing and coding of the gathered data occurred. The acquired data was then meticulously compiled and analyzed. Additionally, data entry and analysis were performed on a computer using Microsoft Excel and the Statistical Package for the Social Sciences (SPSS). It should be remembered that information was first gathered in local units. After required checks, it was converted to international standard units.

3.8 Analytical techniques

The data were evaluated with the goal of attaining the study's goals. Numerous analytical techniques were used in this investigation. A significant portion of the data analysis was conducted using the tabular technique. This approach is widely utilized because it has the natural ability to provide the most accurate image of the agricultural economics in the simplest manner. To analyze data and define socioeconomic features of boro rice producers, input consumption, costs and returns on boro rice production, and to determine the undiscounted benefit cost ratio, relatively basic statistical methods such as percentage and arithmetic mean or average were used (BCR).

The cob-douglas production function was utilized in the research to determine which inputs impacted productivity.

3.8.1 Profitability analysis

Using a set of financial pricing, the net returns on boro rice were calculated. The financial prices used in this research were the market prices obtained by farmers for commodities and inputs acquired during the study period. The following were the cost items considered in the study:

i. Land preparation
ii. Human labor
iii. Seedlings
iv. Urea
v. TSP
vi. MoP
vii. Insecticide
viii. Irrigation
ix. Interest on operating capital
x. Land use

Crop returns were evaluated using the market value of the major goods. Variable cost, fixed cost, and total cost were all discussed in this research. The total variable cost (TVC) comprised land preparation, human labor, seedlings, organic manure, urea, TSP, MoP, pesticides, and irrigation. Only the rental value of land was included in the fixed cost (FC). The total cost (TC) included in both variable and fixed costs.

3.8.1.1 Cost of land preparation

Land preparation is a critical component of the industrial process. The preparation of the land for boro rice cultivation includes plowing, laddering, and other procedures necessary to prepare the soil for seedling planting. It was discovered that the number of ploughings varied considerably across farms and between locations.

3.8.1.2 Cost of human labor

Human labor was once seen as a significant cost component of the manufacturing process. It is often needed for a variety of tasks including land preparation, seeding and transplanting, weeding, fertilizer and pesticide treatment, irrigation, harvesting and hauling, threshing, cleaning, drying, and storage. To assess the cost of human work, we multiplied the recorded man-days per hectare by the pay per man-day for a specific activity.

3.8.1.3 Cost of seed

The price of seed varied significantly according on its quality and availability. The market prices of renowned boro rice seeds were utilized to calculate the cost of seed. To determine the cost of seeds in the research locations, the total amount of seed required per hectare was multiplied by the market price of seed.

3.8.1.4 Cost of urea

Urea was a significant fertilizer in the development of boro rice. The cost of urea was determined using market prices. To determine the cost of urea, we multiplied the reported unit of urea per acre by the market price of urea.

3.8.1.5 Cost of TSP

The cost of TSP was also determined using market prices. To determine the cost of TSP, we multiplied the reported unit of TSP per acre by the market price of TSP.

3.8.1.6 Cost of MoP

MoP was one of the three primary fertilizers used in the cultivation of boro rice. To get the cost of MoP per hectare, we multiplied the market price of MoP by the unit cost of that input per hectare for a certain operation.

3.8.1.7 Cost of insecticides

Farmers employed a variety of insecticides 5-7 times to keep pests and diseases away from their crop. The cost of insecticides was determined using the market price per hectare for the insecticides utilized in the research locations.

3.8.1.8 Cost of irrigation

Water management contributes to the growth of boro rice production. Irrigation costs vary considerably amongst farms. It was determined by the number of times irrigation was required per hectare and the associated expense.

3.8.1.9 Interest on operating capital

The interest rate on operational capital was calculated using the opportunity cost concept. Because not all expenditures were incurred at the start or at any one point in time, the operating capital really reflected the average operating cost across the period. The cost was incurred throughout the production period;

Hence, interest on operating capital for four months at a rate of 9% per year was calculated for Boro rice. The following formula was used to compute interest on operating capital:

IoC= AIit

Where,

IOC= Interest on operating capital

i= Rate of interest

AI= Total investment / 2

t = Total time period of a cycle

3.8.1.10 Land use costs

Land use costs were computed using the potential cost of land use per hectare during a four-month cropping cycle. As a result, the cash rental value of land was utilized to calculate the cost of land use.

