PROFITABILITY OF BORO RICE CULTIVATION IN THE SELECTED AREAS OF NARAIL DISTRICT IN BANGLADESH

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CERTIFICATE

This is to certify that the thesis entitled '**PROFITABILITY OF BORO RICE CULTIVATION IN THE SELECTED AREAS OF NARAIL DISTRICT IN BANGLADESH**' submitted to the Faculty of Agribusiness Management, Sher-E- Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **Master of Science in DEVELOPMEMT AND POVERTY STUDIES,** embodies the result of a piece of bonafide research work carried out by **Md. RAJIB HOSSAIN**, Registration Number: **13-05706** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

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

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DEDICATED TO MY BELOVED PARENTS

PROFITABILITY OF BORO RICE CULTIVATION IN THE SELECTED AREAS OF NORAIL DISTRICT IN BANGLADESH

ABSTRACT

The purpose of the study was to identify the major socio-economic characteristics of the boro rice farmers; to assess the profitability of boro rice production farmers; and to identify problem faced by the farmers in rice boro production. The study was undertaken purposively in Lohagar upazila under Norail district. Validated and well-structured interview schedule (questionnaire) was used to collect data from 95 rice cultivars during 1st January, 2020 to 1st February, 2020. Per hectare gross return of boro rice cultivation under small, medium and large farms were Tk. 119120, Tk. 116900 and Tk. 115040, respectively. Gross margin was found to be Tk. 67081, Tk. 62543 and Tk. 59036 per hectare for small, medium and large boro rice farm, respectively. Total net return were estimated as Tk. 35180, Tk. 34126 and Tk. 29336 for small, medium and large boro rice farm per hectare, respectively. Benefit Cost Ratio (BCR) were found to be 1.15, 1.13 and 1.08 for small, medium and large rice farm, respectively. Cobb-Douglas production function analysis was carried out for examining the factors affecting the profitability of input use. In most of the cases the coefficients of irrigation, cost of land preparation, human labor cost, cost of manure and cost of pesticide appeared to be positive significant except the negative and significant effect of seed cost and cost of TSP. The values of the coefficient of multiple determination of boro rice production were 0.92 which implied that about 92 percent of the total variation in the gross return could be explained by the included explanatory variables of the model. Lack of fertilizer during cultivation time was the l[st] problem and lack of storage facility was ranked the last.

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June, 2020 ***The Author***

TABLES OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

BBS	Bangladesh Bureau of Statistics
TPS	True Potato Seed
BARI	Bangladesh Agricultural Research Institute
GDP	Gross Domestic Product
BCR	Benefit Cost Ratio
NGOs	Non-Governmental Organization
BB	Bangladesh Bank
MP	Murate of Potash
HYV	High Yielding Variety
TSP	Triple Super Phosphate
STW	Shallow Tube Well
DTW	Deep Tube-Well
SPSS	Statistical Package for Social Science
LUC	Land Used Cost
TVC	Total Variable Cost
NR	Net Return

CHAPTER I
INTRODUCTION

1.1 Background of the Study

Bangladesh is an agricultural country with the geographical area of 147570 sq kilometers and population of about 163 millions. The population density per km2 is 1109 people (BBS, 2020). Agriculture is the major dominating sector of the country. Out of total land area of 14.84 million hectares, the net cropped area of the country is 8.29 million hectares and its cropping intensity is 203 per cent (BER, 2020). About 80 percent of its population lives in rural areas, where agriculture is the major occupation and 45.1% (BBS, 2020) labor force are engaged in agriculture. At present the contribution of agriculture to the total GDP (Gross Domestic Product) is 13.6% in which 10.05% comes from crops, 1.19% from forestry, 2.41% from livestock and 3.56% from fisheries (BBS, 2020). In the year (2009-10), Bangladesh earned $687.53 million by exporting agricultural products which is 4.24 percent of total export earnings (BBS, 2020). So agriculture plays vital roles for poverty alleviation and food security by increasing income level of rural population. The population growth rate is 1.36 percent per annum (BBS, 2020) which causes the decreases of farm size in a horrid manner. The extra population is a threat to the total production.

Rice is a prime supply of subsistence of rural populations in maximum Asian nations. There are approximately four billion humans eating over ninety percent of the sector's rice production. Rice changed into selected as the subject within the gift examine due to its outstanding function within the country wide financial system of Bangladesh. The proportion of agricultural GDP in Bangladesh now 13.6 percent (BER, 2020). About 80 percent of total cultivable land is diverted to rice production (McIntire, 1998). Since 1999-2000, boro rice has contributed to more than half of the total rice production in Bangladesh. From 1980's to 2018's,

the production of Boro has increased from 19 to 48 percent while the production of Aus and Aman being decreased from 25 to 7 percent and from 56 to 45 percent, respectively (Ahmed, 2004)). Currently Boro occupies about 41 percent of total rice area and contributes to some 56 percent share of total rice production in Bangladesh. On the other hand, Aman occupies 50 percent of total rice land and contributes to some 38 percent of total production and while Aus taking about 9 percent of total rice area, contributing by 6 percent to rice production (Dev et al., 2009).

A rate of per hectare of low technical efficiency in the production of Modern Variety (MV) rice was observed in Bangladesh (Sharif and Dar, 1996). Given the importance of rice production, yet it is surprising that there have been only a few studies carried out on the efficiency of rice production in Bangladesh. Have farmers promoted their production efficiently along with the progress in available technologies? How have the policies undertaken by governments impacted rice production and a farmer's technical efficiency? These are some of the questions the present study partly sought to answer. Efficiency measures are important because of their vital role in productivity promotion. The efficiency of rice production has been of longstanding interest to the economists and policymakers in Asia because of the strong relationship between rice production and food security in the region (Richard et al., 2007). A number of studies have examined the productive efficiency in its domain of agricultural production (Travers and Ma, 1994; Fan et al., 1994; Wang et al., 1996a, 1996b; Xu and Jeffrey, 1998; Fan, 1999; Tian and Wan, 2000). Some impacts of the advanced techniques in rice production efficiency in developing countries have been touched upon (Bordey, 2004; Chengappa et al., 2003; and Khuda, 2005). In this context Stochastic Frontier approach has found its wide acceptance within the agricultural economics context (Battese and Coelli, 1992, 1995). Some literatures have focused on the Stochastic Frontier model with distributional assumptions by which efficiency

effects can be separated from stochastic elements in the model and for this reason a distributional assumption has to be made (Bauer, 1990). Stochastic Frontier analysis employs a composed error model in which inefficiencies are assumed to follow an asymmetric distribution, usually the half-normal, while random errors are assumed to follow a symmetric distribution, usually the standard normal (Aigner et al., 1977).

Table 1.1 Bangladesh: Boro, Aus and Aman Rice Area and Production Estimates

Variety	MY 2016/17		MY 2017/18		MY 2018/19	
	(Estimate)		(Estimate)		(Forecast)	
	Area	Production	Area	Production	Area	Production
	1,000 HA	1,000 MT	1,000 HA	1,000 MT	1,000 HA	1,000 MT
Boro	4,750	18,890	4,472	17,800	4,800	19,100
Aus	1,098	2,338	1,100	2,350	1,120	2,400
Aman	5,900	13,350	5,700	12,500	5,850	13,200
Total	11,748	34,578	11,272	32,650	11,770	34,700

Source: BBS, 2020

1.1.1 Area, Production and yield of Rice in Bangladesh

Rice is grown throughout the country except in the southeastern hilly areas. The agro climatic conditions of the country are suitable for growing rice year-round. Bangladesh ranks fourth among the rice producing countries in the world after China, India and Indonesia (FAO, 2017). Bangladesh agriculture is dominated by production of rice. There are three rice growing seasons in Bangladesh and these are Aus, Aman and Boro season. Aus are generally cultivated in July-August, Aman in December-January and Boro in March-May cropping season. About 75.0% of the total cropped area is devoted to rice cultivation. There are three rice crops grown in Bangladesh, namely Aus, Aman and Boro. Present statuses of different rice are discussed under the following headings.

1.1.2 Area of Aus crop

Total area under Aus crop has been estimated at 11.05 million hectares this year as compared to 10.75 million hectares in last year which is 2.82 % higher than that of last year. The total area of this year and the last year of Aus by variety are as follows (Table 1.2).

Table 1.2. Estimates of total area by type of Aus crop

Variety	2017-2018		2019-2019		Changes over previous year (%)
	Area		Area		
	(in acres)	(in hectares)	(in acres)	(in hectares)	
Local Aus	3,96,308	1,60,377	4,33,685	1,75,503	(+) 9.43
HYV Aus	22,60,276	9,14,684	22,97,691	9,29,825	(+) 1.66
Total Aus	26,56,584	10,75,061	27,31,376	11,05,328	(+) 2.82

Source: BBS, 2020

1.1.3 Yield rate of Aus crop

Average yield rate of 2018-2019 has been estimated at 2.511 metric tons per hectare which is 0.36 % lower than that of last year. Estimates of yield rates by varieties and combined average yield rate of all varieties are as follows (Table 1.3).

Table 1.3. Estimates of yield rates by type of Aus crop

Variety	2014-2015		2015-2016		Changes over previous year (%)
	Area		Area		
	(in acres)	(in hectares)	(in acres)	(in hectares)	
Local Aus	15.07	1.390	14.93	1.377	(-) 0.93
HYV Aus	29.47	2.719	29.54	2.725	(+) 0.22
Total Aus	27.33	2.520	27.22	2.511	(-) 0.36

Source: BBS, 2020

1.1.4 Production of Aus crop

Total Aus production of 2018-2019 has been estimated at 2.77 million metric tons as compared to 2.70 million metric tons in last year which is 2.43% higher. Estimates of production by varieties and combined total of Aus is as follows (Table 1.4).

Table 1.4. Estimates of production by type of Aus crop

Variety	**2017-2018**	**2018-2019**	**Changes over previous year (%)**
	Production (M. Ton)	Production (M. Ton)	
Local Aus	2,22,892	2,41,733	(+)8.45
HYV Aus	24,86,751	25,33,745	(+) 1.89
Total Aus	27,09,643	27,75,478	(+) 2.43

Source: BBS, 2020

1.1.5 Area of Aman crop

Total area under Aman crop has been estimated 1,38,92,398 acres 56,21,949 hectares this year (2018-19) as compared to 1,40,34,504 acres 56,79,456 hectares of last Year (2017-18). The harvested area has decreased 1.01% by this Year. Comparative area estimates are shown below (Table 1.5):

Table 1.5. Estimates of total area by type of Aman crop

Variety	**2017-2018**		**2018-2019**		Changes over previous year (%)
	Area		**Area**		
	(in acres)	(in hectares)	(in acres)	(in hectares)	
Broadcast Aman	9.03,078	3,65,456	8,37,169	3,38,784	(-) 7.29
Local Transplant Aman	23,13,473	9,36,212	21,55,120	8,72,130	(-) 6.84
HYV Aman	1,08,17.952	43,77,788	1,09,00,108	44,11,035	(+) 0.76
Total Aman	1,40,34,504	56,79,456	1,38,92,398	56,21,949	(-) 1.01

Source: BBS, 2020

1.1.6 Production of Aman crop

Average yield rate of Aman for the financial Year 2018-19 has been estimated 2.500 metric tons per hectare which is 1.46% higher than that of last Year 2017-18. Comparative estimates of Aman production are shown below (Table 1.6).

Table 1.6. Estimates of production by type of Aman (husked) crop

Variety	**2017-2018**		**2018-2019**		Changes over previous year (%)
	Area		**Area**		
	(in acres)	(in hectares)	(in acres)	(in hectares)	
Broadcast Aman	13.12	1.210	12.82	1.183	(-) 2.23
Local Transplant Aman	15.52	1.432	15.76	1.454	(+) 1-53
HYV Aman	30.24	2.789	30.44	2.808	(+) 0.68
Total Aman	26.71	2.464	27.10	2.500	(+) 1.46

Source: BBS, 2020

1.1.7 Production of Aman crop

Total Aman production of Financial Year 2018-19 has been estimated 1,40,54,872 metric tons compared to 1,39,92,874 metric tons of financial Year 2017-18 which is 0.44% higher. Comparative estimates of Aman production are shown below (Table 1.7).

Table 1.7. Estimates of production by type of Aman (husked) crop

Variety	**2017-2018**	**2018-2019**	Changes over previous year (%)
	Production (M. Ton)	**Production (M. Ton)**	
Broadcast Aman	4,42,201	4,00,722	(-) 9.38
Local Transplant Aman	13,40,511	12,67,655	(-) 5.43
HYV Aman	1,22,10,162	1,23,86,495	(+) 1.44
Total Aman	1,39,92,874	1,40,54,872	(+) 0.44

Source: BBS, 2020

1.1.8 Area of Boro crop

Total area under Boro crop has been estimated at 1.18,32,309 acres (47, 88, 276 hectares) in this year (2018-19) as compared to 120, 07, 983 acres (48, 59, 367 hectares) of the last year (201718). The harvested area has decreased by 1.46 % this year. Comparative area estimates are shown below (Table 1.8).

