FINANCIAL PROFITABILITY AND RESOURCE USE EFFECIENCY OF BRRI Dhan29 IN SOME SELECTED HAOR AREAS OF BANGLADESH

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*This is to certify that thesis entitled, "**FINANCIAL PROFITABILITY AND RESOURCE USE EFFECIENCY OF BRRI Dhan29 IN SOME SELECTED HAOR AREAS OF BANGLADESH..**" submitted to the Faculty of Agribusiness Management, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE IN AGRICULTURAL ECONOMICS**, embodies the result of a piece of bona fide research work carried out by **Md. Ziaul Kabir Ratul**, Registration No. **13-05672** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.*

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

Dated:

Place: Dhaka Bangladesh

Dr. B. A. A Mustafi
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DEDICATED TO
MY
BELOVED
FAMILY

ABSTRACT

The present study has been undertaken in the haor areas to investigate the socio-economic profile of the BRRI Dhan29 producers, to estimate per hectare costs and returns of BRRI Dhan29 production, to determine the productivity and profitability level of BRRI Dhan29 cultivation, to determine the resource use efficiency in BRRI Dhan29 cultivation, identify the problems faced by the farmers in BRRI Dhan29 cultivation and to recommend policy implications deriving from the facts above. A total number of 70 BRRI Dhan29 growers were randomly selected by using stratified random sampling technique of which 35 are from Mithamain upazila and 35 from Austogram upazila. Data were collected from the respondents through direct interview method. The collected data were then analyzed following descriptive as well as Cobb-Douglas production function analysis.

It was found that on an average, the surveyed farm families consisted of 8 members of whom 3 were male, 3 were female and 2 were children. The highest portion (68%) of the farmers was within the age group of 15-65 years. On an average, about 40 percent farmers were educated. Agriculture was the major and only occupation of most of the farmers (82%). About 76.3% of the sample of the BRRI Dhan29 growers is small farmers having their own cultivable land 0.76 hectares. Average farm size was 1.82 ha in the study area. Boro -fallow -fallow was the major cropping pattern in the haor area and in the study area average cropping intensity was found to be very low, it was just 127%. Considering all farms, per hectare variable cost was Tk. 41,445 and Tk. 52560. Per hectare gross return from BRRI Dhan29 was estimated Tk. 88081.71,per hectare Gross Margin was Tk. 46637 and net return was Tk. 35522.2. Benefit cost ratio (BCR) was estimated to be 1.68 on full cost basis. The findings led to the conclusion that seed, human labor and irrigation significantly affected the return from BRRI Dhan-29. On the other hand, fertilizer and insecticides were found insignificant. Impact of human labor was found to be negative. Human labor was found to be over utilized but all the other input variables such as seed, fertilizer, insecticides and irrigation were found underutilized. Return to scale was estimated to be 8.16. So we can say BRRI Dhan29 cultivation in haor area was profitable. However, many problems were associated with BRRI Dhan29 cultivation like, floods, quality seed crisis in the sowing period, fertilizer crisis and cost, shortage of hired labor in the peak period, high wage rate, high irrigation cost, diseases, short duration HYV variety and lack of cooperation from Upazila Agriculture Officer (AO), lack of communication facilities and inadequate storage facilities were the major problems. Establishing embankment to prevent sudden flood was the mostly suggested solution from the farmers to prevent flood in haor area. Electricity supply for irrigation was also suggestion from the farmers. Farmers also suggested to reduce input cost and to raise output prices. The concerned agencies should be particularly aware of those problems and take necessary measures to solve those as far as possible.

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Md. Ziaul Kabir Ratul

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ACRONYMS AND ABBREVIATIONS

BBS-Bangladesh Bureau Of Statistics

BCR-Benefit Cost Ratio

BER-Bangladesh Economic Review

eg- example gratia

etc.- et cetera (and others)