3.8.2 Calculation of returns

Gross return

The gross return per hectare was determined by multiplying the entire quantity of product and by-product by their respective per-unit pricing.

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

Gross margin

The term "gross margin" refers to the difference between the gross return on investment and variable costs. Generally, farmers want the highest possible return on their variable cost of production. The reason for employing gross margin analysis is that farmers are motivated by the desire to earn a profit on their variable costs. Gross margin was determined on a television commercial basis.

Gross margins per hectare were calculated by deducting variable expenses from gross return. That is to say

Gross margin= Gross return – Variable cost

Net return

Profit or net return was computed by subtracting the whole production cost from the total return or gross return. That is to say

Net return= Total return – Total cost.

3.8.3 Undiscounted benefit cost ratio (BCR)

The average return on each taka invested in manufacturing is a critical metric for determining profitability. The ratio of total return to total cost per hectare was used to calculate the undiscounted BCR.

BCR= Total return (Gross return)/ Total cost

3.8.4 Cobb-douglas production function

Due to its mathematical features, ease of comprehension, and computational simplicity, the cobb-douglas production function is arguably the most extensively used form for fitting agricultural production data (Heady and Dillion, 1969; Fuss and Mcfadden, 1978). The cobb-douglas approximation may be a suitable fit for production processes in which components are imperfect replacements throughout the whole range of input values. Additionally, the cobb-douglas is reasonably straightforward to estimate since it is linear in parameters in logarithmic form; it is parsimonious in parameters (Beattie and Taylor, 1985).

When two variables are used as inputs, for example, labor and capital, the function may be represented as

$$Y = AL^{\beta_1} K^{\beta_2} e^{v_i - u_i}$$

Where Y = level of output, L and K = Labor and Capital are variable inputs, A = multiplicative constant, β_1 and β_2 are the coefficient of L and K and they represent elasticity of the respective factors of production, and e = error term.

3.8.5 Specification of production model

To solve the Cobb-Douglas production function using the ordinary least squares (OLS) technique, it was changed into the following logarithmic form.

$$\text{Ln } Y_i = \beta_0 + \beta_1 \ln X_{1i} + \beta_2 \ln X_{2i} + \beta_3 \ln X_{3i} + \beta_4 \ln X_{4i} + \beta_5 \ln X_{5i} + \beta_6 \ln X_{6i} + \beta_7 \ln X_{7i} + \varepsilon$$

Where,

Y = Net return (BDT/ha)

X_1 = Cost of land preparation (BDT/ha)

X_2 = Cost of seed(BDT/ha),

X_3= Cost of fertilizer and manure (BDT/ha)

X_4 = Cost of irrigation (BDT/ha)

X_5 = Cost of pesticides (BDT/ha)

X_6 = Cost of hired labor (BDT/ha)

X_7 = Cost of family labor (BDT/ha)

ε= error term.

CHAPTER IV

SOCIO-ECONOMIC CHARACTERSTICS OF BORO RICE GROWERS

This chapter summarizes the socioeconomic features of boro rice farmers. Socioeconomic data are critical components of the study and should be thoroughly evaluated. The socioeconomic profile provides an overview of the respondents' marital status, educational attainment, family type, family size, employment, income and savings information, and agricultural information. Additionally, the socioeconomic profile assists in comprehending the respondents' behavior or traits.

4.2 Respondent's family characteristics

The table 4.1 shows the marital status, family type and family size of the respondents. It is seen that the majority of the respondents were married (92%) followed by a single (8%). The table also indicates that the majority (53%) of respondents had a nuclear family, while 47% had a joint family. The family size of the respondents ranged from 1 to above 7 persons. Boro rice farmers were classified into three categories based on their family size. Farmers having a family size of 1 to 4 members was 39.0%, family size of 5 to 7 members was 38% and family size above 7 members was 23.0%.

