PROFITABILITY AND RESOURCE USE EFFICIENCY OF BORO RICE IN SHERPUR DISTRICT OF BANGLADESH

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PROFITABILITY AND RESOURCE USE EFFICIENCY OF BORO RICE IN SHERPUR DISTRICT OF BANGLADESH

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CERTIFICATE

This is to certify that the research work entitled, **"PROFITABILITY AND RESOURCE USE EFFICIENCY OF BORO RICE IN SHERPUR DISTRICT OF BANGLADESH"** conducted by **SAZIA AFRIN** bearing Registration No. **12-05156 (July-December/2018)** under my supervision and guidance in the partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE (M.S.) IN DEVELOPMENT AND POVERTY STUDIES** in the Faculty of Agribusiness Management, Sher-e-Bangla Agricultural University, Dhaka 1207, Bangladesh. No part of this thesis has been submitted for any other degree or diploma.

I further certify that any help or source of information received during this study has been dully acknowledgement by her/him.

Dated: December, 2019
Dhaka, Bangladesh.

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DEDICATED TO

MY

BELOVED PARENTS

PROFITABILITY AND RESOURCE USE EFFICIENCY OF BORO RICE IN SHERPUR DISTRICT OF BANGLADESH

ABSTRACT

The study was carried out on the profitability and resource use efficiency of boro rice cultivation in Sherpur district of Bangladesh using farm-level survey data. Data were collected from 60 rural households by a random sampling technique with a structured questionnaire from four villages of the study area. The obtained data were analyzed by using tabular and different statistical techniques. The study revealed that the total variable cost and fixed cost were Tk 67583.00 and Tk. 22252.77 per hectare for boro rice production. The gross return and net return were Tk. 112575.00 and Tk. 22739.23 per hectare. Benefit-Cost ratio (BCR) was found at 1.25. Cobb-Douglas production function analysis showed that the key production factors, that is, human labor, insecticide, seed, and education had a statistically significant effect on yield. In the study area, some resources were underused such as human labor, insecticide, MOP, and TSP. Farmers faced some problems to cultivate boro rice such as lack of money, lack of processing and storing facilities, irrigation, lack of market, lack of education, high cost of improved varieties, poor agricultural extension service, low price, natural calamities, etc.

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December, 2018 **The Researcher**

LIST OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

BBS	Bangladesh Bureau of Statistics
GDP	Gross Domestic Product
BCR	Benefit Cost Ratio
NGOs	Non-Governmental Organization
HYV	High Yielding Variety
TSP	Triple Super Phosphate
AWD	Alternate Wet Drying
DP	Demonstration Plot
NDP	Non demonstration Plot
SFA	Stochastic Frontier Approach
NR	Net Return
MFC	Marginal Factor Cost
MVP	Marginal Value Product
DRC	Domestic Resource Cost
DAE	Department of Agricultural Extension
BADC	Bangladesh Agricultural Developmental Corporation

CHAPTER ONE
INTRODUCTION

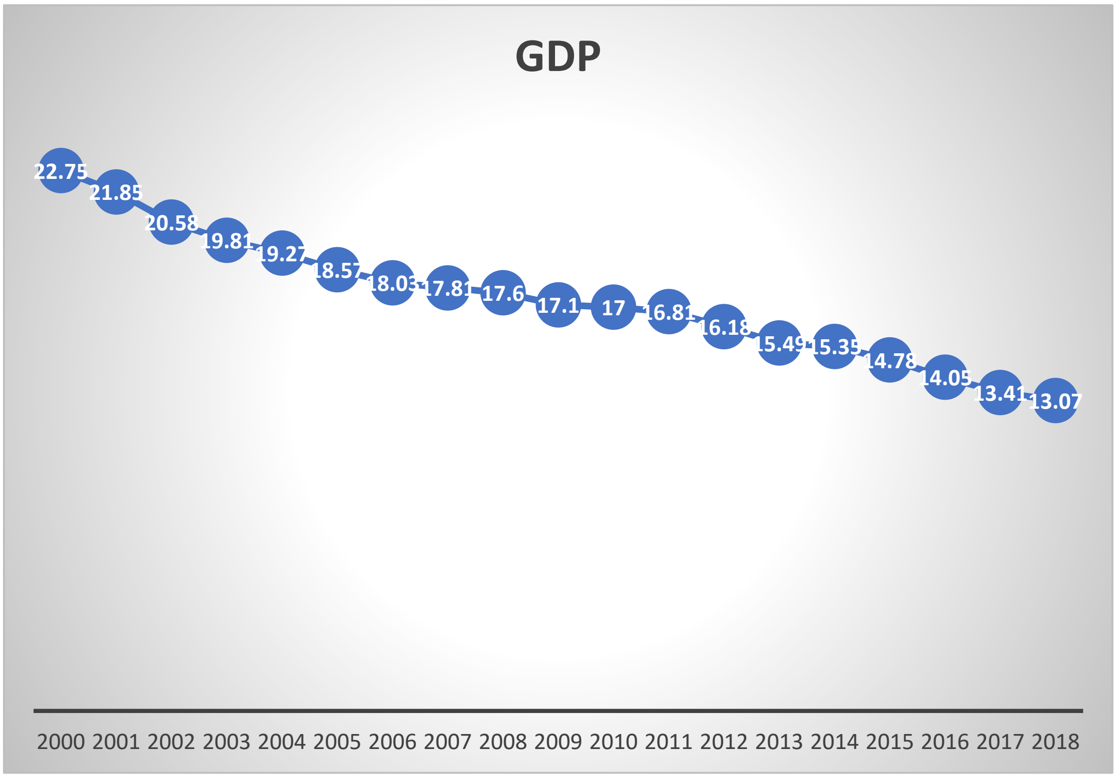
1.1 Background of the study

Bangladesh is mainly an agricultural country of 147570s.qkm with an area of about 163.04 million inhabitants and the density of population is 1253 per square kilometer (World Population Prospects, 2019). Agriculture is the country's largest dominant sector. About 80% of its population lives in rural areas, where agriculture is the main occupation and 41% of the workers work in agriculture (Bangladesh Economic Review 2018). In relation to the contribution to the Gross Domestic Product (GDP), agriculture has a key position in the overall economic sphere of the state.

Through rising the incomes of rural populations, agriculture plays a vital role in alleviating poverty and food security. The additional population threatens overall output. Farming is still synonymous with Bangladesh's economic development. Unless there is a breakthrough in the farming sector the economic development of the country cannot be accomplished. The rice production currently dominates the agricultural sector in large part. Rice is Bangladesh's primary staple food and grain crop. The main source of livelihood for the Bangladeshi people is rice cultivation.

Bangladesh is a small developing country with mostly an agro-based economy. Agricultural sector plays an important role in the overall economic development and food security of this highly populated country. Historically, agricultural sector is prominent for a long time in Bangladesh (Mirza et al., 2015). The agricultural sector (crops, animal farming, forests and fishing) contributes 13.07% to the country's total GDP and it remains as the largest employment sector in Bangladesh economy with about 40.6% of the labor force engaged in agriculture (BBS, 2018). Agriculture is a major source of rural jobs in Bangladesh as over 87% rural people derive at least some income from agriculture (BBS, 2017). The contribution of agriculture to the GDP of Bangladesh is presented in Figure 1.1

Figure 1.1: The contribution of Agriculture to the GDP of Bangladesh



(Source: BBS, 2018)

Major agricultural crops include rice (73.94%), wheat (4.45%), jute (3.91%), rape and mustard (3.08%), lentil (1.54%), potato (1.13%), sugarcane (1.12%) and chili (1.05%) of total GCA dominate the cropping pattern (BBS, 2017). Bangladesh is the fourth biggest rice producer in the world after China, India and Indonesia (DAM, 2017). Rice production is one of the main sources of revenue for the country's economy whereas jute and jute goods are one of the major export earners of the agricultural sector in Bangladesh (Rahman, 2017). The significant contribution of rice in Bangladesh's economy makes these crops very important among all agricultural crops. In Bangladesh, rice is grown in three distinct seasons: Boro (post-monsoon rice), Aus (pre-monsoon rice), and Aman (monsoon rice). Of the three types of rice, Boro rice alone contributes about 56 percent of total food grains, and is also the highest in productivity (3.965 MT per hectare) compared to Aus rice and Aman rice (BBS, 2017). Thus, the production of dry season irrigated rice has a predominant importance for national food security.

Table 1.1: Area of cultivated Boro rice in acres in Bangladesh

Year	Area in acres
2007-08	11385915
2008-09	11654317
2009-10	11631160
2010-11	11787978
2011-12	11886052
2012-13	11762572
2013-14	11837334
2014-15	11960673
2015-16	11793512
2016-17	11060337

(Source: BBS, 2018)

From table, 1.1 it is evident that the area of cultivation of boro is increasing every year. In 2007-08 the area was 11385915acres and in 2016-17 the area is 11793512. Though in 2016-17 the acres of land is decreased. However, to attain self-sufficiency of food we are giving emphasis to produce more rice.