FAO-Food and Agricultural Organization

GM-Gross Margin

GPD-Gross Domestic Product

GR-Gross Return

GR-Growth Rate

HA-Hectare

HSC-Higher Secondary Certificate

HYV-High Yielding Variety

KG-Kilogram

Ln- Natural Log

MFC-Marginal Factor Cost

MMT-Million Metric Ton

MOP-Muriate of Potash

MT-Metric Ton

MVP-Marginal Value Product

RUE-Resource Use Efficiency

SSC-Secondary School Certificate

TSP-Triple Super Phosphate

TVC-Total Variable Cost

CHAPTER 1

INTRODUCTION

1. General Description and Background

Agriculture is the major pillar of the economy of Bangladesh which contributes around 13.65% of Gross Domestic Product GDP (BBS,2019). About 38.56 % of the national labor force is employed by agriculture (BBS, 2019). The contribution of the agriculture to the economy is gradually decreasing but still it is the main basis of our economy. The food security of about 175 million people is ensured through this agriculture. There are three agricultural seasons namely Rabi, Kharif-i and Kharif-ii and three seasons for rice cultivation namely, Aus, Aman and Boro. Presently Boro is the main rice production season, when 53% of our total rice production is produced amounting 474272 million Taka in value.

Agricultural development in an agrarian economy largely depends on the existing nature of man-land relationship. Crop-sharing is one of the earliest forms of production organization in agriculture. It is still a matter of considerable importance in present agriculture in many countries.

2. Food grain Production in Bangladesh and self-sufficiency

When a country meets the total demand of food grain from its own production, it is called self-sufficiency. Net food grain production in Bangladesh increased from 14.48 million metric tons (mmt) in the year 1984-1985 to 22.43 million metric tons (mmt) in the year 1999-2000 and further increased to 36.39 million metric tons (mmt) in the year 2018-2019 (BBS,2019). Requirement of food grain was 15.73 million metric tons in the year 1984-1985. This increased to 21.38 million metric ton in 1999-2000 and 20.15 million metric ton in 2019-2020. As the production of food grain increased at a higher rate than the population growth, the 'food-gap' eliminated, except few natural hazard attacked years. In the year 1999-2000, our grain production for the first time exceeded our total demand for a year with a little surplus of around 1.5 million metric tons. That is Bangladesh enjoyed food grain production surplus for the very first time in the year 1999-2000 (BBS, 2017).

3. Importance of Rice in the Economy of Bangladesh

Rice is the major food in our country. A large number of people with a chronic food deficit were a big problem in our country for a long time. Rice price used to hike almost each and every year due to the shortage. And the lower, middle and fixed income groups had to suffer much from this price hike. So our government had to import rice from abroad like India, Myanmar, and Thailand etc. to support the market almost each year. So the government and agricultural scientists have given endeavor sincerely and continuously in developing modern high yielding varieties and appropriate production technologies to eliminate the grain-gap. As a result, the situations

changes Science 1999-2000. Our government claims that self-sufficiency has been achieved, especially in rice. It is seemed that over the last 70 years our production of rice has been enhanced almost 5 times despite our cultivable land getting squeezed. The cultivable land is reducing due to the non-agricultural usage of land, industrialization, land erosion salinity and urbanization and rehabilitation purpose etc.

Table 1.1: Area and production of Rice in Bangladesh

Year	Rice	
	Acreage(000 acres)	Production (000 M. tons)
2018-2019	28456	36391
2017-18	28699	36278
2016-17	27184	33804
2015-16	28123	34710
2014-15	28209	34710
2013-14	28101	34357
2012-13	28228	33833
2011-12	28487	33889
1971	-	10500

Source: Bangladesh Bureau of Statistics, 2019

Table 1.2: Area, Production and Yield of Boro Rice in Bangladesh

Year	Area (M ha)	Production (MMT)	Yield (t/ha)
2000-01	3.76	11.92	3.17
2001-02	3.77	11.77	3.12
2002-03	3.85	12.22	3.17
2003-04	3.95	12.84	3.25
2004-05	4.06	13.84	3.41
2005-06	4.07	13.98	3.43
2006-07	4.25	14.97	3.52
2007-08	4.61	17.76	3.85
2008-09	4.72	17.81	3.77
2009-10	4.78	18.34	3.84

2010-11	4.77	18.62	3.90
2011-12	4.81	18.76	3.90
2012-13	5.17	18.78	3.63
2013-14	4.79	19.01	3.97
2014-15	4.84	19.19	3.96
2015-16	4.77	18.94	3.97
2016-17	4.48	18.01	4.02
2017-18	4.86	19.58	4.03
Growth Rate (%)	**1.43**	**2.76**	**1.33**

Source: BBS, 2019

Rice plays an important contribution in the overall economy of our country. It is the main cereal crop and staple food in Bangladesh. It is the most important cereal crop which covers 75% of cultivable land and 82% of total irrigated land is under this crop (BBS 2019). About 72% value of total production from agricultural sector comes alone from rice. Annual per capita intake of rice in Bangladesh is the highest in the world. About 35% of rural income comes from agricultural sectors. We can say, 'Rice is a political goods'. Bangladesh is the 3rd rice producing countries in the world after China and India. So it has significant impact on overall economy in Bangladesh.