Table 4.1 Percentage distribution of respondent's family characteristics

Variables	Frequency	Percentage
Marital status		
Single	8	8.0
Married	92	92.0
Total	100	100.0
Type of family		
Nuclear	53	53.0
Joint	47	47.0
Total	100	100.0
Family size		
1 to 4	39	39.0
5 to 7	38	38.0
More than 7	23	23.0
Total	100	100.0

Source: Field survey, 2020

4.3 Respondents occupation and education

From table 4.2 it is seen that, there was no institutional education for 36% of respondents, 49% of respondents had primary level education and only 15% had secondary and above level education. It is also seen that 49% of respondents were involved with only farming practice, whereas 51% of respondents had other occupations with farming. In the case of female head's occupation, 85.87% of females were housewives and only 14.13% of females were involved with earning activities. At the same time, 48% of other family members were engaged with farming and other professions, and 52% of members were unemployed.

Table 4.2 Percentage distribution of occupation and education

Variables	Frequency	Percent
Household head's education		
No institutional education	36	36.0
Primary	49	49.0
Secondary+	15	15.0
Total	100	100
Household head's occupation		
Only Farming	49	49.0
Others with farming	51	51.0
Total	100	100
Female head's occupation		
Housewife	79	85.87
Others	13	14.13
Total	92	100
Other family member's occupation		
Unemployed	52	52.0
Farmer	14	14.0
Others	34	34.0
Total	100	100.0

Source: Field survey, 2020

4.4 Respondents income and savings related information

Table 4.3 shows the respondent's bank account information, average monthly income, average annual savings and major sources of income. The table indicates that only 29%

of the respondents had bank account while majority of the respondents (71%) had not any bank account. A substantial number of respondents (55%) average annual savings was between BDT 1000 to 5000, while only 7% of respondents save more than BDT 5000 in a year. Besides, 38% of respondents saved less than BDT 1000 in a year. It is also seen that 21% of farmers were dependent on agriculture and allied activities for their income whereas, 54% of farmers rely on only agriculture as their earning source. A significant number of respondents (e.g. 25%) were dependent on other activities as their revenue source.

Table 4.3 Percentage distribution of income and savings

Variables	Frequency	Percent
Having bank account		
Yes	29	29.0
No	71	71.0
Total	100	100.0
Average annual savings		
less than 1000	38	38.0
1000 to 5000	55	55.0
More than 5000	7	7.0
Total	100	100
Major income source		
Agriculture	54	54.0
Agriculture and allied activities	21	21.0
Others	25	25.0
Total	100	100.0

Source: Field survey, 2020

4.5 Respondents farming information

Table 4.4 represents the farming information of respondents like land size, years of farming experiences, labor use and storage place.

Boro rice farmers were classified into three categories based on their farm size. The numbers of respondents having land size ‘below 1 acre’,’1 to 3 acres’, and ‘more than 3 acres’ were 43%, 53%, and 4% respectively. The farming experience of a respondent was determined based on involvement in the farming activities related to agriculture. Farmers were classified into four categories based on their farming experience. The highest portion of the boro farmers (37%) had a farming experience of 9 - 10 years, and 33% of farmers had 7-8 years of experience. At last 11% of farmers had less than 7 years' experience whereas 19% of farmers had more than 10 years' experience. In the case of labor usage, majority of the respondents (77%) used both owned and hired labor, while 17% respondents used owned and only 6% used hired labor in their farming activities. It is also found that 59% farmers had storage place for their crops and 41% of farmers had not those facilities.

Table 4.4 Percentage distribution of farming information

Variables	Frequency	Percentage
Size of land holdings		
Below 1 acre	43	43.0
1-3 acres	53	53.0
Above 3 acres	4	4.0
Total	100	100.0
No of years engaged in farming		
Less than 7 years	11	11.0
7-8 years	33	33.0
9-10 years	37	37.0
Above 10 years	19	19.0
Total	100	100.0
Labor use		
Hired	6	6.0
Owned	17	17.0
Both hired and owned	77	77.0
Total	100	100.0
Having storage place for crops		
Yes	59	59.0
No	41	41.0
Total	100	100

Source: Field survey, 2020

4.6 Respondents technical knowledge

Table 4.5 shows that 54% of farmers had access to training or technical knowledge where 46% of farmers had not any kind of training. It is also seen from the table that, majority of the respondents (74.07%) received training from Agricultural Extension Officer and only 25.93% of the respondents received training from NGO's.