From the following table 1.2 shows that in 2007-08 the total production of boro rice was 17761781metric tons, on the other hand, the production of boro is 18013749 metric tons in 2016-17. It is very clear from table 1.2 that the production of boro rice is increasing every year.

Table 1.2: Production of Boro rice in million (mt) 2007-08 to 2016-17

Year	Production in million (mt)
2007-08	17.76
2008-09	17.80
2009-10	18.05
2010-11	18.61
2011-12	18.75
2012-13	18.77
2013-14	19.00
2014-15	19.19
2015-16	18.93
2016-17	18.01

(Source: BBS, 2018)

1.2 Justification of the study

Agriculture plays a very important role in Bangladesh's economy. During the two decades since independence, this sector achieved modest growth and has seen slow transition. The aim of the sector was to substitute conventional and insecure farming with modern sustainable growth agriculture (SFYP). It is therefore crucial to ensure that agricultural inputs can easily be made available, to implement the principles for agriculture extension, to modernize research techniques to improve the quality of agriculture products and to take action to enhance and extend the use of agricultural research-based technologies for sustainable agricultural development.

Rice demand is also rising every day as the population grows. Nevertheless, the current production cannot meet the current demand. But the production of boro rice is more intensive than labour. Boro rising can provide the Bangladeshi rural unemployed with more job opportunities. Most farmers and traders are surviving on the income from the processing and trading of boron rice. The production of boro rice can be used to export large amounts of foreign currency to our countries.

This study would help to provide an image of the profitability boro that lets individual researchers perform additional studies of a similar nature and promotes further study into this particular field of the study. Ultimately, the study should help farmers to operate and maintain their farms efficiently by pointing to their difficulty and planners for better management and planning. The study will help extension staff learn about various problems related to the production of boron rice and recommend that farmers copy the problems.

1.3 Objectives of the study

The objectives of the study are given bellow:

- To determine the socioeconomic characteristics of the boro rice producing farmers.
- To assess the profitability & resources use efficiency of the boro producing farmers.
- To determine factors affecting the gross return of the boro rice producing farmers.
- To identify the major problems associated with boro rice production.

1.4 Outline of the study

The study consists of 7 chapters. Chapter 1 describes the introduction of the study, Chapter 2 relevant to literature. Chapter 3 deals with the methodology of the study. In Chapter 4, the socioeconomic characteristics of the sample farmers, production cost and profit, etc.are presented. In Chapter 5 depicts the total cost, gross return, net return, and Benefit cost ratio and resource use pattern. Chapter 6 reveals the factors affecting in production. Finally, the conclusion, and recommendations of the study are presented in Chapter7.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter presents the review of relevant literature with a view to understand the method and cause-effect relationship of past and present research work on boro rice production. This would help in narrowing down the problem correctly and in selecting the most appropriate technique of analysis. Unfortunately, a few number of economic studies are available in our country. This chapter reviews studies concerning the socio-economic aspects, problems and profitability of rice, which have so far been made by different researcher and organizations.

Islam et al. (2017) conducted to assess the profitability, constraints and factors affecting rice production in coastal area of Shamnagar Upazila, Satkhaira district, Bangladesh by using stratified random sampling method. Simple statistical technique as well as the Cobb-Douglas production function was used to achieve the objectives of the study. The study found that the small farmers (Tk. 10292.89) got higher net returns than the medium (Tk. 6894.39) and large (Tk. 4798.70) farmers per hectare, respectively. The undiscounted BCR was 1.38, 1.23 and 1.15 for small, medium and large farmers respectively. It is found that the coefficient of seed, fertilizer, power tiller, irrigation cost and human labor have significantly impact on gross return. Lack of saline tolerable good quality seeds, high price of inputs, low price of outputs and natural calamity were the major problems for rice farming in the study area though rice farming was a profitable enterprise.

Saha et al. (2017) looked for the economic profitability of Alternate Wet Drying (AWD) irrigation methods over conventional irrigation practices to address concerns of groundwater depletion associated with Boro rice production. In total 80 farmers of which 40 practice AWD and 40 farmers involved in conventional irrigation were selected randomly from Fulbaria and Trishal Upazilas of Mymensingh district and Nakla and Nalitabari Upazilas of Sherpur district. Descriptive as well as statistical analyses were done to achieve the objectives of the study. The key finding of the study is that AWD farmers gained more profit than conventional farmers on Boro rice production. The per hectare gross return and gross cost was higher and lower respectively in AWD farmers than conventional farmers from Boro rice production which ultimately leads higher net return of AWD farmers (Tk. 8621.456/hectare) than conventional farmers (Tk. 4551.204/hectare). The undiscounted Benefit Cost Ratio (BCR) was 1.111 and 1.057 respectively for AWD farmers and conventional farmers. The results indicated that application of AWD method was more profitable than conventional practices in Boro rice production.

Hasan et al. (2016) estimated the technical efficiency of Boro rice farms and determines the important factors affecting the level of technical inefficiency of the farms. This study mainly uses primary data for the analysis, collected from 112 rice producing farms of Jhenaidah district using multistage random sampling technique. The Cobb-Douglas stochastic production frontier approach is employed to estimate the technical efficiency of Boro rice farms. An inefficiency effect model is also used to determine the factors that affect the level of inefficiency of the Boro rice farms. The empirical results of the Cobb-Douglas stochastic production frontier approach show that the technical efficiency of Boro rice production is on average 0.92. This indicates that the level of technical efficiency in the study area is high. It also finds that cost of labor, irrigation, seed and ploughing are the important factors which affect increasing efficiency of Boro rice production. The results from the estimated inefficiency effect model reveal that farm size, age, education, training and credit facility are the significant factors which are negatively related to technical inefficiency of Boro rice production.

Bapari (2016) analyzed the determinants, costs and benefits and resources allocation of both conventional and high yielding rice cultivation over the Rajbari district of

Bangladesh. Data were accumulated from 300 regular rice growers of conventional and high yielding varieties and random sampling technique was applied for selecting the respondents from the study area from which information was collected through pretested questionnaire. Cobb – Douglas production function and gross margin were mainly used to determine the productivities and profits of both rice and the marginal value of the product was highly recommended to derive the optimal use of the resources. Results obtained by applying ordinary least square method showed that the most important factors of production in the study area were irrigation, labor, fertilizer and insecticide costs whose elasticities were 0.904, 0.048, 0.045 and 0.044 respectively and insignificant factors were seed and ploughing costs whose elasticities were – 0.009 and 0.030 respectively for high yielding rice. On the other hand, irrigation, insecticide, seed and ploughing costs of elasticities 0.880, 0.589, 0.116 and – 0.127 respectively were the important factors and minor role-playing factors were labor and fertilizer costs whose elasticities were 0.098 and 0.077 respectively for conventional yielding rice. The core message from productivity analysis was that the irrigation was key variable which played a positive and vital role in producing rice of both varieties.

Rahman et al. (2015) studied a comparative study was conducted within a selected coastal emboldened area of Bangladesh, with a view to comparing the profitability and technical efficiency of boro rice growers between two locations with different level of salinity. Two unions (Pankhali and Tildunga) under polder 31 of Dacope upazila were selected to fulfill the intention of the study. The study revealed that boro rice production was profitable in both of saline water controlled and uncontrolled areas but the realistic favor viewed that economic return was reasonably in controlled area. The returns per taka investment in controlled and uncontrolled areas were 1.70 and 1.60, respectively. The estimated result showed that the average level of technical efficiencies of the sample farmers were about 70.70% and 87.50% for the uncontrolled and controlled areas' farms, respectively. That means, at the given technology and level of inputs, the output could be increased by 29.30% and 12.50%, respectively. Farmer's education and training had positive significant effect on boro rice production. The age of the sampled farmers' had significant positive impact on farming efficiency in the controlled farms but it was negative on the uncontrolled area. The saline water controlling had significant impact on the farming efficiency of boro rice farmers'.

Tama et al. (2015) undertaken to assess the financial profitability of aromatic rice production. A total of 45 farmers of some selected villages of Chirirbandar Upazila of Dinajpur district were considered as sample for achieving these objectives. Collected data were analyzed with descriptive statistics. Total costs for aromatic rice was estimated at Tk. 64446.51 per hectare and per hectare gross return of aromatic rice was Tk. 114243.71. Gross margin for aromatic rice was estimated at Tk. 59999.29 per hectare. Thus, the net return was estimated at Tk. 49797.20 for aromatic rice production. The undiscounted Benefit Cost Ratio on the basis of total cost was 1.77 implying that the aromatic rice production was highly profitable.