Table 1.8. Estimates of total area by type of Boro crop

Variety	**2017-2018**		**2018-2019**		Changes over previous year (%)
	Area		**Area**		
	(in acres)	(in hectares)	(in acres)	(in hectares)	
Local Boro	80,262	32,480	1,12,021	45,332	(+)39.57%
HYV Boro	99,92,250	40,89,542	99,91,968	40,43,531	(-)3.80%
Hybrid Boro	19,35,471	7,83,242	21,07,983	8,53,055	(+)8.91%
Total Boro	1,20,07,993	48,59,367	1,18,32,309	47,88,276	(-)1.46%

Source: BBS, 2020

1.1.9 Yield rate of Boro rice

Average yield rate of Boro in Financial Year 2018-19 has been estimated 4.0851 metric tons rice per hectare which was 4.028 metric tons per hectare in 2017-18. Comparison of estimated yield rates of Boro is shown below (Table 1.9).

Table 1.9. Estimates of yield rate by type of Boro crop

Variety	**2017-2018**		**2018-2019**		Changes over previous year (%)
	Area		**Area**		
	(in acres)	(in hectares)	(in acres)	(in hectares)	
Local Boro	20.81	1.919	20.28	1.870	(-)2.565%
HYV Boro	42.46	3.916	42.82	3.950	(+)0.862%
Hybrid Boro	50.91	4.696	52.25	4.820	(+)2.626%
Total Boro	43.67	4.028	44.29	4.085	(+)1.406%

Source: BBS, 2020

1.1.10 Production area of Boro rice

Total boro production of Financial Year 2018-19 has been estimated at 195,60,546 metric tons compared to 195,75,819 metric tons of Financial Year 2017-18 which is 0.078 % lower. Comparative estimates of Boro production are shown below (Table 1.10):

Table 1.10. Estimates of production by type of Boro (Husked) crop

Variety	2017-2018	2018-2019	Changes over previous year (%)
	Production (M. Tons)	Production (M. Tons)	
Local Boro	62,343	84,779	(+) 35.989 %
HYV Boro	158,35,103	153,64,347	(-)2.973 %
Hybrid Boro	36,78,373	32,38,915	(+) 11 .773 %
Total Boro	195,75,819	195,60,546	(-) 0.078 %

Source: BBS, 2020

1.1.11 Year wise Growth Rate of Rice Production in Bangladesh

Table 1.11 showed that total rice production in Bangladesh 2005-06 was 2,65,30,300 ton and growth rate was 5.46 and total production 2017-18 was 3,62,79,300 and growth rate was 6.08. In 2017-18 growth rate was positive but growth rate negative in 2016-17.

Table 1.11. Year wise growth rate of rice production (ton) in Bangladesh

Year	Production	Growth rate
2005-06	2,65,30,300	5.46
2006-07	2,73,18,000	2.97
2007-08	2,89,31,000	5.9
2008-09	3,13,17,000	8.25
2009-10	3,19,75,000	2.1
2010-11	3,35,40,320	4.9
2011-12	3,39,14,000	1.11
2012-13	3,38,33,000	-0.24
2013-14	3,43,56,300	1.55
2014-15	3,48,61,200	1.47
2015-16	3,50,60,500	0.57
2016-17	3,42,01,500	-2.45
2017-18	3,62,79,300	6.08

Source: BBS, 2020

1.2 Significance of the Study

Agriculture is the single leading producing sector of the economy and it contributes about 13.35% to the total Gross Domestic Product (GDP) of Bangladesh. Agriculture is the main income source of most of the people who are living in rural areas. The total export value of agricultural product is 7.01% of total export of Bangladesh (Bangladesh Economic Review, 2019). The general price levels of other food and non-food commodities are related to rice price. Income of farmers and their food security depends on rice price, so changes in price of rice are highly sensitive to the lower and middle classes of consumers those who live below or on the poverty level. Rice price fluctuates and changes throughout the year due to various reasons. From the beginning of production process, there are a large number of value adding steps associated with rice production and marketing. The marketing of rice and also its bi-products i.e. broken rice, husk, bran etc. increases due to adding values at each steps of its marketing.

1.3 Justification of the Study

Rice is the maximum essential cereal crop in phrases of place of production contribution to the countrywide profits and countrywide financial development good sized place is dedicated to rice manufacturing and tens of millions of farmers had been growing rice in this country. Despite the reality that rice is cultivated substantially in Bangladesh, consistent with hectare yield is tons lower in assessment with that of different rice developing countries of the world. In order to satisfy this deficit, yield according to unit place of rice have to be increased. The range of landless laborers, disguised and unemployed population is growing progressively. Therefore, it is vital to produce food grain to meet meals necessities for the increased population.

Bangladesh is the ninth most populous country in the world. The Government of Bangladesh has given an excessive amount of emphasis on paddy production.

Then each year Bangladesh imports rice. In 2016 Bangladesh has imported 50 lots of rice. Bangladesh soil is suitable for producing rice. In the beyond a few studies were made on the profitability of rice in Bangladesh. But there is no exclusive study on the profitability of rice particularly in the Norail district. As such it was felt that a study on the rice in the area Norail district would be of much importance. This is obviously due to the fact that development basically means larger size productive activities in the economy. But we cannot have more of production unless the goods produced are actually sold out and selling depends on the proper marketing conditions. Besides, the results also would serve as a reference for researchers to embark upon similar or related work in other parts of the country. Some arguments supporting the importance of this study are presented below:

- Firstly, the study helps to know about the socio-economic condition of the farmers.
- Secondly, it is very much important to know about production of rice in the study area and analysis of production cost and margins of the farmers. It helps to identify the different cost items, the share of different cost items to total marketing cost.

- Fourthly, it is important to know the marketing costs and marketing margins of intermediaries. It helps to identify the different cost items, the share of different cost items to total marketing cost. Also, it helps to identify who are the most bearer of marketing cost, the level of marketing margin and net margin of market functionaries. Since all of these costs and margins indeed influence the market participants in participating in the markets. So, this study will give some shed in this line.

- Finally, problems of farmers and solutions and recommendations are important for government officials, non-government organizations and policy makers to formulate effective marketing policy for efficient rice production and marketing. This study will help in this regard.

The study would provide useful information to the producers, traders, consumers, future researcher and planners of this rice. This study has been conducted on profitability analysis which has important policy implications for farmer, and the policy makers in Bangladesh.

1.4 Objectives of the Study

The broad objective of the study is the Profitability of rice in Norail district in Bangladesh. The specific objectives of the study are as follows:

- ✓ To identify the major socio-economic characteristics of boro rice farmers;
- ✓ To assess the profitability of boro rice production farmers;
- ✓ To estimate the contribution of key inputs to the production processes of boro rice production;
- ✓ To identify problem faced by the farmers in boro rice production.

1.5 Limitation of the Study

During the period of data collection, the following problems were encountered by the author:

i. Most of the respondents were now not well educated. They had no preceding idea approximately such an examine. They have been suspicious about the researcher and therefore did not cooperate and it became consequently hard to provide an explanation for the cause of

this research to convince them. At last, the respondents were convinced.

ii. Most of the farmers have been afraid of imposition of taxes. Their tension become that the researcher might use the statistics in opposition to their interest.

iii. The respondents (farmers and intermediaries) did not keep records of their farming business and business activities; they had difficulty in recalling information. It was an added problem to the researcher to collect the reliable data because most of the fanners provided information from their memory.

iv. Sometimes the producer-respondents have been no longer available at their home because they remained busy with their outdoor work. This is why some times greater than two visits have been required to get data from them. So, the author had to give more time and effort to acquire the information.

v. The respondents continually had a tendency not to offer correct information regarding the scale in their preserving, profits and expenditure received from special tasks. Because maximum of the respondents within the have a look at location thought that the investigator was a government officer. They to start with hesitated to reply the question regarding their earnings and expenditure. The respondent's notion that new taxes would be imposed on them if accurate records was furnished. When they understood then they gave applicable information.

vi. Farmers furnished statistics in local devices of measures in reaction to questions which created complexity in analyzing the information.

vii. There changed into a time issue so all information and different important statistics was amassed within the shortest possible time.

1.6 Organization of the Study

The study has been organized into six chapters. Chapter 1 indicates the introduction of the research along with the objectives and justification. In Chapter 2 review of literature is presented and methodology is described in Chapter 3. Socio-economic characteristics of the rice farmers described in Chapter 4, Profitability of rice cultivation are presented in Chapter 5, factors affecting of rice cultivation are presented in Chapter 6, problems and solutions of farmers are presented are presented in Chapter 7 and finally Chapter 8 present the summary of the major findings of the study and concluding remarks.

CHAPTER II
REVIEW OF LITERATURE

The main purpose of this Chapter is to review some related studies in connection with the present study. Although a lot of studies have been done on costs and returns of rice production in Bangladesh, only a few studies have so far conducted related to economic analysis of rice production under different area. This study highlights only a few of the studies, which are considered recent and very relevant to this research. Again, some of these studies may not entirely relevant to the present study, but their findings, methodology of analysis and suggestions have a great influence on the present study and all of these studies have been conducted in Bangladesh, so it has great influence on the present study. Therefore, some of the literatures related to the present study are briefly discussed below:

Akter et al. (2019) conducted a study on factors determining the profitability of rice farming in Bangladesh. The finding of cost-benefit analysis reveals that rice farming is a profitable activity in Bangladesh as the estimated cost of production was lower than the return in the selected study areas. However, the profitability differs among different farmers' group and large farmers are more profitable in rice cultivation than small and medium farmers. In addition, the functional analysis identifies three inputs such as the cost of power tiller, fertilizer and hired labor as the significant determinants of profitability for all farmers in the study regions. Moreover, these factors also differ across the farmer's groups except the cost of fertilizer.

Sujan et al. (2017) conducted a study on financial profitability and resource use efficiency of boro rice cultivation in some selected area of Bangladesh. Result based on Farm Budgeting model showed that per hectare variable cost and total cost of production was BDT (Bangladeshi Taka) 57,583 and BDT 71,208,

respectively. Average yield was found 4.112 ton which was more than the previous year's national average yield of 3.965 ton. The average gross return, gross margin, and net return were BDT 86,548, BDT 28,965 and BDT 15,340, respectively. Benefit-Cost ratio (BCR) was found 1.22 and 1.50 on full cost and variable cost basis. Cobb-Douglas production function analysis showed that the key production factors, that is, human labour, irrigation, insecticide, seed and fertilizer had statistically significant effect on yield. MVP and MFC ratio analysis showed that growers allocated most of their resources in the rational stage of production.

Islam et al. (2017) conducted a study on profitability and productivity of rice production in selected coastal area of Satkhira district in Bangladesh. 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.

Parasar et al. (2016) conducted a study on "resource use efficiency in rice production under SRI and conventional method in Assam, India." To meet the rising demand for rice, the staple food in Assam, the production of rice has to be increased by many folds. Considering the shrinkage of agricultural lands, productivity increase is the only way out to increase the production. System of Rice Intensification (SRI) is reported to enhance rice yield to considerable extent. However, the acceptability of the method by the tradition rice growers of the state is a matter of concern. Further, the resource use status of SRI is yet to be studied systematically in Assam. The present study on resource use in SRI has shown that the resources used in SRI need to be increased for enhanced rice production the state.

Toma et al. (2015) conducted a study on financial profitability of aromatic rice production in some selected areas of Bangladesh. 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.

Long (2015) conducted a study on "Comparative analysis of resource use efficiency between organic rice and conventional rice production in Mekong Delta of Vietnam. The efficiency with which farmers use available resources is very important in agricultural production. The study was conducted to measure and compare resource use efficiency and relative productivity of farming under Organic rice and Conventional rice production in Mekong Delta of Vietnam. One hundred twenty randomly selected farms, 60 from each system, were surveyed. The study explored differences in efficiency and productivity between production systems. Cobb-Douglas production function analysis was used to calibrate resource use efficiency. The results showed that the regression coefficients of expenditure on seed, organic manure and bio-fertilizers in Organic rice cultivation, and expenditure on herbicide and machine labor in Conventional rice cultivation were significant. The efficiency was greater than one for seed, organic manure, machine labor and bio-fertilizer for Organic rice production. In conventional rice production, herbicide and machine labor were underutilized resources. The results suggested that the quantity of these resources was used less than optimum and there exists further scope for increased use of these resources. Other resources were over utilized, such as human labor and bio-pesticide in organic rice production, and seed, chemical fertilizer, pesticide and human labor in conventional rice production.