Table 4.5 Percentage distribution of technical knowledge

Variables	Frequency	Percent
Any training or technical knowledge		
Yes	54	54.0
No	46	46.0
Total	100	100.0
Received training from		
Agricultural Extension Officer	40	74.07
NGO's	14	25.93
Total	54	100.0

Source: Field survey, 2020

CHAPTER V

FINANCIAL ANALYSIS OF BORO RICE PRODUCTION

5.1 Variable cost

5.1.1 Cost of land preparation

The most critical step in the manufacturing process is land preparation. Land preparation operations included ploughing, laddering, and other tasks necessary to prepare the land for Boro rice farming. The number of tillers necessary for land preparation in boro rice cultivation was multiplied by two. Thus, the average cost of land preparation for boro rice production was determined to be BDT 3105.47 per hectare, representing 3.80% of total variable costs.

5.1.2 Cost of seed

The cost of seed varied significantly according on its quality and availability. The overall cost of seed was projected to be BDT 4363.15 per hectare for boro rice cultivation, which representing 5.33 percent of the total variable cost.

5.1.3 Cost of manure

Farmers in the research region employed cow dung to produce their businesses. They purchased a substantial amount of cow excrement from milk producers. It was discovered at a density of around BDT 2095.25 per acre.

5.1.4 Costof urea

Farmers in the study region utilized a variety of fertilizers. The cost of urea per hectare was BDT 4964.37, which representing 6.07 percent of the total variable cost.

5.1.5 Cost of TSP

Among the many types of fertilizers utilized, the rate of TSP application (180.00 kg). The average cost of TSP was BDT 2718.79 which representing 3.32 percent of the total variable cost.

5.1.6 Cost of gypsum

Among the many types of fertilizers utilized, the rate of Gypsum application (112.5 kg). The average cost of Gypsum was found BDT 1426.73 which representing 1.74 percent of the total variable cost.

5.1.7 Cost of MoP

The application of MoP per hectare (114.8 kg). Per hectare cost of MoP was found BDT 2074.45, which represents 2.54 percent of the total variable cost.

5.1.8 Cost of irrigation

Irrigation is one of the most significant expenditures associated with boro rice cultivation. Irrigation is critical for boro rice production. Irrigation water used in the proper dosages aids in the growth of bulb diameter, clove number, leaf number, and plant height. As a consequence, the yield per hectare increases. The average cost of irrigation was found to be around 9-13 times and the average irrigation was found to be 11 times in the study region, totaling BDT 11869.93 per heater, which representing 14.51 percent of the total variable cost.

5.1.9 Cost of insecticides/pesticides

Farmers utilized a variety of pesticides to keep their crops pest- and disease-free. The average cost of pesticides used in boro rice cultivation was determined to be BDT 2301.34, which was 2.81 percent of total variable costs.

5.1.10 Cost of hired labour

Human labor is a significant cost component of the manufacturing process. It is a critical and widely utilized input in the production of boro rice. It is often needed for a variety of tasks including land preparation, seeding, weeding, fertilizer and pesticide treatment, irrigation, harvesting and hauling, threshing, cleaning, drying, and storage. The total cost of hired labour was found to be BDT 31933.76 representing 39.04 percent of total variable cost.

5.1.11 Cost of family labour

The farmer or the family members also works in their land while producing boro rice. It is also included as variable cost. The total cost of family labour was found to be BDT 14950.03 representing 18.28 percent of total variable cost.

5.2 Total variable cost

As a result of the various cost factors listed above, it was determined that the overall variable cost of Boro rice production was BDT 81803.27 per hectare.

Table 5.1 Calculation of variable cost

Items		BDT/ha	Percentage of total variable cost
Land preparation cost		3105.47	3.80
Seed cost		4363.15	5.33
Fertilizer cost	Manure	2095.25	2.56
	Urea	4964.37	6.07
	TSP	2718.79	3.32
	Gypsum	1426.73	1.74
	MoP	2074.45	2.54
Irrigation cost		11869.93	14.51
Pesticides cost		2301.34	2.81
Labour cost	Hired labour	31933.76	39.04
	Family labour	14950.03	18.28
A. Total variable cost		**81803.27**	**100**

Source: Field survey, 2020

5.3 Fixed cost

5.3.1 Rental value of land/land use cost

Land rental values were determined using the potential cost of land usage per hectare during a four-month cropping cycle. The cost of land usage was calculated using the cash rental value of the land. Land usage cost was determined to be BDT 35000.00 per hectare using data obtained from Boro rice farmers and it was 85.53 percent of overall fixed costs.