Hasnain et al. (2015) observed that owing to the application of high yielding variety seeds, chemical fertilizer, pesticide, and irrigation, productivity of rice in Bangladesh has increased in the recent years though it is still lower compared to other Asian countries. A review of existing literature reveals that so far little attention has been given by the researchers in investigating the efficiency of rice production in Bangladesh. They studied to analyze the resources use efficiency of rice production in Bangladesh using data from boro rice farmers. Required data are collected from 115 boro rice producing farmers of Meherpur district selected using multistage random sampling procedure. The study found that the resources use efficiency of boro rice farms in the Meherpur district is 89.5%. It is also found that ‘labor’, ‘fertilizer and pesticide’, ‘seed’ and ‘irrigation’ are the significant factors that affect the level of resources use efficiency while ‘farm size’ and ‘ploughing cost’ are found insignificant in affecting resources use efficiency of boro rice production in the study area.

Kabir et al. (2015) studied to estimate the impact of bioslurry to Boro rice production in Bangladesh. Translog production function through Stochastic Frontier Approach (SFA) was applied for estimating the efficiency of Boro production. Data were collected from biogas users in the four district of Bangladesh: Mymensingh, Pabna, Thakurgaon and Dinajpur. Biogas users have received significant impact from bio-slurry to Boro rice production while chemical fertilizers have no significant impact to same production. The production efficiency of biogas users is notably different from traditional farms. The efficiency differences are explained mostly by farm size, year of education, family size and off-farm income.

Pervin et al. (2014) attempted to examine the profitability of Boro rice-producing farms according to these three tenure groups such as owner, cash tenant and crop share tenant farmers. About 90 sample farmers, 30 owner farmers, 30 cash tenant farmers and 30 crop share tenant farmers were selected for the present study. The average gross returns per hectare were Tk. 108933.00, Tk. 119079.50 and Tk. 117368.48 in owner, cash tenant and crop share tenant farmers respectively. Gross return was higher of cash tenant farmer than other farmer but the total cost of production was higher in owner farmer and cash tenant farmer so their net return is lower than crop share tenant farmer. It was observed that per hectare net return was Tk. 14296.78. 27285.54 and 38615.72 for the owner. cash tenant and crop share tenant farmers respectively. Which indicates that crop share tenant farmer earned more profit than the other farmers.

Reza et al. (2013) investigated to find out the input productivity and resource use efficiency of boro rice farm in Sylhet District. In total 120 farmers were selected randomly from three thanas of Sylhet District named Gohainghat, Fenchugonj and Balagonj, where equal number of samples were collected from each thana. Data were collected through farm survey by using a suitable pretested questionnaire. Cobb-Douglas Production Function, Marginal Value Product (MVP) and Marginal Factor Cost (MFC) are used for analysis. The use of inputs like human labour, seed, irrigation, insecticides, power tiller/animal power are also statistically significant but not for all the crops. Findings of the study revealed that the farmers were inefficient of the use of resources, generally, inputs such as fertilizer, seed and insecticides were under-utilized in Boro Paddy under three categories of farms (animal, power and pooled farm). The ratios of the MVP to the MFC were less than unity for Boro and Aman Paddy of all categories of farms except Boro Paddy in animal operated farm.

Nargis et al. (2013) studied based on the existing state of DEA technology, this paper estimates technical, allocative, economic, and scale efficiency using field-level survey data from a sample of 199 Boro rice farmers in north-central part of Bangladesh for the year of 2010. The results of the study revealed that on average, the farms technical, allocative, economic, and scale efficiencies were 0.93, 0.82, 0.69, and 0.90 respectively. Their existing technical, allocative, economic and scale inefficiencies were 7%, 18%, 31%, and 10%, respectively. In addition, a second stage Tobit regression showed that the variation was also related to farm-specific attributes such as education, family size, seed type, land tenancy, extension services, irrigation machine type, and sources of energy. Although tremendous development has been achieved in crop production in Bangladesh, the evidence suggests that farmers in Bangladesh fail to exploit the full potential of technology, and that input uses might be reduced through the adaptation and spread of improved agricultural mechanization.

Bhuiyan et al. (2012) evaluated the water and fertilizer application efficiency of rice cropping system under bed planting method. Results showed that the bed planting method increased grain yield of rice up to 16% than the conventional method. Bed planting also increased the number of panicle m^{-2}, number of grains $panicle^{-1}$, and 1000-grain weight of rice than conventional method. Sterility percentage and weed infestation were lower in bed planting than conventional method. This study concluded that bed planting method is a new approach for optimum fertilizer and water use efficiency as well as higher yield compared to conventional flat method.

Rahman et al. (2012) estimated the farm-size-specific productivity and technical efficiency of all rice crops. Farm-size- specific resources use efficiency scores were estimated using stochastic production frontiers. Gross return was the highest for small farms and net return was the highest for marginal farms. The lowest net return or the highest cost of production was accrued from both the highest wage rate and highest amount of labour used in medium farms. The marginal farms experienced the highest benefit-cost ratio (BCR) followed by small and medium farms. Average resources use efficiency for large, medium, small, marginal and all farms were respectively 0.88, 0.92, 0.94, 0.75 and 0.88. There were significant resources use inefficiency effects in the production of rice for marginal farms only. In this case, production cannot be increased by increasing efficiency with the existing technology except in marginal farms. The application of efficient management system would be able to increase production in the marginal farms. In the resources use inefficiency effect, age, education and family size had positive impact on efficiency effect, whereas land under household had negative impact on efficiency effect.

Fatema et al. (2011) designed to assess the relative profitability of rice farming in two villages of Tildanga Union in Dacope Upazila of Khulna district in Bangladesh. In total, 120 farmers were randomly selected for the study. Descriptive statistics, activity budgets, Cobb-Douglas production function model were employed to achieve the objectives of the study. The study confirmed that boro rice production were profitable. Boro rice production is more profitable than other rice production. Despite the fact, a large number of farmers prefer rice to shrimp due to environmental effects and welfare grounds of the common people. The present study, of course, assessed the profitability of growing boro rice in Polder 31 and has given some important clues to make the right decisions regarding better options for more environment-friendly profitable crop farming for individual farmers in Polder 31.

Sarkar et al. (2010) conducted to examine the differences in input use, costs and returns of the borrower and non-borrower rice farmers. One hundred samples from four villages under Trishal Upazila of Mymensingh district were selected for the study. The study revealed that borrower farmers used more inputs and attained more returns through higher yield than their counterparts. The yields of rice per hectare were 5260.80 kg and 4177.34 kg for the borrower and non-borrower farmers, respectively. The gross returns and net returns were Tk. 41699.03 and Tk. 4475.64, respectively, for the non-borrower farmers and Tk. 51589.53. and Tk. 8821.68, respectively, for borrower farmers. The undiscounted BCRs were 1.73 and 1.12 in case of non-borrower farmers and 1.74 and 1.21 for the borrower ones.

Nargis et al. (2009) estimated the profitability of MV Boro rice production under shallow tubewell irrigation system. The study was conducted in Ghatail Upazila of Tangail district. In the study, 60 water buyers from 5 villages were randomly selected. The major findings of the study were that about one third of total cost shared by irrigation charge. Though, the water buyers made a significant profit from MV Boro paddy production but the buyers were not fully satisfied with the prevailing one-fourth water charge and claimed for reduction of water charge. Education and farming experience was the important tools to increase profit in MV Boro paddy production. A considerable further scope apparently exists for expansion of STWs by reducing water charge to enhance the productivity of MV Boro paddy and to increase farm income of water buyers.

Dey (2001) analyzed for estimating the returns of BR11 variety of rice in T. Aman season has been conducted using Akino and Hayami model (1975) and Masters model (1996). Using the Akino and Hayami model it was found that the IRR to the total investment in BR11 rice variety research and extension was calculated at 85%. The increased production from BR11 saved foreign exchange of Tk. 109.83 billion, which is 86% of the total foreign exchange savings from HYV T. Aman rice. Under various assumptions of shift multiplier and expenditure, the magnitude of the IRR varies from 64 to 122%. Therefore, the variety BR11 has proved to be as an outstanding contributing variety for increasing rice production in Bangladesh.

Razzaque et al. (2007) carried out at Multilocation testing site Bargunain kharif -II seasons of 1999 and 2000 to find out the probable reason of yield gap of T. aman rice (BR-23) between demonstration plot (DP) with Research management and Non-demonstration plot (NDP) with Farmer management practices. Across the years there exists a big gap in yield (1220 kg ha-1) between DP and NDP. DP gave about 25.15% higher yield than NDP due to use of best quality seed, appropriate age of seedlings (30 days), closer spacing, and optimum number of seedlings per hill, use of balanced fertilizer and pest control in proper time. Although cultivation cost of DP was higher (Tk.2218 ha-1) than that of NDP. Demonstration plots showed higher benefit cost ratio (2.28) than non-demonstration plot (1.98).

Anik et al. (2002) analyzed to evaluate the economic and financial profitability of aromatic and fine rice production, using both primary and secondary data. Forty farmers who cultivated both Kataribhog and Chinigura, and fifteen farmers each producing Pajam and Nizershail were selected from Dinajpur district. The net returns per hectare for the aromatic varieties were higher due to the higher market prices and less production cost of the varieties. Domestic Resource Cost (DRC) ratios showed that Bangladesh had comparative advantage in the production of aromatic and fine rice both from the point of view of export and import substitution, except the Nizershail variety which was marginally unprofitable under export proposition. The study also identified some problems faced by the farmers in producing aromatic and fine rice.