Devi and Singh (2014) analyze “Resource use and technical efficiency of rice production in Manipur.” Rice is regarded as the first cultivated crop in Asia as well as important food crop of India. The cost and return structure and technical efficiency in rice production has been reported in different regions as well as in the state of Manipur to show different regions have adopted the latest technology. Primary data have been collected from the sample rice farms with the help of pre-tested scheduled through personal interview with respondent farmers. Technical efficiency of individual farms has been estimated through stochastic production function analysis. The total cost of cultivation on small farms was much higher than the large farms. Imputed rental value for owned land was the major cost items for all the farms. On an average majority (40%) of the rice growing farmers were operating at the technical efficiency level of (99-100) % in relation to frontier output level. Gross return as well as net return per hectare have been observed to be highest for category I followed by category II. Most of the farms have been observed to be potential to expand production and productivity, increasing technical efficiency as majority has been performing with increasing returns to scale.

Chowdhury et al. (2013) investigated the “Efficiency of Rice Farms during Boro Period in Bangladesh: An Econometric Approach”. They was focusing to achieve the target by improving the efficiency of the farmers. Modern econometric tools, like Stochastic Frontier Approach (SFA) were used for measuring the efficiencies of the farmers. Empirical results of this study shows that average technical, allocative and economic efficiency of the farmers during Boro period were 86 per cent, 75 per cent and 64 per cent respectively.

Nasrin et al. (2011) conducted a study on “Land Tenure System and Agricultural Productivity in a Selected Area of Bangladesh”. They examine relative efficiency of farming under tenancy systems in some selected areas of Mymensingh district.

They were found that share tenant farmers earned significantly lower net return (Tk. 19,252.18) than the cash tenant farmers (Tk. 22,815.89) from Boro rice production and Boro rice production was profitable from the viewpoint of both tenant operators. They also showed that all the explanatory variables (key production inputs) included in the Cobb- Douglas revenue type production function model were important for explaining the variations in gross returns under both tenancy arrangements.

Wadud et al. (2011) conducted a study on Profit Efficiency and Farm Characteristics Evidence from the Rice Farmers in Bangladesh. They examine profit efficiency of rice farmers in some selected district of Bangladesh. From the study they found that estimated profit frontier revealed negative elasticity of price of fertilizers and positive elasticity of wage rates, price of seeds and area of land cultivated. The mean profit efficiency was 69%.

Sarker et al. (2010) conducted a study on comparative economic analysis of borrower & non borrower Boro rice farmers in some selected sites of Mymensingh district. They selected one hundred samples from four villages under Trishall upazila. This study has been conducted to examine the differences in input use, costs & returns of the borrower & non borrower rice farmers. They were found that borrower farmers used more inputs &attained more returns through higher yield than their counterparts. The yields of rice per hector were 5260.80kg & 422177.34kg for the borrower and non-borrower farmers respectively. They also found that borrower farmer's net return and gross return are higher than non-borrower farmers.

Majumder et al. (2009) investigated the productivity & Resource use efficiency of Boro rice production in Bhola district under different tenure conditions. They showed the difference in the efficiency & productivity among owner, cash tenant

& crop share tenant. The total samples in the study were 90 & random sampling technique was used for this study. They found that total gross costs for producing Boro rice was highest in owner farms& lowest in crop share tenants farm because owner operator used more hired labor in compare to other groups. However, the cash tenant farmers were more efficient than crop share tenant farmers because crop share tenant used poor resource and they are unable to invest modern farm inputs. They also mentioned that in Bangladesh the predominant tenancy arrangement share cropping is an inefficient form of tenure arrangement in compare to cash tenancy.

Akanda et al. (2008) conducted a study on Problem of Share crop Tenancy System in Rice Farming in Sherpur district of Bangladesh. The 1984 Land Reform Act in Bangladesh fixed land rent for sharecropping tenants at 33% of harvest yield without input sharing and at 50% with 50% of input sharing. This positively influenced expansion of HYV rice farming. However, the returns for tenants fell over time because of a gradual increase in input prices and wages. This research analyzed the present distribution of returns in the dominant rice farming area in Bangladesh. There was semi feudalism in the tenancy market with landowners earning more from sharecropping than they could from cash renting. Land-rich farmers often cultivated only a small part of their cultivable land and rented out most of it. The existing economic structure did not fairly balance the returns between tenants and landowners. This study suggested the need to reset the land rent at 20% of harvest yield without input sharing and at 40% with input sharing, to protect land-poor tenants.

Arif (2008) conducted a research proposal about comparative profitability and technical efficiency of aromatic BRRI34 and non-aromatic BR11 rice varieties which are transplanted at two contiguous upazilas of dinajpur district. The study reveals that the yield of BRRI dhan34 is found lower than that of BR11 rice. But

gross return of BRRIdhan34 is much higher (Tk.82467/ha) than that of BR11 (Tk.66455/ha) rice. Gross margin was also found higher for BRRIdhan 34 (Tk.58869/ha) than by BR11 rice (Tk.39013/ha) return over per taka investment (BCR) were Tk. 1.87 and Tk. 1.37 for BRRI dhan 34 and BR11 rice.

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

Iqbal (2005) conducted a study on Cost Requirements for Cultivation of Boro Rice (Oriza Sativa) Under Different Farming System at four villages in Mymensingh district of Bangladesh. He considered 25 farmers and 57 plots for this study. After interviewing farmers on specially designed & pre-tested questionnaire, he found that input cost per hectare varied from Tk. 14877 to 18145 and output varied from Tk. 25101 to 31647, respectively under different farmers categories. The benefit cost ratio found in landless, marginal, small, medium & large categories of farmers were 1.87, 1.4, 1.83 and 1.64 respectively. The average total input & output costs per hectare in DA, PT and mixed farming method were Tk. 16855, 15750, 16924 and Tk. 26525, 29400, 27434 respectively.

Barman (2004) attempted to assess the impact of rice-prawn gher farming on land tenure system in southwest Bangladesh. Findings of the study showed that the land tenure systems were changed after the introduction of rice–prawn gher farming system from traditional sharecropping system to fixed rent. Natural risks, calamities and uncertain yield of prawn were the main factors that enforced the land tenure system to change from sharecropping to fixed rent. The amount of rent paid was usually determined by several factors including the location of the land, size and quality of gher farm and the relationship between the landlord and the tenant.

Rahman et al. (2002) studied the technical efficiencies obtained by owner-operated farming and share cropping using Cobb-Douglass Stochastic production function. Mean technical efficiencies obtained by owner operators for Boro, Aus and Aman rice crops were 86 per cent, 93 per cent and 80 per cent respectively whereas mean technical efficiencies obtained by share croppers for Boro, and Aman rice respectively 73 percent and 72 percent. The study reveals that owner-operators were technically more efficient than share croppers in the production of all rice crops. To reduce the difference of technical efficiencies between owner operator and share cropper a perfect share leasing system is inevitable.

Zaman (2002) showed a comparative analysis of resource productivity and adoption of modern technology under owner and tenant farms in a selected area of Dinajpur District. It was found that total cash expenses as well as total gross cost for producing HYV Boro rice were the highest in owner farms and the lowest in tenant farms. Owner operators used more hired labor where tenant operators used more family labor. The maximum return over total cost per hectare was obtained by owner operators and minimum by tenant operators and owner operators were more efficient than tenant operators. It was also found that the degree of adequacy

level in the application of modern farm inputs were higher in owner farms than in tenant farms.

Panda (1996) conducted a study on agricultural tenancy and resource use efficiency. For his analysis he selected two types of villages, Modern Developed Village and Less Developed Village. He found three types of tenurial categories such as the owner operators, owner-cum-tenant operators and tenant operators, from selected villages. The study showed a wide difference in cropping pattern as well as crop yield across village categories. Owner-cum-tenant operators were placed in a better position compared to owner operators and pure tenants. The study finally indicated limited impact of land-ownership on resource use and crop productivity.

Rahman et al. (1993) investigated input use efficiency and productivity of different sizes of farms producing HYV Boro in some selected areas of Brahmanbaria district. Returns to scale and farmers capability of producing at the least cost level were statistically tested. Farm size and productivity relationships were found to be positive. Boro production characterized by increasing returns to scale only for the medium farms. Few inputs were used in Boro production at the least cost combined level. Adequate extension services including application of right quantity of inputs at right time were suggested to achieve efficiency in input use and improving level of profitability.

Islam et al. (1990) examined the impact of tenancy on inputs used and their productivity. They found that the majority of pure tenant farmers reported that 50 percent of the cost of inputs like seeds, fertilizers, insecticides but none for bullock, irrigation and labor were shared by the land owners, while the majority of the owner cum-sharecroppers reported that no cost of inputs were share by the land lords. The pure owner farmers used fertilizer at higher rate followed by

owner-cum share croppers and pure tenant farmers. Finally, it was observed that overall productivity in pure tenant farms were a bit higher as compared to that of pure owner farms.

Hossain (1989) reported about Green Revolution in Bangladesh and observed that in Bangladesh small farmers and tenants had adopted the modern technology at least as much as have large farmers and owner cultivators. The average cost of working capital must be also higher for the small farmers. He also observed that the variation in the prices of agricultural inputs would thus put a negative pressure on income distribution, which might out weight the effect of the inverse relationship between farm size and adoption rates.

Bhuiyan (1987) conducted a survey at some selected villages of Trishal Upazila in Mymensingh for studying the effects of different farm sizes under different tenurial arrangements on production efficiency. He found that the medium farms (0.75 to 2.0 ha) achieved the highest efficiency followed by small farms (below 0.75 ha) and large farms (above 2.0 ha). He also found that production efficiency was higher on owned land than on rented in land.

Talukder (1980) investigated the relative efficiency of the alternative forms of land tenure in irrigated Boro rice production. He found that owner tenant farms obtained the highest yield, gross and net return per acre while yield of crop, gross and net return per acre were the lowest for the pure tenant farms. He also stated that tenant's labor had no price to the landlords similarly landowner's land had no price to the tenants. As a result in the case of owner-cum-tenant farms farmers obtained significantly higher yield on own land than on rented in land.

Jabbar (1977) examined the relative productive efficiency of different tenure classes in the selected areas of Bangladesh. He analyzed the performance of four

tenure classes namely part operators, owner operators, owner-cum-tenants and tenants. He found that of the four tenure classes owner operators were the most efficient. For the relative inefficiency of other tenure classes including share-croppers, he implied that the existing pattern of resource ownership and property relations were improper for obtaining higher level of efficiency.

Conclusion

From the summary of the above studies, it is clear that few of the previous studies conducted in Bangladesh focused on various aspects, but no studies were accomplished in this study area. A number of researchers explained their opinions on their own viewpoint. It should be noted here that such a study like profitability of rice production is a new and important study and no systematic research has yet been carried out in this manner. As a result, no exact literature on similar study could be found. The present study is designed to measure the profitability of rice production in the selected areas of Norail district in Bangladesh.

CHAPTER HI
RESEARCH METHODOLOGY

This Chapter deals with the tools and techniques used for collecting the necessary information of this study. It also addresses the methodology through which the collected data were categorized and analyzed in order to achieve the objective of the study. The design of research involved in the present study has been described in this Chapter.

3.1 Selection of the Study Area

The area where the many varieties of rice has been grown successful was considered as the study area. The area in which a business survey is to be carried out depends on the particular purpose of the survey and the possible cooperation from the farmer. Norail district was purposively selected for the study because of the fact that it is one of the leading rice producing areas of Bangladesh.

The researcher had an easy access to this area, on the other hand, the following considerations were kept in mind for selecting Norail district as a study area.

a. There were a large number of rice growers in that particular area.
b. About 85 percent of the total farmers of the selected area were involved in rice production.
c. The locality has easy accessibility and communication facilities.
d. It is less prone to natural calamities.
e. No related study was conducted in the past.