5.3.2 Interest on operating capital

It should be emphasized that interest on operating capital was computed by factoring in all operational expenses incurred throughout the boro rice production period. Interest on operational capital for Boro rice production was assessed at 9% and converted to BDT 4092.74 per hectare, or 10.47 percent of the total fixed cost.

5.4 Total Fixed cost

Therefore, from the above different cost items it was clear that the total fixed cost of Boro rice production was BDT 39092.74 per hectare.

Table 5.2 Calculation of fixed cost

Item	BDT/ha	Percentage of total
Land use cost	35000.00	89.53
Interest on operating capital @ 9%	4092.74	10.47
B. Total Fixed cost	**39092.74**	100

Source: Field survey, 2020

5.5 Gross return

The gross return per hectare was determined by multiplying the total quantity of primary product and by-product by their respective per-unit pricing. The gross return on boro rice agriculture was BDT 139256.17 per hectare.

Table 5.3 Calculation of gross return

Cost Items	Quantity(Kg/ha)	Price Per Unit (BDT)	Costs/Returns (BDT/ha)
Main product(Rice)	6827.92	20	136558.4
By-product(Straw)			2697.77
C. Gross return			**139256.17**

Source: Field survey, 2020

5.6 Gross margin

Gross margin is the difference between the gross profit and variable costs. Gross margin was determined by subtracting all variable costs from gross return. On the basis of the data, a gross margin of BDT 57452.90 per hectare was determined.

5.7 Net return

Net return or profit was determined by subtracting the whole cost of production from the gross return. On the basis of the data, a net return of BDT 18360.16 per hectare was calculated.

5.8 Benefit cost ratio (undiscounted)

The Benefit Cost Ratio (BCR) is a ratio that is used to compare the benefit per unit of cost. The benefit-cost ratio (BCR) was determined to be 1.15, indicating that one BDT investment in boro rice cultivation yielded 1.15 BDT. According to the aforementioned assessment, boro rice growing is lucrative in Bangladesh.

Table 5.4 Gross margin, net return and BCR

Item	Cost/Returns (BDT/ha)
A. Total variable cost	81803.27
B. Total fixed cost	39092.74
C. Gross return	139256.17
D. Total cost(A+B)	120896.01
E. Gross margin (C-A)	57452.90
F. Net return (C-D)	18360.16
G. Undiscounted BCR (C/D)	**1.15186**

Source: Field survey, 2020

CHAPTER VI

FACTORS DETERMININGBORO RICE PROFITABILITY

6.1Factors affecting the profitability of boro rice

Table 6.1 summarizes the results of the calculated Cobb-Douglas production function for boro rice. The net return on boro rice was utilized as the dependent variable in this function. The functional analysis demonstrates that, among the seven explanatory factors, the cost of land preparation, fertilizer and manure, and irrigation all contributed significantly to the degree of profit gained from boro rice farming in the research region. The adjusted R^2 value for boro rice production was 0.762, indicating that almost 76% of the variance in output could be explained by the independent variables included in the model (Table 6.1). The positive coefficient signs of the significant factors indicate that increasing these expenses by an extra unit might enhance the profit from boro rice growing by the coefficient values associated with these variables (Table 6.1). The fact that the significant factors have negative coefficient values indicates that each extra unit rise in these expenses reduces the profit from boro rice growing by the coefficient values associated with these variables (Table 6.1).

As shown in Table 6.2, the p values for land preparation cost (β = 2.419), fertilizer and manure cost (β = 1.086), and irrigation cost (β = 1.948) were 0.016, 0.032, and 0.018, respectively, which were less than 0.05. A P value less than 0.05 shows that the cost of land preparation, fertilizer and manure, and irrigation are statistically significant at the 5% level of significance.