Table 1.3: Rice producing countries in the world

Rank	Country	Production (MT)
1	China	149,000,000
2	India	118,000,000
3	Bangladesh	36,391,000
4	Indonesia	34,900,000
5	Vietnam	27,500,000
6	Thailand	20,400,000
7	Burma	13,100,000
8	Philippines	11,000,000

9	Japan	7,650,000
10	Pakistan	7,500,000

Source: BBS, 2019

4. Contribution of HYV Boro rice to the Total Production in Bangladesh

Total production of rice in a year is about 36,391,000 metric tons. In Bangladesh rice is produced in three seasons: Aus Aman and Boro. Among these three seasons Boro is dominant for its higher production capacity and its important contribution in attaining self-sufficiencies in food grain. Presently, Boro is the main rice production season. About 19.561 million metric ton boro rice is produced per year in our country. Boro rice contributes 60% of our total rice production in a year in this country. So it can easily be stated that boro rice is the most important crop to ensure the food security of 17.5 million people in this country. According to the terms of area coverage, total cultivated land of rice was 10.11 million hectares and production was 19.98 million metric tons (BBS, 1998/99). But in the year 2018/19 cultivated area of rice increased to 28456 acres and production was 36391 million metric tons. Boro rice coverage and production was represented in table-1.4. Data putted in the table shows that Boro rice cultivated area has enhanced to 11832 million acres and production was 19.561 million metric tons in the year 2018/2019. So it can be easily said that boro rice has the big share of total rice production in our country.

In the year 2018-2019, total acreage of HYV boro is 9.612 million acres and production is 9.612 million metric tons. So the significance of boro rice in the economy of our country is predominant.

Boro season starts from October-November and ends in the month of April. This is winter season in Bangladesh. This is a dry season and rain is very hardly occurrence in the season. Our rivers, haors, beels are almost get dried. So, the crops cultivated in this season required irrigation. So as to say for boro rice cultivation. It requires high irrigation for the boro production.

5. Introduction of Haor area

There are many haors (basin like structure) where water remains either stagnant or in flash flooding condition during the months of June to November and mainly Boro rice is grown in the Rabi season using irrigation. Geographically, most of the haors are situated in seven districts of the North-East Bangladesh. The districts are: Sunamganj, Kishoreganj, Netrokona, Sylhet, Habiganj, Maulavibazar and B. Baria. There are as many as 423 small or large haors in Bangladesh. The Hakaloki haor, Sumir haor, Dakhar haor, Tanguyar haor, Gungiajuri haor, Mukhar haor, Kaowadighir haor etc are the prominent haors in Bangladesh. In terms of ecosystem, crop production practices, and economic activities and over all livelihoods of the

farmers of haor areas are quite different from those of the other parts of the country. The cropping practices particularly Boro rice crop mainly depends on nature. Early flood, hailstorm and drought are the main constraints to grow modern boro rice. These haor areas remain under water almost for six months in a year staring from June/July to November/ December, which is the transplanting time for boro rice and so for BRRI Dhan-29. The available statistics indicate that, the total cultivated area in those haor districts is about 1.26 million hectares of which 0.68 million ha (nearly 66%) is under haor. Almost 80% of this area (i.e. 0.68 million ha) is covered by Boro rice, while only about 10% area is covered by T. Aman production (Huda, 2004). In the haor areas, hybrid rice is also grown (Das, 2004).

6. BRRI Dhan-29 in Haor Area

BRRI Dhan-29 is a High Yielding Variety developed by Bangladesh Rice Research Institute (BRRI) in 1994. The variety is cultivated in Boro season. Due to its different great virtues along with high yielding quality, the variety gets most popularity in our country. The variety is also very popular in haor regions. In spite of having no suggestion to cultivate in the lower land like haor areas from the concerned authority, farmers prefer this variety for its great virtues. The variety is a long duration variety as it takes about 160 days to be harvested. As haor is a flood prone area this variety is not suggested for. Another variety farmer prefers much is BRRI Dhan-28 along with BRRI Dhan-29. Due to the long duration of BRRI Dhan-29 the production is confined to the choice of nature. In some years the ripen paddy fields get sunken under water and damaged. The farmers have to return home with nil handed and broken hearts.