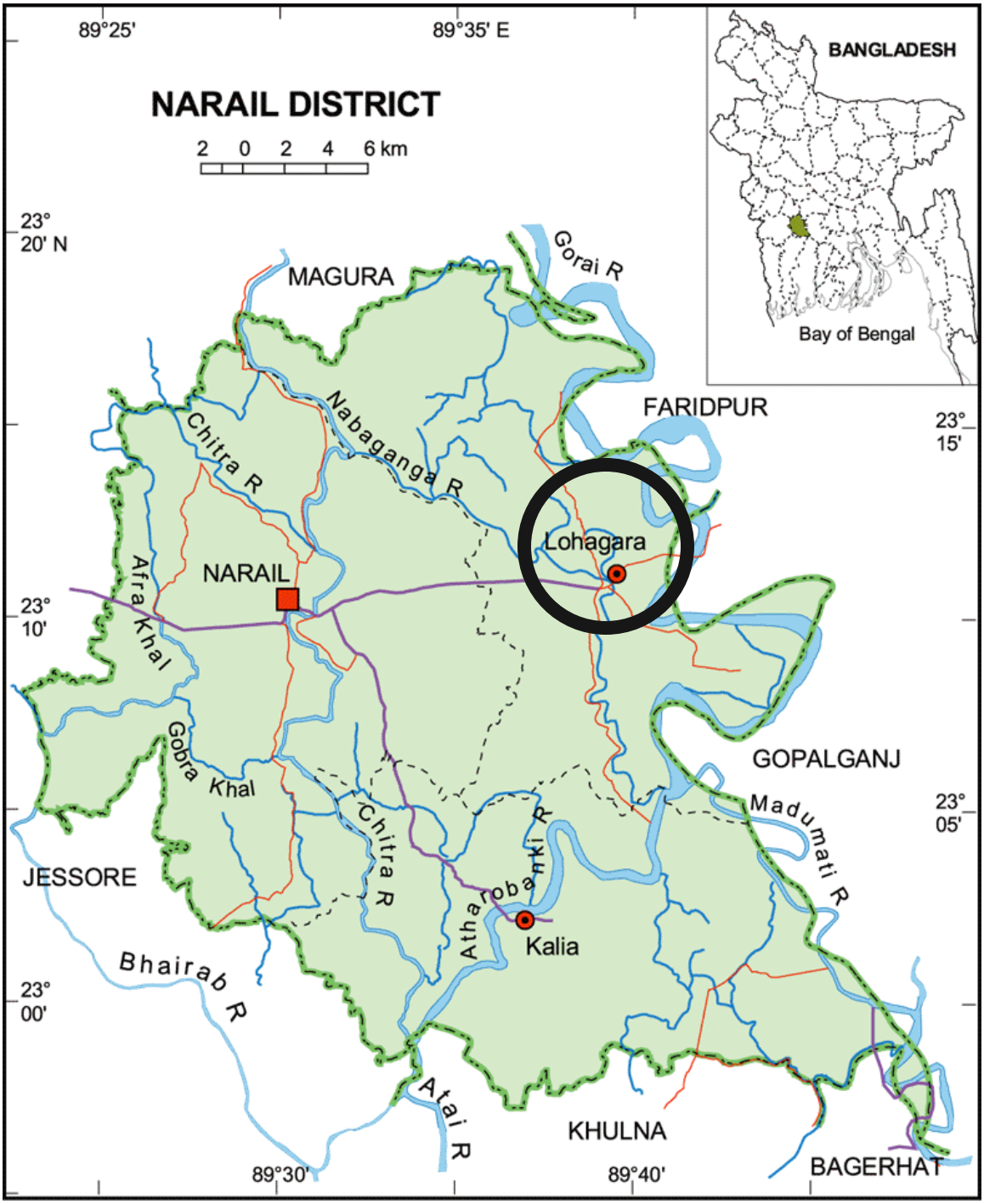


Figure 3.1 Map of Narail district showing Lohagara upazila

Figure 3.2 Map of Lohagara upazila showing the study areas

3.2 Sampling Technique and Data Collection Procedure

There are different types of sampling techniques depending on the nature of population, objectives of the study and degree of precision desired. Data collection procedures are the activities involved in collecting the desired data from the sample. The desired data can be collected through the interview schedule, questionnaire and direct observation. The following sampling techniques and data collection procedures were followed for the present study.

3.3 Sampling Technique

All the rice growers in Norail district were not possible to include in this study because of the paucity of resources and time constraint. A reasonable sample survey, which would represent the population was required in order to meet up the purpose of the study. Simple random sampling technique was adopted in this study. After purposively selecting Norail district, Lohagara upazila was selected randomly from 3 upazilas. Subsequently, three villages from one union also selected randomly namely, Khasipur, Nowkhala and Bathasi were also selected randomly. Therefore, a list of rice producers was constructed with the help of village leaders and field level extension personnel. After preparing the sampling frame ninety-five farmers were selected randomly for primary data collection.

Table 3.1 Distribution of selected sample households in the study areas

Upazila	Unions	Villages	Sample size
Lohagra	Shalnagar	Khasipur	30
		Nowkhala	35
		Batashi	30
Total			**95**

3.4 Preparation of the Interview Schedule

In conformity with the objectives of the study, a preliminary interview schedule was designed in an effort to collect the data from the farmers. It was then 10 pre-tested to verify the relevance of the questions and the nature of responses of the farmers. After pre testing of the questionnaire necessary modifications were made in consultation with the relevant experts.

The interview schedule contained the following items:

i. Socioeconomic characteristics of the growers
ii. Cost and return of rice cultivation
iii. Agronomic practices operated in the rice plot
iv. Problems and constraints faced by the growers
v. Suggestion with respect to the problems faced by the rice farmers.

3. 5 Study and Survey Period

The data were collected through survey during the entire rice growing season precisely from January, 2020 to February, 2020.

3.6 Method of Data Collection

For the present study, data were collected through personal interviewing of the rice growers. Interviews were mainly conducted at the leisure of the farmers with a view to keeping them undisturbed and securing accurate information. Before going to administer the interview, the respondents were made clear about the purpose and objectives of the study. It was explained to the farmers that the study was purely academic. Each time when every interview was completed, the interview schedule was thoroughly checked and properly recorded. If there were such items, which were overlooked or contradictory, they were amended accordingly to suit the purpose. In addition to survey, observation method was also applied to collect information by the researcher. It is better to mention that some

items were recorded initially in local units and finally convened those into standard units while processing data.

3.7 Problems Faced by the Researcher in Data Collection

There were some problems faced by the researcher during the period of data collection. The problems which are enlisted below:

1. Although most of the farmers in the study area were literate, they did not have adequate knowledge on the value of a research study and it was therefore, really difficult to convince them as to the utility of this research.
2. The farmers were afraid of imposition of taxes and because of that they always tried to avoid providing authentic information relating to the actual size of holding and annual income.
3. The farmers were not available at their home because they often remained busy dealing with farm activities in the field, thus sometimes; two or three visits were made for a single interview which was really very time consuming and costly as well.
4. Sometimes it was observed that the farmers would try to reply quickly to the questions in order to get rid of researcher somehow or anything like this.
5. The researcher had to depend solely on the memory of the farmers for collecting data because they did not care to keep any written records for their farm business.

3.8 Profitability Analysis

The primary and ultimate goal of a farm is profit maximization. Some of the other goals are attaining a particular output level or business size; reserving a certain amount of time for leisure activities; business growth; business survival; and maintaining a stable income over time (Kay, 1981). As most farms try to receive maximum profit in a perfectly competitive market situation, conditions responsible

for maximum profit were given emphasis in the present study. Profit or net return is the difference between total revenue (gross return) i.e. total value product (TVP) and the total factor cost (TFC). TFC included all kinds of variables and fixed costs concerned with the production process. A farm will not know its maximum profit unless the TVP is compared with TFC. Farmers' profit was also shown by gross margin (GM) analysis, where only variable costs were deducted from total revenue.

The TVP was the value of output and was given by

$TVP= py= p*TPP=g(y)* f(x_1) = g[f(x_1)]* f(x_1)$

Where,
p is the unit price of output; y is the quantity of output and x1 stands for ith input. On the other hand, total factor cost (TFC) of a product includes all kinds of variable and F fixed cost items involved in the production process; and was given by

Total factor cost. $TFC=rx_1 +b=h(x_1)*x_1 +h$

Where,
r is the factor price, which in general is a function of the quantity of the factor used i.e. r=h(xl)] and b is the fixed costs.

Given the definition of total value product (TVP) and total factor cost, the profit equation can be define as follows:
Profit, 7t = TVP-TFC
K =£[/(*,)]*/(*,) - [Kx,)* X ' + b]or,

The analytical procedure involves the arrangements of the collected data in systematic ways, costing of the input used, quantifying the effect of inputs on yield, etc.

The following analytical procedures were followed in the present study.

3.8.1 Processing and tabulation of data

The collected data were subsequently compiled, coded, edited, summarized and scrutinized carefully. The computer packages MS excel, SPSS were used for the data entry, aggregation and analysis.

3.8.2 Measurement of cost items

For any profitability analysis the costs incurred upon various inputs need to be analyzed. There are two types of cost i.e. variable and fixed cost. The variable costs are those which vary directly with the level of production. The fixed costs are those, which are to be borne even when no production is carried out. The costs were calculated on the basis of prices prevailed in the study area during the period of study. The cost items were specified as follows:

3.8.2.1 Cost of labor inputs

Any exertion of mind or body undergone partly or wholly with a view to some good other than the pleasure derived directly from it is called labor. So the cost, which was incurred upon any exertion of body or mind by both human and animal labor in rice production was considered.

3.8.2.2 Cost of material inputs

All inputs cost other than labor input costs were the material input cost for rice cultivation. The material inputs cost for rice cultivation were specified as shown below.

i) Cost of seed

In the study area most of the rice growers used home supplied seeds/ seedlings rather than from the market. The cost of home supplied seeds/seedlings was usually charged at the average market price. The costs of purchased seeds/ seedlings were calculated according to the payment made.

ii) Cost of manure

The rice growers used different types of manure namely cow dung, farm yard manure (FYM), compost etc. The cost of manure was calculated on the basis of actual price paid by the growers.

iii) Cost of fertilizers

The rice growers applied different types of fertilizer, namely urea, triple super phosphate (TSP), Muriate of potash (MoP), Gypsum and Zinc. The cost of fertilizers was calculated on the basis of actual price paid by the growers.

iv) Cost of pesticides

The farmers used different pesticides in producing rice. The costs of insecticides were computed on the basis of actual cost incurred per hectare of land in producing rice.

v) Land use cost

Value of the land was found to be different for different plots, depending on the location. Fertility and topography of the soil. Cost of land can be computed in different ways. The following three ways are mostly used

i) The rental value

ii) Interest on value of land, and

iii) Opportunity cost from the best alternative use.

Land was estimated for the cropping period at the rental value in the study area. For rice production, the cropping period considered was four months.

vi) Interest on operating capital

Interest on operating capital was computed taking into account all costs incurred upon the production of different crops. Hence interest was charged at the rate of 10 percent per annum and was estimated for 6 month period. The following formula was adopted:

$$\text{Interest on operating capital} = \frac{\text{(Operating capital X interest rate X time considered)}}{2}$$

3.9 Analytical Technique for Efficiency Estimation

Cobb-Douglas production function is the most widely used form for fitting agricultural production data, because of its mathematical properties, ease of interpretation and computational simplicity (Heady and Dillon, 1969). It is a homogeneous function that provides a scale factor enabling one to measure the return to scale and to interpret the elasticity coefficients with relative ease. It is also relatively easy to estimate because in logarithmic form it is linear and parsimonious (Beattie and Taylor, 1985). Thus, Cobb Douglas specification provides an adequate representation of the agricultural production technology.

3.9.1 Specification of the Cobb-Douglas Production Function

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

$$Y = aX_1{}^{b1}\, X_2{}^{b2}\, X_3{}^{b3}\, X_4{}^{b4}\, X_5{}^{b5}\, X_6{}^{b6}\, X_7{}^{b7}\, X_8{}^{b8}\, X_9{}^{b9}\, X_{10}{}^{b10} e^{ui}$$

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

$$\ln Y = \ln a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + b_7 \ln X_7 + b_8 \ln X_8 + b_9 \ln X_9 + b_{10} \ln X_{10} + U_i$$

Where,

Y= Gross income from year-round rice cultivation (Tk/ha);

X_1= Cost of land preparation (Tk/ha);

X_2= Cost of seed (Tk/ha);

X_3= Cost of irrigation (Tk/ha);

X_4= Cost of human labor (Tk/ha);

X_5= Cost of urea (Tk/ha);

X_6= Cost of TSP (Tk/ha);

X_7= Cost of gypsum (Tk/ha);

X_8= Cost of MoP (Tk/ha);

X_9= Cost of manure (Tk/ha);

X_{10}= Cost of pesticide (Tk/ha);

a= Intercept;

b_1…..b_{10}= Coefficient of the respective variable;

U_i= Error Term;

i= 1, 2,…….10.

3.10 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 rice production is calculated by the following way.

3.10.1 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 by- product.

3.10.2 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.

3.10.3 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 rice production farms in the study areas.

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

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

P_m = Per unit price of rice (Tk/kg);

Q_m = Total quantity of the rice production (kg/ha);

P_f = Per unit price of other relevant (Tk/kg);

Q_f = Total quantity of other relevant thing (kg/ha);

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

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

TFC = Total fixed cost (Tk) and

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

3.10.4 Undiscounted Benefit Cost Ratio (BCR)

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

$$BCR = \frac{\text{Total Return}}{\text{Total Cost}}$$

CHAPTER IV

SOCIO-DEMOGRAPHIC PROFILE OF RICE PRODUCING FARMERS

4.1 Introduction

This Chapter deals with the socioeconomic characteristics of the farmers. Socioeconomic characteristics of the farmers are important in profitability of rice cultivation. People differ from one another in many respects. Behavior of an individual is largely determined by his/her characteristics. There are numerous interrelated and constituent attributes that characterize an individual and profoundly influence development of his/her behavior and personality. It was, therefore, assumed that enterprise combination, consumption pattern, purchase pattern and employment patterns of different farm household would be influenced by their various characteristics.