Additionally, Costs of seed, pesticides, paid labor, and family labor, on the other hand, were not statistically significant.

Table 6.1 Factors affecting the profitability of boro rice production

Factors	Coefficient	p-value	Std. Error
Constant	-0.623	**0.000***	3.286
Cost of land preparation	2.419	**0.016****	0.985
Seed cost	1.258	0.181	0.933
Cost of fertilizer and manure	1.086	**0.032****	0.744
Irrigation cost	1.948	**0.018****	0.812
Cost of pesticides	-1.471	**0.051***	0.740
Hired labor cost	-.029	0.982	1.265
Family labor cost	-.704	0.147	0.481
R^2=0.762			

Source: Field survey, 2020

Land preparation, fertilizer and manure, and irrigation cost coefficients were 2.41, 1.086, and 1.95, respectively. The positive indication implies that if the farmer raises the cost of land preparation, manure, and irrigation by 1 BDT, the farmer's net return will grow by 2.41, 1.086, and 1.95 BDT, respectively, while all other inputs stay same. (Table 6.1)

The most logical explanation for these findings is that if farmers can finance these input expenses efficiently, they will also be able to achieve a greater amount of output and sales. As a result, the net value of return will be large as well.

CHAPTER VII

PROBLEMS OF BORO RICE PRODUCTION

Farmers had several difficulties in cultivating boro rice. The issues were social and cultural in nature, as well as financial and technological in nature. This chapter will discuss some of the difficulties associated with the development of boro rice. Farmers' issues were recognized based on their perspectives. The following sections highlight the primary issues associated with boro rice cultivation:

7.1 Problems of boro rice production

7.1.1 Low price of output

During harvesting season, the majority of farmers were forced to sell a big amount of their crop to satisfy different commitments like as household needs and loan repayment. However, as a result of the abundant supply, boro rice prices remained low throughout the harvest season. As a consequence, they were unable to earn a living from their crops. As seen in Table 7.1, 84 percent of boro rice producers rated this as a serious concern.

7.1.2 High price of quality seed

The high price of high-quality seed was also a significant constraint for cultivating boro rice in the research location. According to Table 7.1, almost 79 percent of boro rice producers rated this as a serious concern.

7.1.3 Lack of operating capital

Farmers in the study region were constrained by capital restrictions. To cultivate boro rice, a significant sum of cash was required to acquire numerous inputs such as human labor, seed, fertilizers, and pesticides. Around 71% of boro rice farmers said that they lacked the funds necessary to purchase the appropriate number of inputs for the relevant operations, classifying this as a serious issue. (Table 7.1).

7.1.4 High price of fertilizers

Farmers claimed that a scarcity of fertilizers at a fair price was impeding their ability to produce. According to table 7.1, around 66% of boro rice producers cited this as a concern.

7.1.5 Shortage of human labour

The majority of human labor is utilized in the seed/seedling planting and harvesting stages of boro rice production. Boro rice is a time-consuming spice. Human labor was not available at several phases of boro rice production, including planting, intercultural activities, and harvesting. According to Table 7.1, around 62% of boro rice producers rated this as a severe concern.

7.1.6 Lack of quality seed

Lack of quality seed was one of the most important limitations of producing boro rice in the study area. From Table 7.1 it is evident that about 57 percent boro rice growers reported this as high problem.

7.1.7 Lack of scientific knowledge of farming

Despite the fact that new agricultural technologies have been implemented in the research region, a substantial proportion of farmers lack enough information about the suitable dosages and processes for using modern inputs and technology in their companies. This was an issue for around 49% of boro rice producers. (Table 7.1).

7.1.8 Poor storage facilities

Historically, the bulk of farmers stored their boro rice in their homes. Due to a lack of storage facilities, boro rice deteriorated significantly throughout the harvest and post-harvest period. As a result, they had several setbacks, including weight loss and rotting boro rice. According to Table 7.1, 43% of sample farms reported having inadequate storage facilities.

7.1.9 Inadequate extension service

Several farmers claimed that they had gotten no extension assistance from the Department of Agricultural Extension (DAE) about better boro rice growing practices over the course of the research. Around 38% of boro rice producers identified this as a significant issue (Table 7.1). Farmers in both locations reported receiving little assistance from the block supervisor or Agricultural Extension Officer.