Kadian et al. (2007) determined that T. Aman (wet season rice)- Fallow- Boro (summer) rice is the dominant cropping system in Bangladesh. The introduction of both double transplanting of boro rice and high yielding potato varieties into the rice based cropping system proved beneficial as higher productivity and returns were obtained from the T. Aman rice- Potato-double transplanted Boro rice compared to the other systems. In spite of higher cost of double transplanted technology of boro rice over traditional system, the T. Aman-Potato-DT Boro system gave about 35-47% higher gross margin (net profit) than the conventional T.Aman-Potato-Boro Rice pattern. Including double transplanting of boro rice in the T.Aman-Potato-Boro rice pattern, the margin of gross profit was increased between US$ 700 to 1000/ hectare. The double transplanting of boro rice can be practiced successfully in the upper and middle highlands as an option for optimizing the productivity of T.Aman-Potato-Boro rice cropping pattern

Uddin (1997) conducted a study of Boro paddy marketing in some selected areas of Jamalpur district and found that profit and marketing cost was highest for the millers. The study reveals that lack of communication, lack of adequate market functionaries, and lack of adequate market information, price fluctuation, lack of marketing facilities and lack of adequate storage facilities along with higher market toll and uncertainty in electricity supply were the major marketing problems

Miah (1999) conducted a study on Boro paddy marketing in selected areas of Tangail district. The study shows that Faria, Bepari, Miller, Arathdar and retailer who were involved in Boro paddy/rice marketing formed a complex marketing channel. The margin was the highest for miller followed by Bepari and Arathdar. The millers also received the highest profit. The Arathdar obtained the lowest profit. Major problems in the study area were low price of Boro paddy, poor communication and transportation facilities, inadequate credit facilities and lack of adequate storage facilities etc.

Research Gaps

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

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

Methodology is the theory of producing knowledge through research that we use. It provides a rationale for the way we proceed a researcher. Methodology is more than particular activities, such as doing a survey or interviewing people. It answers the question of how we should go about finding out knowledge (Williamson et al. 20018). This chapter presents a detailed sequential steps of research work for instance, selection of the study area, preparation of survey schedule, selection of sample, period of data collection and analysis of data. The study was conducted to measure profitability and resource use efficiency of boro rice in a selected area of Bangladesh and also to determine socio-economic characteristics of farmers. Necessary data were collected from the farmers of the selected areas and analyzed in terms of the objectives set for the study.

3.2. Topography of Bangladesh

Bangladesh is located in South Asia in a northern latitude range of 20^{o}34' to 26^{o} 38' and in east longitude 88^{o}01' and 92^{o}41' (BBS 2017). The subtropical mountain land is Bangladesh. The average winter weather is between 17 and 20.6^{o}C and the average summer temperature is between 26.9 and 21.1^{o}C and the mean precipitation between regions varies (Shahid, 2010; Shahid and Behrawan, 2008). Agriculture is the main source of rural production and contributes 11.70% of GDP and 42.7% of workforce (BBS 2017). Bangladesh is the world's fourth largest country to grow rice. 51,804 million tons of rice have been produced in the 2015-2016 financial year (BBS, 2017).

The average size of farmland in 1960 (Rashid, 1978) was 3.1 acres and in 2014 it was reduced to 1.23 acres per person (WB, 2015). Land holdings are highly dispersed and small and marginal farmers are mainly. There has been also significant land use change by bringing crop diversification from double to triple crops (Islam, 2003). In the year 2014-2015, aman rice was cultivated in 48.44% and boro was 42.40% of land (BBS, 2014). T. aman is a rainfed crop and in other two seasons, irrigation is the source of water. Approximately, 60% of the cultivated area is under irrigation coverage (FAO, 2013) and rice accounts for 75.01% area of total cultivated area (BBS, 2014).

However, Bangladesh confronted loss in Boro rice production in changing climate (GAIN, 2015) and Aman season rice faces the most production losses due to natural hazards like floods, heavy downpour and water rush (BBS, 2014). Figure 3.2

Source: www.gogle.com/mapofbanglades

3.3 Selection of the Study Area

The selection of the study area is an important step for farm management or production economics study and such a study usually requires selection of an area for collecting data in accordance with the objectives set for the study. The area in which a farm business study is to be made depends on the particular purposes of the survey and possible cooperation from the farmers.

Figure 3.3

Source: www.banglapedia.com/sherpur

The main reasons for selecting the villages were as follows:

i. Availability of a large number of farmers

ii. The large number of respondents and reliable sources of data were expected to obtain under these study areas

iii. Easy accessibility and good communication facilities in these villages and

iv. Researcher herself was fairly well known to the local customs and practices and was able to speak the farmers’ language. A good cooperation was expected from the respondents.

3.4 Selection of Sampling Technique

The primary purpose of the sampling is to pick a small group that is fairly true to the population. Two considerations must be taken into account when choosing specimens for a study. In statistical analysis, the sample size should be so large as to provide enough independence. On the other hand this should be within the limits imposed by physical, human and finance capital for handling field research, data processing and evaluation (Mannan 2001). Because of diversity in the technical and human environment, it is necessary to 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, 1993). The term ‘population’ refers to the households, the farms etc. where a sample is representative under a study.

A deliberate random sample approach was used in this analysis. The district of Sherpur was first intentionally chosen. Sherpur sadar upazilla has then been selected through deliberate random sampling among 5 upazillas in the Sherpur district. Upazilla Sherpur sadar is broken down into 9 unions. The upazila is the second lowest tier of administrative government in Bangladesh. The districts of Bangladesh are divided into sub-districts called upazila (Sarker, 2010).For each union's selection, union wise information on the Boro rice was taken from the upazilla DAE office.

The unions were also chosen on the basis of the purposively selected highest boro concentration. Eventually, four villages are randomly selected out of the most concentrated selected boro rice producing villages. **The villages were Namapara, Shibpur, Charbabna, Gouripur.**

3.5 Sample Size

All farmers could not be included in the study because space, money and staff were limited. In order to achieve the goals of the analysis, the appropriate sample size was taken into account. A total of 60 farmers have been selected for the final study goal. The required sample was first obtained from the selected Agricultural Office in the listing of boro rice producers. 200 farmers from the selected area have been found to have boro rice grown. Of the 200 farmers, 100 **small-house farmers cultivating** boro rice for at least 3 years have been identified. Total 60 farmers were then selected from villages randomly. Figure 3.5

Name of the Upazilla	Villages	No. of Sample
Sherpur Sadar	Namapara	15
	Shibpur	15
	Charbabna	15
	Gouripur	15

3.6 Preparation of Survey Schedule and Pre-testing

In any farm management or manufacturing economics research (Amin, 2013), planning of the survey schedule is very important. In this respect, the main consideration is to obtain reliable information from the respondents to plan an adequate survey schedule. A draft survey schedule was prepared in accordance with the aims of the study, which enabled reliable data from farmers to be collected. The draft timetable was then reviewed and new information not included in the draft timetable was taken into account. The draft survey schedule was pre-tested by researcher herself. The draft survey was conducted among 5 boro rice producers of small farmers in selected area. Thus the draft schedule was improved, rearranged and modified in the light of the actual and practical experience gained during the pre-test.

After making necessary adjustment a final survey schedule was developed in logical sequence.

The final schedule included the following information parts:

i. General information of respondents
ii. Respondent’s socio-demographic information
iii. Farm holding status of the respondents
iv. Information about boro rice production
v. Respondent’s opinion

The first part of the questionnaire contained respondent’s identification, village and union name. Second part contained information about respondent’s socio-economic conditions, their age, sex, education, occupation, income etc. Different code was used for this purpose. This part also contained questions about respondent’s family member’s source of income, education, occupation etc. The third part provided the farm holding status of the farmers such as the information on homestead land, owned land, land given to others, land taken from others etc. The fourth part contained the boro rice production related information such as the unit cost of inputs and the price and quantity of output. The last part of the questionnaire contained respondent’s perception regarding impact of boro rice production in socio economic status of the farmers and constraints faced by them to boro rice production.

3.7 Period of the Study

The researcher herself collected necessary data through personal interviews with the selected farmers. Data were collected during the period from 1st August to 15th August 2019. Data relating to inputs and outputs involved in the production of boro rice were collected by visiting the study area during this period.