4.1.1 Age distribution of farmers

Age of the farmers ranged from 17 to 72 years. All the variables were categorized on the basis of their possible scores except age was categorized based on the classification provided by the Ministry of Youth and Sports, Government of the People's Republic of Bangladesh. The distribution of the rice farmers according to their age is shown in Table 4.1.

Table 4.1 Distribution of the farmers according to their age

Age group (Years)	Farmers			
	Small	Medium	Large	All farmers
	Number (%)	Number (%)	Number (%)	Number (%)
23-35 years	3 (8.57)	17 (56.67)	15 (50)	35 (36.84)
36-50 years	25 (71.43)	12 (40)	13 (43.33)	50 (53.63)
Above 50 years	7 (20)	1 (3.3)	2 (6.67)	10 (10.53)
All age group	35 (100)	30 (100)	30 (100)	95 (100)

Source: Field Survey, 2020

Farmers were classified into three age groups: 23-35 years, 36-50 years and above 50 years. Out of 95 samples farmers of all categories, 53.63 percent belonged to the age group of 36-50 years, 36.84 percent 23-35 years and 10.53 percent was in above 50 years age group. On the other hand, out of 35 farmers of small farm categories, 571.43 percent belonged to the age group of 36-50 years, 8.57 percent 23-35 years and 20 percent were in the age group of above 50 years (Table 4.1). On the other hand, out of 30 farmers of medium farm categories, 56.67 percent belonged to the age group of 23-35 years, 40 percent 36-50 years and 3.3 percent were in the age group of above 50 years. On the other hand, out of 30 farmers of large farm categories, 50 percent belonged to the age group of 23-350 years, 43.33 percent 36-50 years and 6.67 percent were in the age group of above 50 years.

4.1.2 Education distribution of farmers

The education scores of the farmers ranged from 0 to 16. On the basis of their educational scores, the rice cultivars were classified into four categories, namely "illiterate (0-0.5), primary (1-5), secondary (6-10) and above secondary (above 10). This distribution of the farmers according to their education are shown in the Table 4.2.

Table 4.2 Distribution of the farmers according to their education

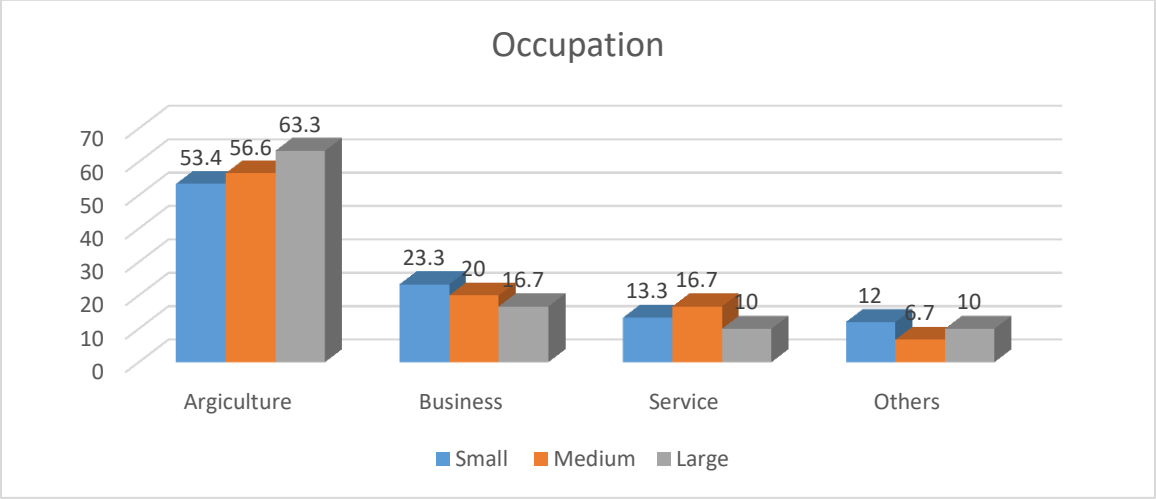
Education group (Classes)	**Farmers**			
	Small	Medium	Large	All farmers
	Number (%)	Number (%)	Number (%)	Number (%)
Illiterate (0-0.5)	4 (11.43)	8 (26.67)	10 (33.33)	22 (23.16)
Primary level (1-5)	12 (34.29)	4 (13.33)	3 (10)	19 (20)
Secondary level (6-10)	10 (28.57)	11 (36.67)	10 (33.33)	31 (32.63)
Above secondary level (>10)	9 (25.71)	7 (23.33)	7 (23.33)	23 (24.21)
All education group	35 (100)	30 (100)	30 (100)	95 (100)

Source: Field Survey, 2020

Table 4.2 shows the literacy levels of different categories of farmers. In the case of small farms, 34.293 percent of the farmers had primary level of education, 28.57 percent of the farmers had above secondary level of education, 25.71 percent of the farmers had above secondary level of education and 11.43 percent of the farmers had illiterate. In the case of medium farms. 26.67 percent of the farmers had secondary level of education, 36.67 percent of the farmers had secondary level of education, 23.33 percent of the farmers had above secondary level of education and 13.33 percent of the farmers had primary level of education. On the other hand, in the case of large farms, 33.33 percent of the farmers had illiterate and secondary level of education, 10 percent of the farmers had primary level of education and 23.33 percent of the farmers had above secondary level of education.

4.1.3 Occupation of the farmers

Family expenditure of the respondents varied from 1 to 4. The respondents were classified into the following four categories based on their occupation: (agriculture)", (business), (Service) and (others). The distribution of the farmers according to their occupation is shown in Figure 4.1.



Source: Field Survey, 2020

Figure 4.1 Distribution of the farmers according to their occupation

Figure 4.1 indicated that majority 53.4 percent of the small farmer's agriculture had their occupation, while 23.3 percent of the small farmers business had their occupation, 12 percent of the small farmers' others had their occupation and only 13.3 percent of the small farmer's service holder. The highest 56.6 percent of the medium farmers had agriculture their occupation, 23.3 percent of the medium famers had business their occupation, 16.7 percent of the medium famers had service their occupation. Data presented in the Figure 4.1 revealed that the highest 63.3% of the large farmers had agriculture compared to 16.7 percent of the large farmers having business their occupation and only 10 percent of the large farmers had service and others their occupation.

4.1.4 Family size

To describe the family size of the respondents, the category has been followed as represented by Poddar (2015). Family size scores of the farmers ranged from 2 to 9. According to family size, the respondents were classified into three categories as shown in Table 4.3.

Table 4.3 Distribution of the farmers according to their family size

Family size (Numbers)	**Farmers**			
	Small	Medium	Large	All farmers
	Number (%)	Number (%)	Number (%)	Number (%)
Small family (2-4)	24 (68.57)	23 (76.66)	22 (73.33)	69 (72.63)
Medium family (5-6)	10 (28.57)	5 (16.67)	4 (13.33)	19 (20)
Large family (above 6)	1 (3.3)	2 (6.67)	4 (13.33)	7 (7.37)
All family size group	35 (100)	30 (100)	30 (100)	95 (100)

Source: Field Survey, 2020

The Table 4.3 shows the average family size of the selected farmers under different farming systems. Out of 35 small farmers, 68.57 percent belonged to the small family of 2-4 members, 28.57 percent had 5-6 persons and 33.3 percent were in the large family size of above 6 persons. On the other hand, out of 30 medium farmers, 76.66 percent

belonged to the small family size of 2-4 persons, 16.67 percent had 4-6 persons and 6.67 percent were in the large family size of above 6 persons. On the other hand, out of 30 large farmers, 73.33 percent belonged to the small family size of 2-4 persons, 13.33 percent had 5-6 persons and 13.33 percent were in the large family size of above 6 persons.

4.1.5 Farm size

The farm size of the respondents varied from 0.27 to 5.91 hectares. The respondents were classified into three categories based on their farm size as followed by DAE (DAE, 1999): "small farm" (0.21 – 1.0 ha) and "medium farm" (1.0 -3.0). The distribution of the farmers according to their farm size is shown in Table 4.4.

Table 4.4 Distribution of the farmers according to their farm size

Farm size (Hectares)	Farmers	
	Number	Percent
Small farm (0.21-1.0 ha)	35	36.84
Medium farm (1.01-3.0 ha)	30	31.58
Large farm (above 3 ha)	30	31.58
All age group	95	100

Source: Field Survey, 2020

Table 4.4 indicated that the majority 36.84 percent of the farmers possessed small farms, 31.58 and 31.58 percent of them having medium farms and large farm size.

4.1.6 Annual family income

Annual income score of the respondents ranged from 20 to 562 (in thousands). On the basis of the observed scores, the respondents were classified into three categories as shown in Table 4.5.

Table 4.5 Distribution of the farmers according to their annual income

Income ('000' tk.)	Farmers			
	Small	Medium	Large	All farmers
	Number (%)	Number (%)	Number (%)	Number (%)
Low income (100-200)	23 (65.71)	25 (83.33)	24 (80)	72 (75.79)
Medium income (201-250)	9 (25.71)	3 (10)	2 (6.66)	14 (14.74)
High income (above 250)	3 (8.58)	2 (6.67)	4 (13.33)	9 (9.47)
All income group	35 (100)	30 (100)	30 (100)	95 (100)

Source: Field Survey, 2020

Table 4.5 indicated that the majority 65.71 percent of the small farmers had 100-200 thousand annual family income followed by 25.71 percent of the small farmers had 100-250 thousand annual family income and only 8.58 percent of the small farmers had above 250 thousand annual family income. About 83.33 of the medium farmers had 100-200 thousand annual family income, while 10 percent of them having 201-250 thousand annual family income and only 6.67 percent of the medium farmers had above 250 thousand annual family income. Data presented in the Table 4.6 revealed that the highest 80 percent of the large farmer's had 100-200 thousand income compared to 6.66 percent of the large farmers having 201-250 thousand annual family income and only 13.33 percent of the large farmers had above 250 thousand annual family income.

4.1.7 Credit received

Credit received score of the respondents ranged from 20 to 350 (in thousands. On the basis of the observed scores, the respondents were classified into three categories as shown in Table 4.6.

Table 4.6 Distribution of the farmers according to their credit received

Credit received (Scores)	Farmers			
	Small	Medium	Large	All farmers
	Number (%)	Number (%)	Number (%)	Number (%)
Bank (1)	9 (25.71)	3 (10)	10 (33.33)	22 (23.16)
NGOs (2)	15 (42.86)	9 (30)	11 (36.67)	35 (36.84)
Relatives (3)	6 (17.14)	11 (36.67)	5 (16.67)	22 (23.16)
Others (4)	5 (14.29)	7 (23.33)	4 (13.33)	16 (16.84)
All credit received group	35 (100)	30 (100)	30 (100)	95 (100)

Source: Field Survey, 2020

Table 4.6 indicated that majority 42.86 percent of the small farmers received credit from NGOs, while 25.71 percent of the small farmers received credit from bank, 17.14% credit received from relatives and only 14.29 percent of the small farmer's credit received from others sources. The highest 36.67 percent of the medium farmer's credit received from relatives, 30% of the medium farmers received credit from NGOs, 23.33% and 10 percent of the medium famers credit received from others and bank, respectively. Data presented in the Table revealed that the highest 36.67% of the large farmer's credit received from NGOs compared to 33.33 percent of the large farmers' credit received from bank, 16.67% and 13.33 percent of the large farmers credit received from relatives and others, respectively.

4.1.8 Training received

Credit received score of the respondents ranged from 20 to 350 (in thousands. On the basis of the observed scores, the respondents were classified into three categories as shown in Table 4.7.

Table 4.7 Distribution of the farmers according to their training received

Credit received (Scores)	Farmers			
	Small	Medium	Large	All farmers
	Number (%)	Number (%)	Number (%)	Number (%)
No training (0)	12 (34.29)	6 (20)	8 (26.67)	26 (27.37)
Low training (1-3)	4 (11.43)	4 (13.33)	3 (10)	11 (11.58)
Medium training (4-6)	5 (14.29)	20 (66.67)	15 (50)	40 (42.11)
High training (above 6)	14 (40)	0	4 (13.33)	18 (18.95)
All age group	35 (100)	30 (100)	30 (100)	95 (100)

Source: Field Survey, 2020

Table 4.7 indicated that the majority 40 percent of the small farmers had high training on rice cultivation, while 34.29 percent of the small farmers had no training, 11.43% and 14.29 percent of the small farmer's had low and medium training on rice cultivation. The highest 66.67 percent of the medium farmer's had medium training on rice cultivation, while 20% of the medium farmers had no training on rice cultivation, 13.33% and 0 percent of the medium famers had low and high training on rice cultivation, respectively. Data presented in the Table revealed that the highest 50% of the large farmers had medium training on rice cultivation compared to 26.67 percent of the large farmers had no training on rice cultivation, 10% and 13.33 percent of the large farmers had low and high training on rice cultivation, respectively.