7. Justification of the Study

The production of BRRI Dhan-29 in haor areas has a great importance to the total production in our country. BRRI Dhan-29 contributes the most in the total production in haor areas. The production of this variety in haor area is higher than any other varieties cultivated in that region, even higher than from BRRI dhan 28, which is a short duration variety and suggested for lower lands like haor areas. BRRI Dhan-29 is not suggested for haor areas due to long duration of harvesting and the risk of getting damaged by sudden flood. But some other varieties like as BRRI dhan 28 is suggested by scientists and concerned authorities for lower lands like haors for their short duration of harvesting. But why farmers of the haor areas (wetland) prefer this long duration BRRI Dhan-29 to other short duration varieties? This study attempted to investigate the reasons behind this fact. The study also endeavored to assess the profitability and resource use efficiency in cultivating

BRRI Dhan-29. The farm households of that are not small at all. The farmers in haor areas mostly depend on this single crop for their livelihood for the whole year to meet all the other family expenses. Besides these areas having lack of communication are poor in using modern technologies, education and other facilities that can influence their life style, income and farm practices. Moreover, the production and income of the farm household are always risky due to

flash flood, hailstorms, blasts in the crop etc. So it is transparently comprehended that the paddy cultivation and farm income are associated with many problems in the haor areas. Hence, the problems should be realized intensively and necessary steps to be taken to improve the rice production and farm income as well.

Taking this ideas in mind the study have endeavored to get a deep insight into the productivity , profitability and resource use efficiency of cultivating BRRI Dhan- 29 in the haor areas. Finally, the problems in haor areas will be pointed out and necessary remedial steps will be suggested to enhance sustainable rice production and food security of our country. Hence the findings of the study will help the planners and policy makers in making rational production plans and the scientists in conducting more researches in rice production in haor areas.

8. Objectives of the Study

The following objectives were set for to give specific directions to the study:

I. to investigate the socio-economic profile of BRRI Dhan-29 producers in the haor areas,
II. to estimate per hectare costs and returns and the profitability level of BRRI Dann-29 in the haor areas,
III. to determine the resource use efficiency (RUE) in BRRI Dhan-29 production in haor areas,
IV. to identify the problems in cultivating BRRI Dahan-29 in haor areas and to suggest policy recommendations derived from the study above.

9. The organization of the Thesis

The thesis consists of nine chapters. Chapter 1 includes the introduction and justification of the research objectives. Chapter 2 represents the reviews of literature related to the study. Chapter 3 indicates the research methodologies of the study. A brief description of the study area was given in the chapter 4. The socio-economic characteristics of BRRI Dhan-29 producers in haor area were described in chapter 5. The cost, return and profitability analysis of BRRI Dhan-29 production was described in chapter 6. The resource use efficiency was estimated on chapter-7. The last chapter-8 includes the conclusion, summary, recommendations of the study.

10. Limitations of the study

The study on profitability and resource use efficiency of BRRI Dhan-29 is useful to provide significant information for farmers, extension workers, planners, scientists etc. However, it is noteworthy that the study suffers from several limitations to. Followings are some limitations of the study:

- The study is conducted only among 70 samples. The result derived from this small amount of sample should not be interpreted for the general condition.
- The study is conducted in the specific haor area of Kishoreganj district of Bangladesh. So the result should be interpreted cautiously.
- Quantification of the family labor is very difficult to calculate in agriculture.
- The study was confined with the BRRI Dhan-29 rice growers during Boro season of the year 2019-2020. So, the comments and forecasting based on the research findings should be made consciously for the whole country and for the other varieties cultivating in other regions.

CHAPTER 2

REVIEW OF THE LITERATURE

Review of literature in the relevant context is very significant in the aspect that it provides a good opportunity for reviewing the stock of knowledge and information relevant to the future research. The knowledge and information give a guideline for the future research problems and justifying the results.

The literature related to costs, returns and resource use efficiency in BRRI Dhan-29 production has been reviewed in this chapter. Costs, return and efficiency might vary from time to time, region to region, farmer to farmer. Therefore, attempts have been made for reviewing the most relevant studies. Very few works had been conducted on BRRI Dhan-29 cultivation in haor areas of Kishoreganj.