3.8 Collection of Data and Accuracy of Data

Collection of accurate and reliable data and other necessary information from the field is not an easy task. It must be done properly since the success of the survey depends on the reliability of data. The researcher herself collected the relevant data from the farmers through face to face interview. Data was collected according to the structured questionnaire and face to face interviews had been carried out by paper and pencil. After fixing the survey schedule, the researcher herself stayed in the respective area and collected the primary data from individual households. Before conducting actual interviews, the whole academic purpose of the present study was clearly explained to the respondents. Initially, the farmers hesitated to answer the questions but when they were assured that the study was purely an academic one and it would not affect them adversely then they were cooperative with the researcher. Farmers were requested to provide correct information as far as possible. Usually, the respondents do not keep records of daily/ annual transactions of their activities. Hence, it was very difficult to collect actual data and the researcher has to rely on the memory of the respondents. Questions were asked systematically in a simple manner and explanation was made whenever felt necessary. After each interview was finished, the schedule was checked to ensure data had been properly recorded on each item. If such issues are ignored or inconsistent, a new interview would correct them. Data collected in the local unit were then translated to standard international units to eliminate errors. In the case of irregularities and delays, required confirmation was requested and data was reviewed and corrected by repetitively visited neighboring farmers.

3.9 Entry and Processing of Data

For the sake of consistency and completeness each survey schedule was verified after data collection. For proper editing the filled interview schedules were sorted, scrutinized and checked to avoid inconsistency. The data were then transferred from the interview schedule to MS Excel sheet and analysis was done by using STATA and SPSS 23.0

3.10 Analytical Techniques

Data were analyzed with the purpose of fulfilling the objectives of the study. Both descriptive and statistical analysis was used for analyzing the data.

3.10.1 Descriptive Analysis

Tabular technique of analysis was generally used to find out the socio-demographic profile of the respondent, to determine the cost, returns and profitability of boro rice farm enterprises. It is simple in calculation, widely used and easy to understand. It was used to get the simple measures like average, percentage etc.

3.10.2 Production Function Analysis

The production role is the technical connection between the output and the input variable. In order to estimate the output function, its properties must be defined, leading to an explicit functional form stated. Cobb Douglas output is one of the most common manufacturing functions of statistical estimation. Originally C.W used this feature. P.H and Cobb. Over twenty years, Douglas measured marginal labor and capital productivities in US manufacturing industries. Their main purpose was to estimate the shares of labor and capital in total product; hence they used this function with the constraint that the sum of elasticities or regression coefficients should total one. Later on, they relaxed this restraint. Cobb and Douglas originally fitted the function to time series 1930s and 1940s; the same form was used for cross section of industries. This form of the function was subsequently used in many production function studies for technical units (crops, livestock) and farm-firms in agricultures. The popularity of this function is because of the following characteristics of the function:

(i) It directly provides the elasticities of production with respect to inputs;

(ii) It allows more degrees of freedom than other algebraic forms (like quadratic function) which allow increasing or decreasing marginal productivities, and

(iii) It simplifies the calculations by reducing the number of regression to be handled in regression analysis. The original form used by Cobb and Douglas was

$$\mathbf{Q = aL^{\beta}K^{1-\beta}U}$$

This forces sum of elasticities to one. Their later modification was

$$\mathbf{Q = aL^{\alpha}K^{\beta}U}$$

Where, $\boldsymbol{\alpha} + \boldsymbol{\beta}$ need not equal one. In agriculture, this form of function has not been used in its original form. Neither the sum of elasticities is kept equal to one nor is the number of variables limited to two. Even then as the basic idea of functional form was provided by Cobb and Douglas, various forms of this function have continued to be called as Cobb-Douglas production function. The Cobb–Douglas production function, in its stochastic form, may be expressed as $Yi = \beta_1 X_{2i}{}^{\beta 2} X_{3i}{}^{\beta 3} e^{ui}$ ……………….. (3.1)

Where,

Y = output

X_2 = labor input

X_3 = Capital input

u = stochastic disturbance term,

e = base of natural logarithm.

From Eq. (3.1) it is clear that the relationship between output and the two inputs is nonlinear. However, if we log-transform this model, we obtain:

$\ln Y_i = \ln\beta_1 + \beta_2 \ln X_{2i} + \beta_3 \ln X_{3i} + u_i$

$= \beta_0 + \beta_2 \ln X_{2i} + \beta_3 \ln X_{3i} + u_i$………….. (3.2)

Where $\beta_0 = \ln\beta_1$.

Thus written, the model is linear in the parameters β_0, β_2, and β_3

The properties of the Cobb–Douglas production function are quite well known and is therefore a linear regression model. Notice, though, it is nonlinear in the variables

Y and X but linear in the logs of these variables. In short, (3.2) is a log-log, double-log, or loglinear model, the multiple regression counter part of the two-variable log-linear model.

The properties of the Cobb–Douglas production function are quite well known:

1. β_2 is the (partial) elasticity of output with respect to the labor input, that is, it measures the percentage change in output for, say, a 1 percent change in the labor input, holding the capital input constant.

2. β_3 is the (partial) elasticity of output with respect to the capital input, holding the labor input constant.

3. The sum ($\beta_2 + \beta_3$) gives information about the returns to scale, that is, the response of output to a proportionate change in the inputs. If this sum is 1, then there are constant returns to scale, that is, doubling the inputs will double the output, tripling the inputs will triple the output, and so on. If the sum is less than 1, there are decreasing returns to scale—doubling the inputs will less than double the output. Finally, if the sum is greater than 1, there are increasing returns to scale— doubling the inputs will more than double the output.

Before proceeding further, note that whenever you have a log–linear regression model involving any number of variables the coefficient of each of the X variables measures the (partial) elasticity of the dependent variable Y with respect to that variable. Thus, if you have a k-variable log-linear model:

$$\ln Y_i = \beta_0 + \beta_2 \ln X_{2i} + \beta_3 \ln X_{3i} + \dots \dots + \beta_k \ln X_{ki} + u_i \quad \dots\dots\dots\dots\dots (3.3)$$

Each of the (partial) regression coefficients, β_2 through β_k, is the (partial) elasticity of Y with respect to variables X_2 through X_k. Assuming that the model (3.2) satisfies the assumptions of the classical linear regression model; we obtained the regression by the OLS. (Acharaya, 1988).

3.10.3 Specification of the Cobb-Douglas Production Function

The input-output relationships in boro rice farming was analyzed with the help of Cobb-Douglas production function approach. To determine the contribution of the most important variables in the production process of boro rice farming, the following specification of the model was used.

$Y = aX_1b_1X_2b_2X_3b_3X_4b_4X_5b_5X_6b_6e^{ui}$ ………….. (3.4).

The Cobb-Douglas production function was transformed into following logarithmic form so that it could be solved by ordinary least squares (OLS) method.

$\ln Y = \ln a + \beta_1 \mathrm{In} X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + U_i$….(3.5)

Where,

Y= Return per hectare (Tk/ha)

Ina= Intercept of the function

X_1= Cost of human labor (Tk/ha)

X_2= Cost of Urea (Tk/ha)

X_3= Cost of TSP (Tk/ha)

X_4= Cost of MOP (Tk/ha)

X_5 = Cost of Irrigation (Tk/ha)

X_6 = Cost of Seed (Tk/ha)

b_1, b_2. . ….. b_6 = Coefficients of the respective input to be estimated; and

U_i = Error term. Coefficient of the respective variable; i= 1, 2….6

3.11 Measurement of Resource Use Efficiency

In order to test the efficiency, the ratio of Marginal Value Product (MVP) to the Marginal Factor Cost (MFC) for each input were computed and tested for its equality to 1. i.e., MVP/MFC = 1.

The marginal productivity of a particular resource represents the additional to gross returns in value term caused by an additional one unit of that resource, while other inputs are held constant.

When the marginal physical product (MPP) is multiplied by the product price per unit, the MVP is obtained. The most reliable, perhaps the most useful estimate of MVP is obtained by taking resources (Xi) as well as gross return (Y) at their geometric means.

In this study the MPP and the corresponding values of MVP were obtained as follows:

MPPxi*Pyi = MFC,

Where,

MPPxi *Pyi=MVP

But, MPP = bi*(Y/Xi),

So, MVP = bi* (Y/Xi) Pyi

Y = Mean output

bi = regression coefficient per resource

Xi = Mean value of inputs

Pyi= price of output

MFC = price per unit of input.

3.12 Decision Criteria:

The decision criteria for choosing efficiency will be-

*When the ratio of MVP and MFC is equal to unity indicates that the resource is efficiently used.

*When the ratio of MVP and MFC is more than unity implying the resource is underutilized. *When the ratio of MVP and MFC is less than unity implying the resource is overused.

3.13 Profitability Analysis

Cost and return analysis is the most common method of determining and comparing the profitability of different farm household. In the present study, the profitability of boro rice farming is calculated by the following way

3.13.1 Calculation of 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 byproduct.

3.13.2 Calculation of 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.

3.13.3 Calculation of 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.

The following conventional profit equation was applied to examine farmer's profitability level of the boro rice producing farms in the study areas.

Net profit, $\pi = \Sigma P_m Q_m + \Sigma P_f Q_f - \Sigma (P_{xi} X_i) - TFC$.

Where, π = Net profit/Net return from boro rice farming (Tk/ha);

P_m = Per unit price of boro rice (Tk/kg); Q_m= Total quantity of the boro rice production (kg/ha);

Q_f = Per unit price of other relevant boro rice (Tk/kg);

P_f = Total quantity of other relevant boro rice (kg/ha);

P_{xi} = Per unit price of i-th inputs (Tk);

TFC = Total fixed cost (Tk); and

X_i = Quantity of the i-th inputs (kg/ha);

i = 1, 2, 3,..............., n (number of inputs).