4.1.9 Experience in rice cultivation

Experience rice ranged from 4 to 54. On the basis of their experience, the farmers were classified into the following three categories "low experience" (4-15), "medium experience" (16-30) and "high experience" (above 30). Table 4.8 contains the distribution of the farmers according to their experience.

Table 4.8 Distribution of farmers according to their experience rice cultivation

Categories (Years)	Farmers			
	Small	Medium	Large	All farmers
	Number (%)	Number (%)	Number (%)	Number (%)
Low (4-10)	7 (20)	8 (26.67)	6 (20)	21 (22.11)
Medium (11-20)	19 (54.29)	16 (53.33)	14 (46.67)	49 (51.58)
High (>20)	10 (28.57)	6 (20)	10 (33.33)	26 (27.37)
All age group	35 (100)	30 (100)	30 (100)	95 (100)

Source: Field Survey, 2020

Table 4.8 showed that the highest proportion 54.29 percent of the small farmers had 11-20 years of experience, while 28.57 percent of the small farmers had above 20 years' experience and 20 percent of the small farmers had 4-10 years' experience in rice cultivation. In case of medium farmers, the highest 53.33 of the farmers had 11-20 years' experience, whereas 26.67 percent of the farmers had 4-10 years' experience in rice cultivation and only 20 percent had above 20 years' experience. Again, the highest 46.67 percent of the large farmers had (11-20 years) experience, while 33.33 percent of the large farmers had above 20 years' experience and 20 percent of the large farmers had 4-10 years' experience in rice cultivation.

4.10 Conclusion

This Chapter discussed the socioeconomic characteristics of the rice farmers. The findings of discussion clearly indicate the socioeconomic characteristics from each other in respect of age, education, family size, experience in rice cultivation, occupation, annual family income, farm size, credit received and training received.

CHAPTER V
PROFITABILITY OF BORO RICE PRODUCTION

5.1 Introduction

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

5.2 Pattern of Input Use for Rice Cultivation

Farmers in the study areas used various inputs for rice cultivation. Farmers used on an average family labor was 37 man-days and hired labor was 162 man-days. On an average, they sowed 65 kg seed per hectare of farms. They applied at the rate of urea 163 kg/ha, TSP 94 kg/ha and MP 85 kg/ha. It was observed that among the chemical fertilizer, farmers used highest amount urea for the farms. In the study areas, farmers also applied gypsum (36 kg/ha) and manure 1117 kg/ha for rice cultivation.

Table 5.1 Level of input use per hectare of boro rice cultivation

Particulars	Farms				
	Small	Medium	Large	All farms	Price Tk./unit
Human labor (man-day)					
Family	42	33	36	37	400
Hired	59	62	65	62	400
Seed (kg)	65	63	67	65	60
Urea (kg)	150	165	174	163	20
TSP (kg)	90	93	99	94	27
MP (kg)	70	90	95	85	18
Manure (kg)	1100	1200	1051	1117	3
Gypsum (kg)	34	36	38	36	36

5.3 Profitability of Boro Rice Production

To determine the profitability and compare it among the rice production farmers the following costs and returns items were calculated.

5.3.1 Estimation of Cost

Costs are the expenses incurred in organizing and carrying out the production process. In the production process farmers used two categories of cost, variable cost and fixed cost. The variable costs of rice production include the cost of seed, animal and power tiller cost for land preparation, fertilizer, manure, irrigation and pesticide. In this study the fixed costs include family labour cost, interest on operating capital and lease value. Farmers used both homes supplied and purchased inputs. The costs of purchased inputs were estimated on the basis of the actual payments made by the farmers and for home supplied inputs, opportunity cost principle was applied to determine their value.

5.3.1.1 Cost of land preparation

In the study area, power tiller was mainly used for land preparation. Power tiller was used on contact basis. Most of the farmer used animal labor for leveling their land. By adding power tiller cost and animal labor cost total cost of animal labor and power tiller was found. Table 5.2 indicates that per hectare animal labor and power tiller cost for rice production were Tk. 4075, Tk. 4250 and Tk. 4500 for small, medium and large farmers respectively and their percentages of total cost of production were 4.85, 5.13 and 5.25 percent respectively.

5.3.1.2 Cost of human labor

For rice production human labor is the most important inputs. It was required for different operations like land preparation, weeding, fertilizing, using pesticide, harvesting, carrying, threshing, drying, storing, etc. In this study, human labor was measured in man-days. One man-day was equivalent to 8 hours work of an adult

man. For women and children, man equivalent day was estimated. This was computed by converting all women and children day into man equivalent day according to the following ratio. 1 man –day = 1.5-woman day = 2 child day.

Per hectare hired labor cost of rice is shown in Table 5.2. Per hectare hired labor costs were Tk. 23600, Tk. 24800 and Tk. 26000 for small, medium and large farmers respectively and their percentages of total cost of production were 28.12, 29.96 and 30.34 percent respectively.

5.3.1.3 Cost of seed

Cost of seed varied widely depending on its quality and availability. Per hectare costs of seeds of rice production were Tk. 3900, Tk. 3780 and Tk**.** 4020 for small, medium and large farmers respectively and their percentages of total cost of production were 4.65, 4.57 and 4.69 percent respectively (Table 5.2).

5.3.1.4 Cost of urea

Per hectare costs of urea were Tk. 3000, 3300 and 3480 for the small, medium and large farmers respectively and their percentages of total cost of production were 3.57, 3.99 and 3.07 percent respectively.

5.3.1.5 Cost of TSP

Per hectare costs of TSP were Tk. 2430, 2511 and 2673 for the small, medium and large farmers respectively and their percentages of total cost of production were 2.89, 3.03 and 3.12 percent respectively.

5.3.1.6 Cost of MP

Per hectare costs of MP were Tk. 1260, 1620 and 1710 for the small, medium and large farmers respectively and their percentages of total cost of production were 1.50, 1.96 and 1.99 percent respectively.

5.3.1.7 Cost of gypsum

Per hectare costs of gypsum were Tk. 1224, 1296 and 1368 for the small, medium and large farmers respectively and their percentages of total cost of production were 1.46, 1.57 and 1.60 percent respectively.

5.3.1.8 Manure cost

Per hectare cost of manure for small, medium and large farmers were Tk. 3300, 3600 and 3153, respectively and their percentages of total cost of production were 3.93, 4.35 and 3.68 percent respectively (Table 5.2).

Table 5.2 Per hectare cost of boro rice production

Particulars	Small		Medium		Large		All farms
	(Tk/ha)	%	(Tk/ha)	%	(Tk/ha)	%	**(Tk/ha)**
Hired labor	23600	28.12	24800	29.96	26000	30.34	24800
Land preparation	4075	4.85	4250	5.13	4500	5.25	4275
Seed	3900	4.65	3780	4.57	4020	4.69	3900
Urea	3000	3.57	3300	3.99	3480	4.07	3250
TSP	2430	2.89	2511	3.03	2673	3.12	2538
MP	1260	1.50	1620	1.96	1710	1.99	1530
Gypsum	1224	1.46	1296	1.57	1368	1.60	1296
Manure	3300	3.93	3600	4.35	3153	3.68	3351
Irrigation	6750	8.04	6650	8.03	6550	7.64	6650
Pesticide	2500	2.98	2550	3.08	2550	2.99	2534
A. Total variable cost	**52039**	62.00	**54357**	65.67	**56004**	65.35	**54124**
Lease value	12500	14.89	12500	15.10	12500	14.59	12500
Family labor	16800	20.01	13200	15.95	14400	16.80	14800
Interest on operating capital	2601	3.10	2717	3.28	2800	3.27	2706
B. Fixed Costs	31901	38.00	28417	34.33	29700	34.65	30006
Total cost (A+B)	83940	100	82774	100	85704	100	84130

Source: Field survey, 2020

Note: Quantity and rate for land preparation are expressed in no. of tiller or power tiller per hectare and Tk. per tiller units, respectively. Quantity and rate of human labour are expressed in man-days per hectare and Tk. per man-days units, respectively.

5.3.1.9 Cost of pesticides

The pesticides used by the farmers in the study area were Vittaku, Sunforan, Rijent, Dithane M-45, Thiovit 80wp and Rovral 50wp, etc. Table 5.2 reveals that per hector cost of pesticides were Tk. 2500, Tk. 2550 and Tk. 2550 for small, medium and large farmers respectively and their percentages of total cost of production were 2.98, 3.08 and 2.99 percent respectively (Table 5.2).

5.3.1.10 Cost of irrigation

Cost of irrigation is one of the most important costs for rice production. Production of rice largely depends on irrigation. Right doses application of irrigation water help to increase bulb diameter, number of cloves, and number of leaves and plant height. As a result yield per hectare is being increased. Per hectare cost of irrigation cost were Tk. 6750 Tk. 6650 and Tk. 6650 for small, medium and large farmers respectively and their percentages of total cost of production were 8.04, 8.03 and 7.64 percent respectively (Table 5.2).

5.4 Total Variable Cost

In the study area, the total variable costs varied from year to year. It was observed that the total variable cost per hectare for rice cultivation were Tk. 52039, Tk. 54357 and Tk. 56004 for small, medium and large farmers and their percentages of total cost of production were 62.00, 65.67 and 65.35 percent (Table 5.2).

5.4.1 Fixed cost

5.4.2 Lease value

The farmers used the land as per conditions of leasing arrangement. The term leasing cost means the cost which was required for rice farmers to take land lease which would be used for rice production to a particular period of time. Leasing cost varies from one place to another depending on the location, soil fertility, topography of the soil and distance from the sources of water etc. Leasing cost

was the single highest cost item in the study areas. The value of own land was calculated as opportunity cost concept. Land use cost for rice production was estimated at the prevailing lease value per hectare in the study area. The lease value of per hectare land were estimated at Tk. 12500, Tk. 12500 and Tk. 12500 for small, medium and large farmers and their percentages of total cost of production were 14.89, 15.10 and 14.59 percent respectively (Table 5.2).

5.4.3 Family labor

In the study area, it was estimated that per hectare family labor cost for rice cultivation were Tk. 16800, Tk. 13200 and Tk. 14400 for small, medium and large farmers and their percentages of total cost of production were 20.01, 15.95 and 16.80 percent (Table 5.2).

5.4.4 Interest on operating capital

It is evident from Table 5.2 that interest on operating capital per hectare were Tk. 2601, 2717 and 2800 for small, medium and large farmers which covered 3.10, 3.28 and 3.27 percent of the total cost.

5.4.5 Total fixed cost

In the study area, it was estimated that per hectare total fixed cost for rice cultivation were Tk. 31901, 28417 and 29700 for small, medium and large farmers which comprised of 38.00, 34.33 and 34.65 percent of total cost.

5.4.6 Total cost of boro rice production

The total cost was calculated by adding up total variable cost and total fixed cost. In the study per hectare total cost of rice cultivation were calculated at Tk. 83940, Tk. 82774 and Tk. 85704 for small, medium and large farmers (Table 5.2).

5.5 Return of Boro Rice Production

5.5.1 Gross return

Per hectare gross return of rice production under small, medium and large farms are shown in Table 5.3. Gross return per hectare consisted of the value of main product and by-product also. Per hectare return was calculated by multiplying the total amount of products by their respective average market price. The average market price of rice was Tk. 20 per kg. Per hectare gross return of rice cultivation under small, medium and large farms were Tk. 119120, Tk. 116900 and Tk. 115040 respectively which indicates that per hectare gross return of small farms were higher than medium and large farms (Table 5.3).

5.5.2 Gross margin

Gross margin is the gross return over variable cost. Gross margin was calculated by deducting the total variable cost from the gross return. On the basis of the data, gross margin was found to be Tk. 67081, Tk. 62543 and Tk. 59036 per hectare for small, medium and large rice farm respectively (Table 5.3).

5.5.3 Net Return

Net return or profit was calculated by deducting the total production cost from the gross return. On the basis of the data the net return were estimated as Tk. 35180, Tk. 34126 and Tk. 29336 for small, medium and large rice farm per hectare (Table 5.3).