7.1.10 High cost of irrigation water

The yield of boro rice fluctuates according on the amount of irrigation water used. In the studied locations, the majority of farmers lacked their own shallow tube well or deep tube well, necessitating a larger payment to the water supply. Farmers reported having to pay a higher irrigation water bill. According to Table 7.1, almost 35% of boro rice producers identified this as a serious concern.

7.1.11 Adulteration of fertilizer, insecticide, and pesticide

Chemical fertilizers, insecticides, and pesticides are the primary inputs in the cultivation of boro rice. Numerous farmers have reported being duped into spreading tainted fertilizers and chemicals to their agricultural fields. As shown in Table 7.1, about 22% of boro rice producers confronted this issue severely.

Table 7.1 Problems of boro rice production

Type of Problems	No. of farmers	Percentage of farmers	Rank
Low price of output	84	84.00	1
High price of quality seed	79	79.00	2
Lack of operating capital	71	71.00	3
High price of fertilizers	66	66.00	4
Shortage of human labor	62	62.00	5
Lack of quality seed	57	57.00	6
Lack of scientific knowledge	49	49.00	7
Poor storage facilities	43	43.00	8
Inadequate extension service	38	38.00	9
High cost of irrigation water	35	35.00	10
Adulteration of fertilizer, insecticide and pesticide	22	22.00	11

Source: Field survey, 2020

CHAPTER VIII

CONCLUSION AND RECOMMENDATION

7.2 Conclusion

Rice is a staple meal for virtually all of Bangladesh's population and is critical for agricultural growth and food security. The majority of farmers lack access to current kinds of seed, fertilizer, insecticides, and other contemporary technology, all of which have an effect on the yield and profitability of rice per hectare.

Boro rice is a significant cereal crop farmed mostly for commercial purposes by farmers. The studied regions offer enormous potential for the growth of boro rice. The research results indicate that boro rice cultivation is a very lucrative activity that may contribute to the socioeconomic development of sample farmers in the study locations. 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 boosted, therefore assisting farmers in many places in easing rural poverty. Farmers were unaware of the need of applying inputs at the appropriate time and dosage. Thus, well-designed management training tailored to their specific challenges, requirements, objectives, and resources may result in effective production techniques and a sustained income from boro rice farming.

7.3 Recommendation

According to the study's findings, boro rice is a viable industry that may provide income and job opportunities for Bangladesh's rural population. However, several difficulties and limits were encountered in achieving the aforementioned goals. The following suggestions may be made to help farmers overcome the limits associated with boro rice cultivation.

- The majority of respondents said that the input costs associated with producing boro rice were considerable. As a result, the government should take required steps to reduce the cost of inputs that have a major beneficial effect on yield. Subsidies on inputs like as seed, fertilizer, and pesticides should be supplied.

- Numerous farmers stated that they were not compensated fairly for their crops. To provide a fair price for boro rice and to contain price volatility, the government should intervene in the procurement and marketing processes. In general, a fair pricing policy should be intended to minimize rice price volatility, allowing farmers to make a better return from the sale of their harvests.
- The majority of farmers struggled with capital shortages. The government may encourage both public and private sector organizations to take the lead in assisting marginal and small farmers in obtaining institutional agricultural finance at lower interest rates and with more favorable terms and conditions.
- Farmers were forced to sell their goods at a loss during or shortly after harvest due to a lack of storage facilities. Thus, the government may establish storehouses in rural regions near farmers' fields, allowing farmers to keep their goods during the off season and sell it at a profit.
- The majority of farmers indicated that labor was limited in rural regions, as workers sought higher wages in metropolitan areas. As a consequence, the wage rate was high, which increased the cost of agriculture. The government may take measures to improve the rural sector's attractiveness in order to decrease labor migration. When labor availability in rural areas increases, the pay rate naturally decreases. While the Government of Bangladesh is expanding subsidy programs to benefit marginal and poor farmers via agricultural inputs, rigorous monitoring operations across several ministries and agencies should be stressed to ensure that only genuine needy farmers get assistance.