3.13.4 Benefit Cost Ratio (BCR)

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

BCR= Total Return /Total Cost

3.14 Problem Faced in Collecting Data

During the period of data collection, the researcher faced the following problems.

i) Most of the farmers felt disturbed to answer questions since they thought that the researcher might use the information against their interest. To earn the confidence of the farmers a great deal of time was spent.

ii) The farmers do not keep records of their activities and day to day expenses. Therefore, the author had to depend upon their memory.

iii) The farmers were usually busy with their filed works. So, the researcher sometimes also had to pay extra visits to meet the farme

CHAPTER FOUR

SOCIOECONOMIC CHARACTERISTICS

4.1 Introduction

The socioeconomic characteristics of sample farmers are covered in this section. In inferring the planning of production, the socioeconomic features of farmers are significant. The sample households finished by studying socioeconomic aspects. These included age distribution and family size. Occupation, employment, women's participation, pattern of land ownership, etc. These aspects are discussed briefly below.

4.2 Age Distribution

The study classifies all groups of farmers in the study area as set out in table 4.2. The table shows that the majority of farmers in the study area are middle aged. Out of the samples, 21.00% were in the 20-30-year age group, 65% belonged to the 31-50-year age group and, 24% fall into the over 51-year age group. This result suggests that the majority of sampling farmers were in the most involved 31-50-year age group suggesting that more physical efforts have been made for agriculture.

Table 4.2 Age Distribution

Age category	**Percent (%)**
20-30 years	21
31-50 years	65
Above 51 years	24

Source: Field Survey, 2019.

4.3. Educational status

Education improves people's effectiveness. Table 4.3 indicates that 15% of the farmers were illiterate, 46% had a primary school, 27% of the farmers had a J.S.C level education, 12% were secondary school graduates.

Table 4.3 Educational status

Level of education	**Percentage (%)**
Illiterate	15
Primary school certificate	46
Junior school certificate	27
Secondary School Certificate	12

Source: Field Survey, 2019.

4.4. Occupational Status

Different types of occupation and rice production were used by selected farmers in this study area. It was noted that agriculture was the primary occupation of Boro rice farmers as a primary source of income. Some of them had the chance to participate in other sports. Farmers ' employment status is listed in table 4.4 below. From the figure, it is evident that 74% of farmers were involved in agriculture and 61% in Boro rice. Non-agricultural research is carried out by participants at 26%, of which very few were also involved in industry.

Table 4.4 Occupational status

Types of occupation	**Percentage (%)**
Agriculture	74
Boro Rice	61
Non-agricultural	26
Business	6
Rickshaw, van pulling	9
Others	12

Source: Field Survey, 2019.

4.5. Gender and marital status

Table 4.5 depicts that 92 percent of farmers were male and 8 percent were female. In the study area, 95 percent of the farmers were married and 5 percent were unmarried.

Table 4.5 Gender and marital status

Particulars	Percentage (%)
Male	92
Female	8
Married	95
Unmarried	5

Source: Field Survey, 2019.

4.6. Farm size and ownership

The study farmers are categorized as: landless farmers (less than 49 decimal), small farmer (50-249 decimal), medium farmer (250-749 decimal) and large farmer (above 750 decimal) (GOB, 2009). The table 4.6 shows that in the sample, 22 percent were landless farmer, 62 percent were small farmer, 12 percent were medium farmer and only 4 percent were large farmer.

Table 4.6: Farm size and ownership

Types of farmers	Percentage (%)
Land less (less than 49 decimal)	22
Small Farmer (50-249 decimal)	62
Medium Farmer (250-749 decimal)	12
Large Farmer (above 750 decimal)	4

Source: Field Survey, 2019.

4.7. Income status

In the study area, the rice farmers ' incomes were divided into less than 150,000, from 150,000 to 250,000 and more than 250,000. It is evident from the table 4.7 that most of the farmer’s yearly income belonged to the category of 150,000 to 250,000. About 49 percent of the rice farmers were earned Tk. 150,000 to 250,000 per year, 47 percent of the farmers were earned Tk. less than 150,000 per year and 4 percent farmers were earned Tk. Above 250,000 per year.

Table 4.7: Income status

Level of income	**Percentage (%)**
Less than 150,000 Tk.	47
151,000-250,000 Tk.	49
Above 251,000 Tk.	4

Source: Field Survey, 2019.

4.8 Access to medical services

Table 4.8 indicates, 24 percent farmers in the sample were given medically by the MBBS physician, 46 percent had access by the village doctor to the health service, 33 percent had access by the homeopathic gate to medical services. Very few farmers have provided quack medicine.

Table 4.8: Access to medical services

Types of treatment	**Percentage (%)**
MBBS doctor	24
Village doctor	46
Homeopathic doctor	33
Quack	3

Source: Field Survey, 2019.

4.9 Dependency Ratio

The ratio of dependency is an age-population ratio in economics, geography, and demography of those usually not employed (the dependent portion) and those traditionally employed (the productive portion). The real (or effective) dependence ratio examines the ratio between economically active and inactive employees. The successful dependency ratio not only discusses the age profile but also whether people are economically active.

It is used for calculating the strain on the population of production. With the proportion increase the responsibility of maintaining the education and pensions of economically dependent citizens on the active part of the population can be increased. This results in direct impacts on financial expenditures on things like social security, as well as many indirect consequences. Each and every family is rationally composed of both income earners and dependents.

Table 4.9 present the depending members per income earner. In this present study the average dependency ratio was found 1.34.

Table 4.9: Dependency ratio

Types of farmers	**Percentage (%)**
Total family members	288
Total dependent members	165
Total earning members	123
Dependency ratio	1.34

Source: Field Survey, 2019.

4.10 Sources of Credit Facilities of the Respondent

For all forms of agriculture, the funding available is an important factor. Banks, NGOs, relatives and their own funds are the source of credit facilities for Boro farmers. The study includes numerous NGOs including BRAC, ASA, CARE, Nobolok etc. that use this fund in the Boro-rice-growing industry, to provide loans to the lower farmer's prices. Around 12% of the farmers were borrowing from banks, 31% were borrowing from NGOs and 15% were borrowing loans from their family members as stated by the farmers. 42% of farmers used their own money (Table 4.10).

Table 4.10 Sources of Fund Facilities of the Sample Farmers

Items No.	Percent (%)
Bank	12
NGOs	31
Relatives	15

4.11 Involvement of Women

Women in our country are the most deprived one but at present this situation is changing. Approximately half of our country's population is female. Therefore, our country's total economic and social growth is not possible without their development. In this research, women's implications are divided into 3 groups in boro rice farming: 1 female participation, 2 female participation, and 3 female participation. Table 5.4 shows that 19.62% of farmers have used 1 woman on their farm, 10.12% of farmers have used 2 women on their farm. The result therefore indicates that the involvement of women in the cultivation of boro rice was very limited.

Table 4.11 Involvement of Women

Items No.	Percent (%)
No women involvement	42
One women involvement	51
Two women involvement	7

4.12 Size of Land Holdings of the Sample Farmers

The scale of the land held by boro rice farmers is listed in various categories in the present study. Size of land holdings includes homestead area, orchard, pond, cultivated land, fellow land, leased in, leased out and mortgage in as reported by the sample farmers. It is evident from the table 5.5 that the average area 15 decimal, 86 decimal, 13 decimal, 25 decimals were homestead area, cultivated land, leased out, leased in and mortgaged in 18 decimals, area respectively hold by the sample farmers on an average.

Table 4.12 Size of Land Holdings of the Sample Farmers

Types of land	Average area (Decimal)
Homestead	15
Orchard	10
Pond	9
Cultivated land	86
Fellow land	2
Leased in	25
Leased out	13
Mortgage in	18
Total	178

Source: Field survey, 2014.

4.13 Barriers of boro cultivation

In the study area farmers appear some barriers such as lack of money, lack of water for irrigation, lack of market for selling products, lack of education, poor agricultural extension service delivery, lack of knowledge etc. (Figure 4.13). About 91% farmers mentioned low price of rice regularly. This survey depicts that 79.17% of farmers mentioned lack of money. High cost of improved varieties is noted by 73 % farmers are also crucial barriers faced by farmers.

Particulars	Regularly	Occasionally	Rarely	Not at all
Lack of money	62	32	4.7	1.3
Lack of processing and storing facilities	35	23	11	31
Irrigation	42	26	19	23
Lack of market	69	27	3	1
Lack of education	23	15	9	53
High cost of improved varieties	73	24	2	1
Poor agricultural extension service	51	24	17	8
Low price	91	9	0	0
Natural calamities	68	21	8	3

CHAPTER FIVE
COST AND RETURN OF BORO RICE FARMERS

5.1 Introduction

The main aim of this chapter is to evaluate boro rice costs and returns. In addition, the costs and returns of cultivation per hectare of the boro rice have been measured. Therefore, this chapter estimates cost and return for boro rice. Cost items are divided into two categories for the cost estimation and return of boro rice production: (1) variable cost and (2) fixed cost. Variable cost included the cost of all variable factors like human labor, tillage, seed, fertilizer, manure, irrigation water, and insecticides. On the other hand, fixed cost was calculated for interest on operating capital. On the return side net return and undiscounted benefit cost ratio (BCR) were determined in this chapter.