Table 5.3: Per hectare cost and return of boro rice production

Sl. No.	Items	Small farm	Medium farm	Large farm	All farm
A.	Total Production (kg/ha)	5631	5520	5427	5526
B.	Price of rice (Tk./kg)	20	20	20	20
C.	By-product (straw tk./ha)	6500	6500	6500	6500
D.	Gross return (GR)	119120	116900	115040	117020
E.	Total variable costs (TVC)	52039	54357	56004	54124
F.	Total costs (TVC+TFC)	83940	82774	85704	84130
G.	Net return (GR-TC)	35180	34126	29336	32890
H.	Gross margin (GR-TVC)	67081	62543	59036	62896
I.	Benefit-cost ratio (BCR) = GR/TC	1.42	1.41	1.34	1.39

5.5.4 Benefit cost ratio (Undiscounted)

Benefit Cost Ratio (BCR) is a relative measure, which is used to compare benefit per unit of cost. Benefit Cost Ratio (BCR) was found to be 1.42, 1.41 and 1.34 for small, medium and large rice farm respectively which implies that one-taka investment in rice production generated Tk. 1.42, 1.41 and 1.34 (Table 5.3). From the above calculation it was found that rice production is profitable in Bangladesh but there is a difference in profitability among individual farm groups. It can be seen from table 5.3 that small farmers are making the highest amount of profit while the large farmers are earning the lowest amount of profit from their rice production.

5.6 Conclusion

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

CHAPTER VI
FACTOR AFFECTING PROFITABILITY OF BORO RICE CULTIVATION

6.1 Introduction

An attempt has been made this Chapter to identify and measure the effects of the major variables on rice production. Cobb-Douglas production function was chosen to estimate the contribution of key variables on the production process of rice production. The estimated values of the model are presented in Table 6.1.

6.2 Functional Analysis for Measuring Production Efficiency

Production function is a relation or a mathematical function specifying the maximum output that can be produced with given inputs for a given level of technology. Keeping in mind the objectives of the study and considering the effect of explanatory variables on output of rice production, ten explanatory variables were chosen to estimate the quantitative effect of inputs on output.

Management factor was not included in the model because specification and measurement of management factor is almost impossible particularly in the present study, where a farm operator is both a labor and manager. 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 and 5 percent levels of significant.
- Stage of production was estimated by returns to scale which was the summation of all the production elasticity of various inputs.

The estimated coefficients and related statistics of the Cobb-Douglas production function for rice production are shown in Table 6.1.

Land preparation cost (X_1)

The magnitudes of the coefficients of land preparation cost was positive and significant for rice production (Table 6.1). The regression coefficients of land preparation (X_1) were 0.750, the result of the analysis indicated that, keeping other factors constant, 1 percent increase in additional expenditure on land preparation would increase the yield of rice by 0.750 percent.

Seed cost (X_2)

The regression coefficients of seed cost (X_2) was negative and significant at 1 percent level of significance. The regression coefficients of seed cost (X_2) was -1.218, which implied that, other factors remaining the same, if expenditure on seed cost was increased by 1 percent then the yield of rice would be decreased by 0.218 percent (Table 6.1).

Irrigation cost (X_3)

The magnitudes of the coefficients of irrigation cost was positive and significant for rice production (Table 6.1). The result of the analysis indicated that, keeping other factors constant, a 1 percent increase in additional expenditure on irrigation would increase the yield of rice by 0.412 percent.

Human labour cost (X_4)

The regression coefficients of Human labour (X_4) was positive and significant at 1 percent level of significance. The regression coefficients of human labour (X_4) was 0.311, which implied that, other factors remaining the same, if expenditure on human labour was increased by 1 percent then the yield of rice would be increased by 0.311 percent (Table 6.1).

Urea cost (X_5)

The regression coefficients of urea (X_5) was insignificant for rice production (Table 6.1). The regression coefficients of urea (X_5) was 0.229, which implied that, other factors remaining the same, if amount of urea was increased by 1 percent then the yield of rice would be increased by 0.229 percent.

TSP cost (X_6)

The regression coefficient of TSP cost (X_6) of rice production was negative and significant at 1 percent level of significance, which implied that if the expenditure on TSP was increased by 1 percent then the yield of rice would be decreased by 0.494 percent, other factors remaining constant (Table 6.1).

Gypsum cost (X_7)

The regression coefficients of gypsum (X_7) was insignificant for rice production (Table 6.1). The regression coefficients of gypsum (X_7) was 0.066, which implied that, other factors remaining the same, if amount of urea was increased by 1 percent then the yield of rice would be increased by 0.066 percent.

MoP cost (X_8)

The regression coefficients of MoP (X_8) was insignificant for rice production (Table 6.1). The regression coefficients of MoP (X_8) was 0.116, which implied

that, other factors remaining the same, if amount of MoP was increased by 1 percent then the yield of rice would be increased by 0.116 percent.

Table 6.1 Estimated Values of Coefficients and Related Statistics of Cobb- Douglas Production Function

Explanatory variables	Coefficient	Standard error	t-value	p- value
Intercept	1.425**	.448	3.185	.002
Cost of land preparation (X_1)	.750*	.286	2.623	.010
Cost of seed (X_2)	-1.218**	.425	-2.866	.005
Cost of irrigation (X_3)	.412**	.098	4.200	.000
Cost of human labor (X_4)	.311**	.085	3.675	.000
Cost of urea (X_5)	.209	.177	1.182	.240
Cost of TSP (X_6)	-.494**	.162	-3.048	.003
Gypsum (X_7)	.066	.041	1.603	.113
Cost of MoP (X_8)	.116	.116	.998	.321
Cost of manure (X_9)	.397*	.188	2.112	.038
Cost of pesticide (X_{10})	.545**	.111	4.912	.000
R^2		0.930		
Adjusted R^2		0. 922		
Return to scale		1.094		
F-value		111.867***		

Source: Field survey, 2020

Note: ** Significant at 1 percent level; * Significant at 5 percent level and NS: Not Significant

Manure cost (X_9)

The regression coefficient of manure cost (X_9) of rice production was positive and significant at 5 percent level of significance, which implied that if the expenditure on manure was increased by 1 percent then the yield of rice would be increased by 0.397 percent, other factors remaining constant (Table 6.1).

Cost of Insecticide (X_{10})

The regression coefficient of insecticides cost (X_{10}) of rice production was positive and significant at 1 percent level of significance, which implied that if the expenditure on insecticides was increased by 1 percent then the yield of rice would be increased by 0.545 percent, other factors remaining constant (Table 6.1).

Coefficient of multiple determinations (R^2)

The values of the coefficient of multiple determination of rice production was found to be 0.930 Which implied that about 93 percent of the total variation in the gross return could be explained by the included explanatory variables of the model. So we can say the goodness of fit of this regression model is better since R^2 indicates the goodness of fit of the regression model (Table 6.1).

Adjusted R^2

Here the term adjusted means adjusted for the degrees of freedom. The adjusted R^2 for rice production was found to be 0.922 which indicated that about 92 percent of the variations of the output were explained by the explanatory variables included in the model (Table 6.1).

Returns to scale in rice production

The summation of all the production coefficients of rice production is equal to 1.094. This means that production function for shrimp farming exhibits increasing returns to scale. This means that, if all the variables specified in the model were increased by 1 percent, gross return would also be increased by 1.094 percent (Table 6.1).

F-value

The F-statistic was computed to denote the overall goodness of fit of any fitted model. The F-value for the rice production was estimated at 111.867 which were highly significant at 1 percent level. It means that the explanatory variables included in the

model were important for explaining the variation in gross return of rice production (Table 6.1).

6.4 Conclusion

It is evident from the Cobb-Douglas production function model, which the included key variables had significant and positive effect on rice production except the positive and insignificant effect of urea cost, gypsum cost and MoP cost.

CHAPTER VII

PROBLEM OF THE BORO RICE FARMERS

7.1 Problem Faced by the Farmers in Boro Rice Production

Problems faced by the farmers in producing rice Bangladesh has an economy mainly dependent on agriculture. But this agricultural sector is negligible still now. Various problems are associated with this sector. Experience has shown that farmers in Bangladesh seldom get the required quantity of seeds, adequate fund, fertilizers, pesticides, technical support and finally the remunerative price of their produces. They are economically not very capable of investing the required fund for producing crops due to their low capital base and scarcity of cash fund. Fanners generally complain of receiving insufficient support from government agencies. In this Chapter an attempt is made to identify some major problems of rice production Relative problems and constraints of rice production. The sample farmers were asked to stale whether they faced any problems with regard to rice production. It was observed that most of the fanners were facing some important problems in growing rice. It may be noted that the problems confronted by the individual farmers were not identical. Some problems were in fact more severe than others. However, those problems and constraints which the farmers emphasized upon are shown in Table 7.1 and described below:

7.1.1 Lack of fertilizer in cultivation time

Fertilizer is the most important input for producing rice. They used usually Urea, TSP, Gypsum, Boron and MP for the better production of rice. Farmers had to use fertilizer several times in their field. Fertilizer crisis is a common subject in the production period in our country. About 17.89% of the farmers in the study area responded this problem. Some traders made artificial crisis to make sure higher price of fertilizers. In the study area, it was the 1st problem in the rank order (Table 7.1).

7.1.2 Low price of rice

Low price of rice particularly just after harvesting of the product caused disincentive for the farmers to produce the crops. About 17.89% of the farmers in the study area responded this problem. In the study area, low price of rice was the 2nd in rank order.

Table 7.1 Problems of rice production

Problem	Respondents Number	Percent	Rank order
Lack of fertilizer in cultivation time	28	29.47	1st
Low price of rice	17	17.89	2nd
Lack of credit	15	15.79	3rd
High rate of input price	12	12.63	4th
Poor quality of pesticide	8	8.42	5th
Lack of government attention	5	5.26	6th
More infestation of diseases and pest	4	4.21	7th
Unavailability of labor	3	3.16	8th
Lack of quality seed	2	2.11	9th
Lack of storage facility	1	1.06	10th
Total	95	100	

Source: Field Survey 2020

7.1.3 Lack of credit

In the study area, most of the farmers reported that they did not have adequate amount of operating capital. Most of them failed to receive the institutional credit. As a result, financial inability and pressing need for cash money force them to borrow money from non- institutional sources and they have to pay high interest rate. About 17.89% of the farmers in the study area responded this problem. In the study area, lack of adequate fund was the 3rd most severe problem (Table 7.1).

7.1.4 High rate of input price

Different kind of inputs such as seed, fertilizer, pesticides and insecticides. Petrol & diesel were used to produce rice. But sorry to say that most of the farmers had to pay high market price than the reasonable. About 12.63% of the farmers in the study area responded this problem. In the study area, high rate of input price was the 4th severe problem among the farmers (Table 7.1).

7.1.5 Poor quality of pesticide

Different type of insect and pest arc affected of rice and causes low production. To avoid these losses farmers had to use different kind of pesticides to control insect and pest. But in the production period, the quality insecticides and pesticides are not available and the price of insecticides and pesticides is high. About 8.42% of the farmers in the study area responded this problem. The farmers faced this problem every year. In the study area, poor quality of pesticide was the 6th problems among the farmers (Table 7.1).

7.1.6 Lack of government attention

During the investigation, most of the farmers complained that they did not get enough support from the government. Only large farmers were benefited from the government institution. Input price should be reduced, proper training should be provided to the farmers. About 5.26% of the farmers in the study area responded this problem. In the study area, lack of government attention was the 6th problems among the farmers (Table 7.1).

7.1.7 More infestation of diseases and pest

For rice production diseases and pest infestation was the last problems of 10% yield losses of production the growers in the study area. About 4.21% of the farmer in the study area farmers thought that more infestation of diseases and pest

was the big problem for rice cultivation. The study areas, more infestation of diseases and pest was 7th in the rank order.

7.1.8 Unavailability of labor

In the study area, most of the farmers could not get labor in time. So they had to depend on own. Very often they faced labor crisis. Even they had to pay illogically very high price. In the study area, unavailability of labor was the most severe problem among the farmers. About 3.16% of the farmer in the study area farmers thought that lack of quality seed was the big problem for rice cultivation. The study areas, unavailability of labor was 8th in the rank order.

7.1.9 Lack of quality seed

High quality of seed is the main input for rice cultivation. Farmers in the study area could not get high quality of seed. Sometimes seed were mixed with some other particle and could not proper germination. About 2.11% of the farmer in the study area farmers thought that lack of quality seed was the big problem for rice cultivation. The study areas lack of quality seed was 9th in the rank order.

7.1.10 Lack of storage facilities

There was a lack of storage facility for rice growers was the major problem in the study areas. Most of the products were sold just after harvest at a low price due to lack of proper storage facilities. About 1.06% of the farmers in the study area famers reported that lack of storage facilities and high charge for storage discouraged them to produce more rice. In the rank order, problem of lack of storage facility was the 10th in order.

CHAPTER VIII

SUMMARY, CONCLUSION AND POLICY RECOMMENDATIONS

8.1 Introduction

This Chapter discusses the summary, conclusion and policy recommendations of the study. These chapter summaries on Introduction (Chapter 1), Review of literature (Chapter 2), Methodology (Chapter 3), Socio-economic characteristics (Chapter 4), Cost and returns (Chapter 5), Factor affecting profitability of rice production (Chapter 6), Problem faced by the farmers in boro rice production (Chapter 7), Finally Chapter 8 presents summary, conclusion and policy recommendations of the study.