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Appendices

Appendix A.Interview schedule

Village... **Upazilla**..

A. Socio-economic characteristics

1. **Name**:
2. **Age**: a) Below 20 years b) Between 20-35 years c) Between 36-50 years d) Above 50 years
3. **Marital status**: a) Single b) Married c) Divorcee
4. **Education**: a) Illiterate b) Illiterate but can sign c) Primary d) Secondary e) Diploma/Technical f) Graduation g) Post graduation h) Others
5. **Type of family**: a) Nuclear b) Joint
6. **Size of land holdings**: a)Below 1 acre b) 1-3 acres c) 3.01-5 acres d) Above 5 acres

7. Annual income: a) Below 1 lakh b) Between 1-3 lakh c) Between 3-5 lakh d) Above 5 lakh

8.Annual savings: a) Below 20000 taka b) Between 20000-35000 taka c) Between 35001-50000 taka d) Above 50000

9.How many years have you been engaged in farming? a) 1-2 years b) 3-4 years c) 5-6 Years d) 7-8 years e) 9-10 f) Above 10 years

10.Off-farm employment: a) Yes b) No

11.Labor use: a) Hired b) Owned c) Both hired and owned

12.How do you control pests and diseases?

a) Biological and organic control method b) Chemical pesticides

b) Integrated Pest Management (IPM) d) Chemical pesticides and IPM

13.Do you belong to any Boro rice related co-operative/association? a) Yes b) No

14.Do you received any training for Boro rice cultivation? a) Yes b) No

15. **If yes, Received training from**: a) Agricultural institution b)NGO c) Agricultural Extension Officer d) Others

16. Do you have a storage place for your crops? a) Yes b) No

B. Information on inputs

17.Planting time: Month ……………………… Week……………………………

18.Variety Name:

19.Soil Type:

20.Source of Seed

Source	Kg	BDT/Kg
a) Home		
b) Purchase		

C. Cost of cultivation

21. Human Labor cost (Per unit area)

Operations	Human labor (Hrs./Days)		Price/wage
	Family	Hired	
a. Land preparation			
b. Planting			
c. Fertilizer application			
d. Intercultural operation			
e. Insecticide application			
f. Harvesting			
g. Others			

22. Material cost (Per unit area)

Particulars	Quantity/Times	Rate
a. Seed		
b. Irrigation		
c. Manure		
d. Urea		
e. TSP		
f. DAP		
g. MoP		
h. Bio-fertilizers		
i. Insecticide & Pesticides		
j. Others		

23. Other cost:

D. Production in survey area

Items		Hectare	Kg	BDT
Area of land used to cultivate				
Total production	Main product			
	By-product (Straw)			
Total post-harvest loss				
Total volume of sales				
Sales price /kg				

E. Constraints of Boro rice production

1.

2.

3.

F. Suggestions

1.

2.

3.

Thank you so much for your cooperation

Name of the enumerator:

Signature:

Date:

Appendix B. Cobb-doglus production function output

Table B.1 Model fitting information of the variables

Model Summary			
Model	R	R Square	Adjusted R Square
1	.873[a]	.762	.749
a. Predictors: (Constant), ln_family_labor, ln_urea, ln_gypsum, ln_tsp, ln_pesticide, ln_manure, ln_irrigation, ln_mop, ln_seed, ln_land, ln_hired_labor			

Table B.2 Factors affecting the net return of boro rice production

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.623	3.286		2.190	.0.0008
	ln_land	2.419	.985	1.375	2.455	.016
	ln_seed	1.258	.933	.704	1.348	.181
	ln_manure	1.589	.744	.891	2.136	.035
	ln_urea	-1.003	.561	-.562	-1.788	.077
	ln_tsp	.235	.616	.136	.381	.704
	ln_gypsum	-2.159	.651	-1.256	-3.318	.001
	ln_mop	-1.165	.764	-.685	-1.524	.131
	ln_irrigation	1.948	.812	1.117	2.400	.018
	ln_pesticide	-1.471	.740	-.846	-1.988	.050
	ln_hired_labor	-.029	1.265	-.017	-.023	.982
	ln_family_labor	-.704	.481	-.398	-1.463	.147
a. Dependent Variable: ln_net_return						