5.1 Variable cost

5.2.1 Labour cost

The most important and mostly used input for the development of boro was human labor. It contributed a large share of the total cost of production of boro rice. Human labour, including preparing ground, weeding, fertilization, using insecticides and harvesting, is required for various activities and management. In the study area, there were two sources of work for human beings, one for families and one for hired labor. The appraisal of the hired labor was made as compensation of the farmers ' marginal cash salaries. The amount of work used for the production of boro rice is 106-man days per hectare from Table 6.2. Total human labor costs are equal to Tk. 37100 /ha.

The valuation of family supplied labour was done as the average wage of the hired labour was taken as the opportunity cost of the family supplied labour. It can be observed that boro rice growers used on an average 106 man-days/ha total human labour where on an average 51 man-days/ha was family supplied labour. In the study area on an average wage rate was Tk 350.00 per man-day. So, total cost of family supplied labour for boro rice amounted to Tk 17850.00 per hectare. As the boro rice production is the labour intensive work. It reduces the unemployment problem. Group based boro rice cultivation in the selected area plays vital role for the reduction of the poverty.

5.2. 2 Cost of tillage

For boro rice production the average per hectare tillage cost was Tk 8000. (Table 5.2)

5.2.3 Cost of seeds

The seed cost is the main cost item for the production of boro rice. In the area under consideration, farmers were found to use both seeds supplied and bought at home. The total seed demand for boro rice per hectare was 56 kg / ha.. The average prices of seeds were Tk. 53 per kg for boro rice production. Table 6.2 shows that the total cost of seeds for boro rice production was Tk. 2968.00. To maintain the higher production high yield verity is required for the production.

Table 5.2: Variable cost

Items of returns/costs	Unit	Quantity	Amount BDT	Total Value (Tk.)
Human (hired) labour	Man-day	55	350	19,250
Human (family) labour	Man-day	51	350	17,850
Tillage	Tk	2 times	-----	8,000
Seeds	Kg	56	53	2968
Urea	Kg	270	20	5,400
TSP	Kg	140	25	3,500
MOP	Kg	80	15	1,200
Gypsum	Kg	45	10	450
Zinc Sulphate	Kg	15	51	765
Manure	Kg	450	2	900

Pesticides	Tk	n.a	-	2,100
Irrigation	Tk	n.a	-	5,200
Total	Tk	-	-	67,583

Source: Field Survey, 2019

5.2.4 Cost of Urea

The cost of urea is TK 5400.00. It is very useful to get the bumper production.

5.2.5 Cost of TSP

The cost of TSP is TK 3500.00. It provides nutrient to plant to become more vigor.

5.2.6 Cost of MOP

The cost of MOP is TK 1200.00.

5.2.7 Cost of Gypsum

The cost of Gypsum is TK 765.00.

5.2.8 Cost of Zinc Sulphate

The cost of Zinc Sulphate is TK 450.00.

5.2.9 Cost of manure

In this study total manure cost is 900.00 Tk per hectare when per unit manure cost is 2.00 Tk

5.2.10 Cost of irrigation

Irrigation water is an important input in winter boro rice cultivation. Per hectare cost of irrigation water was Tk 5200.00 for boro rice (Table 5.2).

5.2.11 Cost of insecticides

In the study area, farmers applied insecticides to protect from the attack of pests and diseases. Cost of insecticides amounted to Tk 2100 per hectare for boro rice (Table 5.2).

5.2.12 Total variable cost

Summation of the costs of variable inputs gave the total variable costs which were Tk 67583.00 per hectare for boro rice production.

5.3.1 Interest on operating capital

Interest on operating capital was calculated by taking into account all the operating costs incurred during the production period of boro rice. Per hectare interest on operating capital was Tk 2252.77 and rental value of one-hectare land is Tk. 20000.00 for boro rice production. So total fixed cost is Tk. 22252.77

Items of returns/costs	Unit	Quantity	Amount BDT	Total value (Tk)
Interest on OC for 4 months	Tk	67583	@10%	2252.77

Table 5.3.2: Fixed cost

Items of costs	Unit	Quantity	Amount BDT	Total value (Tk)
Rental value	Tk	20000.00	1	20000
Total	Tk	-	-	22252.77

5.4 Total cost

In order to estimate total cost per hectare all the resources used in boro rice production has been recapture together. Per hectare total cost of boro rice production was Tk. 89835.77 (Table 5.4).

Table 5.4: Per hectare total cost of boro rice production

Items of returns/costs	Unit	Quantity	Amount BDT	Total value (Tk)
Human (hired) labour	Man-day	55	350	19,250
Human (family) labour	Man-day	51	350	17,850
Tillage	Tk	2 times	-----	8,000
Seeds	Kg	56	53	2,968
Urea	Kg	270	20	5,400
TSP	Kg	140	25	3,500
MOP	Kg	80	15	1,200
Gypsum	Kg	45	10	450
Zinc Sulphate	Kg	15	51	765
Manure	Kg	450	2	900
Pesticides	Tk	n.a	-	2,100
Irrigation	Tk	n.a	-	5,200
Total	Tk	-	-	67,583
A. Total Operating Cost (TOC)				67,583
Interest on Operating Capital @ 10%				2,252.77
B. Total Variable Cost (TVC)				69,835.77
Rental Value of land				20,000
C. Total Fixed Cost (TFC)				20,000
D. Total Cost (TVC+ TFC)				89,835.77

Source: Field Survey, 2019

5.5: Gross returns

Here gross returns of the boro rice production is= (Main product+ By-product). Total value of by products is Tk10200. The quantity of main product is 5850Kg. If the price of the boro rice per unit is 17.5 then it becomes the total value of boro rice main product is Tk.102375. So the gross return of the boro rice production is= (102375 + 10200) = 112575.00

Table 5.5: Gross return

Items of returns/cost	Unit	Quantity	Priceper unit(TK)	Total value(Tk)
Main product	Kg	5850	17.5	10,2375
By-product	TK	n.a	-	10,200
Gross returns	TK	-	-	112,575

Source: Field Survey, 2019

If the gross return of the boro rice production is increased and the production cost of boro rice decrease then we will get highest rate of return through boro rice cultivation.

5.6 Net Return

The net return of boro rice production is depending on both gross return and total cost of the boro rice production.Net return is Tk. 22739.23

Table 5.6: Net return **(**Gross return – Total cost**)**

Items of returns/costs	Unit	Gross return	Total cost	Total value (Tk)
Net return	Tk	112575	89835.77	22739.23

Source: Field Survey, 2019

5.7 BCR

Benefit cost ratio was calculated by dividing gross return by gross cost or total cost. It implies return per taka invested. It helps to analyze financial efficiency of the farm. It was evident from the study that the benefit cost ratio of boro rice farming was accounted for 1.25 implying that Tk. 1.25 would be earned by investing Tk. 1.00 for boro rice production. So, the boro rice farming was found to be profitable for farmers (Table 5.7).

Table 5.7: BCR

Items of returns/cost	Gross Return	Gross cost	Ratio
BCR	112575	89835.77	1.25

Source: Field Survey, 2019

CHAPTER SIX

FACTORS AFFECTING OF BORO RICE PRODUCTION

6.1 Introduction

In this Chapter, the effects of main variables on boro rice production are identified and measured. In order to assess the contribution of the major variables to the boro rice production process the Cobb-Douglas production function has been chosen. Table 7.1 presents the estimated values of the model.

6.2 Functional Analysis for Measuring Production Efficiency

Output function is a relationship or mathematical function, which indicates the total output to be achieved with certain inputs to a certain technological level. In order to estimates the effect of the inputs on output seven explanatory variables are selected taking into account the objectives of the study and considering the effects of explainable variables on production of boro rice. Other independent variables like water quality, soil condition, time etc., which might have affected production of farm enterprises, were excluded from the model on the basis of some preliminary estimation. A brief description is presented here about the explanatory variables included in the model.

6.3 Estimated Values of the Production Function Analysis

- F-value was used to measure the goodness of fit for different types of inputs.
- The coefficient of multiple determinations (R^2) indicates the total variations of output explained by the independent variables included in the model.
- Coefficients having sufficient degrees of freedom were tested for significance level at 1 percent, 5 percent and 10 percent levels of significant.

Table 6.3: Estimated Values of Coefficients and Related Statistics of Cobb-Douglas Production Function Model for boro rice.