8.2 Summary and Conclusions

Bangladesh is predominantly an agricultural country. Agricultural development is still synonyms with the economic development. At present agricultural sector are largely dominated by the rice production. Rice is the staple food of Bangladesh and basically rice cultivation is the major source of livelihood of the people of Bangladesh. On the basis of seasonal classification, three types of rice are grown in Bangladesh namely – Aus, Aman and Boro. HYV Boro rice covered the largest portion of the total rice production of the country. The population growth rate is 1.36 percent per annum (BBS 2020) which causes the decreases of farm size in a horrid manner. The area under study was a rice growing area. An attempt has been made in this study to examine the profitability of rice producing farms farmers. The overall objective of the study will be measure profitability of rice producing farms and also identify the socioeconomic characteristics of the farmers in the study area. The following are the specific objectives:

- ✓ To identify the major socio-economic characteristics of boro rice farmers;
- ✓ To assess the profitability of boro rice production farmers;

- ✓ To estimate the contribution of key inputs to the production processes of boro rice production;
- ✓ To identify problem faced by the farmers in boro rice production.

All the rice growers in Norail district were not possible to include in this study because of the paucity of resources and time constraint. A reasonable sample survey, which would represent the population, was required in order to meet up the purpose of the study. Simple random sampling technique was adopted in this study. After purposively selecting Norail district, Lohagara upazila was selected randomly from 3 upazilas. Subsequently, six villages from one union namely, Shalnagar was also selected randomly. From one union six villages namely, Khasipur, Nowkhala, Bathashi, Chakshi, Rarchondhopur and Mondolbarg were selected randomly as a locale of the study. Therefore, a list of rice producers were constructed with the help of village leaders and field level extension personnel.

It was observed from the socioeconomic characteristics that out of 95 samples farmers of all categories, 53.63 percent belonged to the age group of 36-50 years, 36.84 percent 23-35 years and 10.53 percent was in above 50 years age group. On the other hand, out of 35 farmers of small farm categories, 571.43 percent belonged to the age group of 36-50 years, 8.57 percent 23-35 years and 20 percent were in the age group of above 50 years. On the other hand, out of 30 farmers of medium farm categories, 56.67 percent belonged to the age group of 23-35 years, 40 percent 36-50 years and 3.3 percent were in the age group of above 50 years. On the other hand, out of 30 farmers of large farm categories, 50 percent belonged to the age group of 23-350 years, 43.33 percent 36-50 years and 6.67 percent were in the age group of above 50 years. In the case of small farms, 34.293 percent of the farmers had primary level of education, 28.57 percent of the farmers had above secondary level of education, 25.71 percent of the farmers had above secondary level of education and 11.43 percent of the farmers had illiterate. In the case of

medium farms. 26.67 percent of the farmers had secondary level of education, 36.67 percent of the farmers had secondary level of education, 23.33 percent of the farmers had above secondary level of education and 13.33 percent of the farmers had primary level of education. On the other hand, in the case of large farms, 33.33 percent of the farmers had illiterate and secondary level of education, 10 percent of the farmers had primary level of education and 23.33 percent of the farmers had above secondary level of education. The majority 53.4 percent of the small farmer's agriculture had their occupation, while 23.3 percent of the small farmers business had their occupation, 12 percent of the small farmers' others had their occupation and only 13.3 percent of the small farmer's service holder. The highest 56.6 percent of the medium farmers had agriculture their occupation, 23.3 percent of the medium famers had business their occupation, 16.7 percent of the medium famers had service their occupation. The highest 63.3% of the large farmers had agriculture compared to 16.7 percent of the large farmers having business their occupation and only 10 percent of the large farmers had service and others their occupation. Out of 35 small farmers, 68.57 percent belonged to the small family of 2-4 members, 28.57 percent had 5-6 persons and 33.3 percent were in the large family size of above 6 persons. On the other hand, out of 30 medium farmers, 76.66 percent belonged to the small family size of 2-4 persons, 16.67 percent had 4-6 persons and 6.67 percent were in the large family size of above 6 persons. On the other hand, out of 30 large farmers, 73.33 percent belonged to the small family size of 2-4 persons, 13.33 percent had 5-6 persons and 13.33 percent were in the large family size of above 6 persons.

The majority 36.84 percent of the farmers possessed small farms, 31.58 and 31.58 percent of them having medium farms and large farm size. the majority 65.71 percent of the small farmers had 100-200 thousand annual family income followed by 25.71 percent of the small farmers had 100-250 thousand annual family income and only 8.58 percent of the small farmers had above 250 thousand annual family

income. About 83.33 of the medium farmers had 100-200 thousand annual family income, while 10 percent of them having 201-250 thousand annual family income and only 6.67 percent of the medium farmers had above 250 thousand annual family income. The highest 80 percent of the large farmer's had 100-200 thousand income compared to 6.66 percent of the large farmers having 201-250 thousand annual family income and only 13.33 percent of the large farmers had above 250 thousand annual family income. The majority 42.86 percent of the small farmers received credit from NGOs, while 25.71 percent of the small farmers received credit from bank, 17.14% credit received from relatives and only 14.29 percent of the small farmer's credit received from others sources. The highest 36.67 percent of the medium farmer's credit received from relatives, 30% of the medium farmers received credit from NGOs, 23.33% and 10 percent of the medium famers credit received from others and bank, respectively. Data presented in the Table revealed that the highest 36.67% of the large farmer's credit received from NGOs compared to 33.33 percent of the large farmers' credit received from bank, 16.67% and 13.33 percent of the large farmers credit received from relatives and others, respectively. The majority 40 percent of the small farmers had high training on rice cultivation, while 34.29 percent of the small farmers had no training, 11.43% and 14.29 percent of the small farmer's had low and medium training on rice cultivation. The highest 66.67 percent of the medium farmer's had medium training on rice cultivation, while 20% of the medium farmers had no training on rice cultivation, 13.33% and 0 percent of the medium famers had low and high training on rice cultivation, respectively. Data presented in the Table revealed that the highest 50% of the large farmers had medium training on rice cultivation compared to 26.67 percent of the large farmers had no training on rice cultivation, 10% and 13.33 percent of the large farmers had low and high training on rice cultivation, respectively. The highest proportion 54.29 percent of the small farmers had 11-20 years of experience, while 28.57 percent of the small farmers had above 20 years' experience and 20 percent of the small farmers had 4-10

years' experience in rice cultivation. In case of medium farmers, the highest 53.33 of the farmers had 11-20 years' experience, whereas 26.67 percent of the farmers had 4-10 years' experience in rice cultivation and only 20 percent had above 20 years' experience. Again, the highest 46.67 percent of the large farmers had (11-20 years) experience, while 33.33 percent of the large farmers had above 20 years' experience and 20 percent of the large farmers had 4-10 years' experience in rice cultivation.

The results of profitability analysis of boro rice it was found that per hectare land preparation cost for rice production were Tk. 4075, Tk. 4250 and Tk. 4500 for small, medium and large farmers respectively and their percentages of total cost of production were 4.85, 5.13 and 5.25 percent Per hectare hired labor costs were Tk. 23600, Tk. 24800 and Tk. 26000 for small, medium and large farmers respectively and their percentages of total cost of production were 28.12, 29.96 and 30.34 percent. Per hectare costs of seeds of rice production were Tk. 3900, Tk. 3780 and Tk. 4020 for small, medium and large farmers respectively and their percentages of total cost of production were 4.65, 4.57 and 4.69 percent. Per hectare costs of urea were Tk. 3000, 3300 and 3480 for the small, medium and large farmers respectively and their percentages of total cost of production were 3.57, 3.99 and 3.07 percent. Per hectare costs of TSP were Tk. 2430, 2511 and 2673 for the small, medium and large farmers respectively and their percentages of total cost of production were 2.89, 3.03 and 3.12 percent. Per hectare costs of MP were Tk. 1260, 1620 and 1710 for the small, medium and large farmers respectively and their percentages of total cost of production were 1.50, 1.96 and 1.99 percent. Per hectare costs of gypsum were Tk. 1224, 1296 and 1368 for the small, medium and large farmers respectively and their percentages of total cost of production were 1.46, 1.57 and 1.60 percent. Per hectare cost of manure for small, medium and large farmers were Tk. 3300, 3600 and 3153, respectively and their percentages of total cost of production were 3.93, 4.35 and 3.68 percent. Per hector cost of

pesticides were Tk. 2500, Tk. 2550 and Tk. 2550 for small, medium and large farmers respectively and their percentages of total cost of production were 2.98, 3.08 and 2.99 percent. Per hectare costs of irrigation cost were Tk. 6750 Tk. 6650 and Tk. 6650 for small, medium and large farmers respectively and their percentages of total cost of production were 8.04, 8.03 and 7.64 percent.

Total variable cost per hectare for boro rice cultivation were Tk. 52039, Tk. 54357 and Tk. 56004 for small, medium and large farmers and their percentages of total cost of production were 62.00, 65.67 and 65.35 percent. The lease value of per hectare land were estimated at Tk. 12500, Tk. 12500 and Tk. 12500 for small, medium and large farmers and their percentages of total cost of production were 14.89, 15.10 and 14.59 percent. Per hectare family labor cost for rice cultivation were Tk. 16800, Tk. 13200 and Tk. 14400 for small, medium and large farmers and their percentages of total cost of production were 20.01, 15.95 and 16.80 percent. Interest on operating capital per hectare were Tk. 2601, 2717 and 2800 for small, medium and large farmers which covered 3.10, 3.28 and 3.27 percent of the total cost. Per hectare total fixed cost for rice cultivation were Tk. 31901, 28417 and 29700 for small, medium and large farmers which comprised of 38.00, 34.33 and 34.65 percent of total cost. Per hectare total cost of boro rice cultivation were calculated at Tk. 83940, Tk. 82774 and Tk. 85704 for small, medium and large farmers.

Per hectare gross return of boro rice cultivation under small, medium and large farms were Tk. 119120, Tk. 116900 and Tk. 115040 respectively which indicates that per hectare gross return of small farms were higher than medium and large far**ms**. Gross margin was found to be Tk. 67081, Tk. 62543 and Tk. 59036 per hectare for small, medium and large boro rice farm. Total net return was estimated as Tk. 35180, Tk. 34126 and Tk. 29336 for small, medium and large rice farm per hectare. Benefit Cost Ratio (BCR) were found to be 1.15, 1.13 and 1.08 for small,

medium and large boro rice farm respectively. Small farmers are making the highest amount of profit while the large farmers are earning the lowest amount of profit from their rice production.

Cobb-Douglas production function analysis was carried out for examining the factors affecting the profitability of input use. The most important ten explanatory variables were included in the model to explain the gross income or return of boro rice cultivation. In most of the cases the coefficients of irrigation, cost of land preparation, human labor cost, cost of manure and cost of pesticide appeared to be positive significant except the negative and significant effect of seed cost and cost of TSP. The summation of co-efficient of different inputs were greater than one implying that the production functions exhibited increasing returns to scale. The values of the coefficient of multiple determination of rice production was 0.922 which implied that about 92 percent of the total variation in the gross return could be explained by the included explanatory variables of the model. Production function for boro rice production exhibits increasing returns to scale (1.094). This means that, if all the variables specified in the model were increased by 1 percent, gross return would also increase by 1.094 percent. . The F-value for the boro rice farmers was 111.867 which were highly significant at 1 percent level. Unavailability of labor was the 1^{st} problem in the study area followed by high rate of input price, lack of adequate fund, lack of fertilizer in time, poor quality of pesticide, lack of government attention and more infestation of diseases and pests.

8.3 Policy Recommendations

Based on the findings of the present research, the following recommendations are put forward.

On the basis of the salient findings of the study, certain broad implications that can be derived for policy makers and extension personnel to design suitable development strategy for increasing the rice production in the study area are indicated here:

- ✓ For increasing production of boro rice necessary inputs particularly HYV seeds. Fertilizers, insecticides and pesticides etc. should be made available to the farmers just before the growing period.

- ✓ To reduce the cost of seed it will be necessary to produce sufficient quality seeds locally and make them available to the farmers in time at a reasonable price.

- ✓ The farmers, who were more experienced and contacted frequently with extension workers, were more efficient. So, experience and frequency of extension contact should be increased to help skill development.

- ✓ Domestic consumption of boro rice requires to be raised from the present state. A well-coordinated move towards popularization of intake of rice as a major substitute of cereals is yet to be made. Massive publicity of diversified uses of potato products should be made through mass media.

- ✓ Good quality seed and low price of input should be ensured for increasing rice production because rice producers achieved only 70 % of their potential yield.

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