Explanatory variables	**Parameter**	**Values of coefficients**	**P-value**
Intercept	β_0	5.1280***	0.00392
Human labor (X_1)	β_1	0.659***	0.000122
Urea (X_2)	β_2	0.416**	0.015116
TSP (X_3)	β_3	-0.030	0.678651
MOP (X_4)	β_4	0.064	0.751158
Irrigation (X_5)	β_5	0.018	0.638751
Seed (X_6)	β_6	0.264**	0.023511
F-value		24.31***	
R^2		0.75061	

Note:

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

Source: Authors Estimation

6.4 Interpretation of the results

Human Labor (X_1)

It can be seen from Table 6.3 that the magnitude of the regression coefficient of labor cost was 0.659 for boro rice. It was positive and was statistically significant at one percent probability level. This indicates that an increase in one percent of labor remaining other factors constant, would result in an increase in the gross return by 0.659 percent.

Urea (X_2)

The value of insecticide for boro rice in magnitude regression was 0.416. At 5% probability level, it was positive and significant. It indicates that an increase in insecticide value of one percent would result in a gross profit rise of 0.416 percent and that other variables would remain constant.

Seed (X_6)

The magnitude of the seed cost regression coefficient was 0.264 with a positive sign. At five percent probability level, it was highly significant. This means that one percent increase in seed costs will lead to an increase of 0.264 percent in gross return for boro rice, holding other factors constant (Table 6.3).

Remaining others variables like TSP, MOP and Irrigation are statistically insignificant so they have no significant effect on production of Boro rice.

Coefficient of multiple determinations (R^2). It is evident from Table 6.3 that the value of the coefficient of multiple determinations (R^2) was 0.75061 for boro rice. It indicates that about 75 percent of the total of the gross returns are explained by the explanatory variables included in the model.

Goodness of fit (F - value). The F-value was 24.31 for boro rice, which implies good fit of the model. That is, all the explanatory variables included in the model were important for explaining variation of boro rice production.

6.5 Resource Use Efficiency in Boro Rice Production

A ratio equal to unity indicated the optimal use of this variable, a ratio more than a unit indicated that yield might be improved through use of more resources, in determining the efficiency of resource usage. The unprofitable asset rate has been shown to be less than unit cost, which is to be decreased to minimize losses as farmers use this factor over time. The negative MVP value indicates that the resource is used indiscriminately and inefficiently.

The ratio of MVP and MFC of labor (0.104) for boro rice production was positive and greater than one, which indicated that in the study area labor was under used (Table 6.5). So, farmers should increase the use of labor to attain efficiency considerably.
The MVP and MFC labor ratios (0.104) were positively and gratefully higher than one for boro rice production, which showed that work was being carried out in the study area. Farmers should therefore significantly increase the use of labor in order to achieve efficiency.

Table 6.5 showed that the ratio of MVP and MFC of TSP (-5.609) for boro rice farming was negative and less than one, which indicated that in the study area TSP for boro rice production was over used. So, farmers should decrease the use of TSP to attain efficiency level.

The ratio of MVP and MFC of MOP was found to be (6.785) for boro rice farming was positive and greater than one, which indicated that in the study area use of manure was under used (Table 6.5). So, farmers should increase the use of MOP for boro rice production to attain efficiency considerably.

Table 6.5 showed that the MVP and MFC proportions were more than one positive (22.119), implying that insecticide application was under-used. Table 6.5 showed that insecticide use was not being used. Farmers should therefore increase fertilizer use in boro production to achieve efficiency.

It was evident from the table 6.5 that the ratio of MVP and MFC of Urea (1.058) for boro rice farming was positive and more than one, which indicated that in the study area use of urea for boro rice farming was under used. So, farmers should increase the use of urea to attain efficiency in boro rice production.

Table 6.5 Estimated Resource Use Efficiency of Boro rice Production

Variables	Geometric mean (GM)	Y(GM)/ Xi(GM)	Coefficient	MPV(Xi)	MFC	r=MVP/ MFC	Comment
Yield	112575						
Human labour	37100	3.034	0.659	36.42	350	0.104	Over utilized
TSP	3500	32.16	-0.030	-140.23	25	-5.609	Over utilized
MOP	1200	93.81	0.064	101.78	15	6.785	Under utilized
Urea	5400	20.85	0.416	21.16	20	1.058	Under utilized

Source: Field survey, 2019

CHAPTER SEVEN

CONCLUSION, POLICY IMPLICATIONS AND LIMITATION

7.1. Introduction

This chapter summarizes the main finding of the study and provides some recommendations and future research direction. The organization of this chapter is as follows: Section 7.2 summarizes the main findings to answer the three research objectives. Section 7.3 provides some policy recommendations based on the findings and Section 7.4 presents further research directions.

7.2 Conclusion

The principal findings of the study is that the boro rice cultivation in Sherpur district was a profitable venture. The trend line for boro rice also give the evidence on behalf of increasing tendency of area and production of boro rice. Growth rate in production of boro rice is greater than growth rate in area. Thus boro rice area and production in Bangladesh is always bright to meet the increasing demand. This study also made the best effort to develop a short forecasting of area and production of boro rice in Bangladesh. Our forecast showed an increasing pattern in area and production of boro rice.

It is evident that 74% of farmers were involved in agriculture and 61% in boro rice. Non-agricultural research is carried out by participants at 26%, of which very few were also involved in industry. Male headed household were 92 percent and female headed 8 percent. The study shows that in the sample, 22 percent were landless farmer, 62 percent were small farmer, 12 percent were medium farmer and only 4 percent were large farmer. About 49 percent of the rice farmers were earned Tk. 150,000 to 250,000 per year, 47 percent of the farmers were earned Tk. less than 150,000 per year and 4 percent farmers were earned Tk. Above 250,000 per year. In the present study the average dependency ratio was found 1.34.

Around 12% of the farmers were borrowing from banks, 31% were borrowing from NGOs and 15% were borrowing loans from their family members as stated by the farmers. 42% of farmers used their own money. The average area 15 decimal, 86 decimal, 13 decimal, 25 decimals were homestead area, cultivated land, leased out, leased in and mortgaged in 18 decimals, area respectively hold by the sample farmers on an average.

The amount of work used for the production of boro rice is 106 man days per hectare where 51 man-days/ha was family supplied labour. Total human labor costs are Tk. 37100 /ha. For boro rice production the average per hectare tillage cost was Tk 8000.00. The total seed demand for boro rice per hectare was 56 kg / ha.

Farmers faced some problems to cultivate boro rice such as lack of money, shortage of labor, lack of processing and storing facilities, irrigation, lack of market, lack of education, high cost of improved varieties, poor agricultural extension service, low price, natural calamities etc.

About 91% farmers mentioned low price of rice regularly. This survey depicts that 79.17% of farmers mentioned lack of money. High cost of improved varieties is noted by 73 % farmers are also crucial barriers faced by farmers.

7.3 Recommendations

- In the study it was observed that some resource were over used and some under used. In this regard, the officials of DAE should make more meeting with farmers, celebrate campaign after a certain period of time through these activities farmers would be aware regarding using the resources.

- Agricultural marketing should be a vital issue of policy makers, because now-a-days it's a very common scenario; farmers don't get fair price of their products and become looser every year. In the study area we saw that they are facing problem of selling agricultural products. Attention should be given to improve marketing facilities of the study area. To ensure the fair price of agricultural products government should deeply rethink about the DAM; it must be redesigned with the official who are expert about agricultural marketing and agribusiness like graduate of agricultural economics and agricultural marketing.

- Since irrigation is the key factor of the production of boro rice. So the supply of electricity at a reasonable cost should be available in the study area.

- Extension service should be more available, farmers do not get enough service from DAE. They can disseminate the modern technologies to the farmers to increase the production of rice. More access of modern technologies to farmers can bring wellbeing economically.

- Lack of finance is a common phenomenon of our farmers. Policymakers have to reconsider about the financial facility of farmers because farmers are maker of the nation; their sound existence is the sign of wellbeing. Krishi Bank can provide loan without any interest to small and landless farmers because they are more vulnerable to climate change or any natural calamities. But real scenario is different farmers go to rural usury for finance and they victims with the high interest rate; they get impoverished day by day and vicious cycle of poverty. To survive our farmer's government should be attentive on financial facility of farmers and create an easiest way of providing loan to small and landless farmers.

- HYV of boro seed should be made available to the farmers in the production season within a very affordable cost.

7.4. Limitations and future research focus

The present study suffers from a number of limitations. The limitations of the study are as follows:

Inadequate fund and time availability for the study was an important limitation. Due to shortage of fund and time the study could not cover wide areas for collection of necessary information from the farmers; only 60 farmers were selected for the purpose of the study. The researcher had to depend on the memory of the farmers for collecting necessary information because many of them did not keep any written record or kept record partially. Despite a few limitations, the findings of the present study may provide some valuable information for the farmers, extension workers and researchers.

It could be mentioned here that the future researchers could take up a broad - based study with large samples, a further study can be undertaken by taking into account different farm sizes to assess the impacts on income generation through boro cultivation. This may provide an avenue for policymakers to devise region-specific adaptation policies that will have the potential to address way of producing employment to reduce poverty.

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