Arif (2008) conducted a study on technical efficiency of BRRI Dhan-29 in the context of Bangladesh. The study showed that the levels of technical efficiency in Bogra and Dinajpur ranged from 75 %, 77 % to 93 %, and 98% with a mean of 83 %, 87% which suggests that average rice output falls 17 %, 13% short of the maximum possible level. Therefore in the short run there is scope to increase technical efficiencies on rice farms in the study area. The study also showed that the empirical results indicated that the coefficients of MP, seed cost, mechanical power cost were positive and significant which implied that an increase in the magnitudes of these variables would result the positive impacts on rice production.

Islam (2017) undertook a study on the adaptation of the BRRI Dhan-29 variety and observed that annual income of the farmers had a significant relationship with their adoption of BRRI dhan-29 production technologies.

Majumder (2008) observed that for HYV Boro rice production in owner, cash tenant and crop share tenant operator the rumination of the coefficients were 0.63, 0.85 and 0.62 which means that the production functions exhibit decrease returns to scale.

Majumder showed that the values of MVPs that for seedling and insecticide are greater than one and positive (5.496 and 18.387 respectively) indicating that the farmers had opportunities to increase per hectare output by using more seedling and insecticide. Again the MVPs for human labor and fertilizer were 0.639 and 0.462, which are positive but less than one. It indicates that there was no scope for spending more for labor which would decrease profit.

Rahman (2016/17) undertook an economic investigation on BRRI Dhan-29 production in the context of haor areas of Bangladesh. He showed that the average farm size of the sample farmers was 0.79 hectare and most farmers (around 75%) were small farm type. It was observed that about 11% sample farmers were illiterate and 33% of farmers' level of education was primary. The majority of farmers (65%) belonged to active age group (between 31 to 50 years). The study

found that, per hectare production cost for BRRI dhan-29 was Tk. 80,493. He observed that the regression coefficient of human labor cost, fertilizer cost and irrigation cost of BRRI dhan-29 was 0.354, 0.151 and 0.146, respectively, which were positive and significant. On the other hand, the coefficient of seedling and insecticide cost of BRRI dhan-29 was positive but insignificant. An important fact he found that per hectare yield of BRRI dhan-29 (5780 kg/ha) was about 12% lower than hybrid (6450 kg/ha). Despite producing lower yield BRRI dhan-29 harvested about 8% and 73% higher gross return and gross margin, respectively due to higher paddy price for larger market demand and lower production cost.

Shahin (2016) conducted a research on the profitability of high yielding BRRI Dhan-29 production in some selected areas of Bangladesh. He observed that average yield of BRRI Dhan-29 in Jamalpur district was 3000 kg/acre. The gross returns (including by product) from BRRI Dhan-29 were estimated Tk. 56750.00. The average net returns per acre were found Tk. 10875.00 for BR29. On the basis of gross costs per hectare, production cost of BR-29 was estimated at Tk. 45875.00. He also observed that BCR of BRRI Dhan-29 rice production showed 1.23 that Tk. 1.23 would be earned by spending each Tk. 1.00 investing in the rice production. So, it is clear that BRRI Dhan-29 rice production is profitable in the study area. He found the co-efficient of seed, human labor, and fertilizer are positive and irrigation, pesticides were negative.

Sajedur (2011) carried out a study in haor areas namely, Sunamganj and Habiganj district to evaluate the productivity, profitability, resource use efficiency and farmers' perception of producing of BRRI dhan-29 and hybrid rice production. He estimated that per hectare variable cost of hybrid was about 12% higher than BRRI dhan-29 where yield of BRRI dhan-29 was about 12% lower than hybrid rice. In spite of producing low yield, BRRI dhan-29 gave about 8% and 73% higher gross return and gross margin, respectively due to negative net return from hybrid rice. Portion of human labor cost was found higher compare to all the other factors of production for both BRRI dhan-29 and hybrid rice production. Farmers' share in total income was found higher for BRRI dhan-29 (47.74%) than hybrid rice (32.19%). The coefficient of human labor, fertilizer, insecticides and irrigation cost were found positive and statistically significant. Resource use efficiency of BRRI dhan-29 shown that, fertilizer, insecticide and irrigation were greater than one (underutilization) where excessive use of human labor and seed rate. Study also revealed that, the majority of the farmers preferred BRRI dhan-29 to hybrid rice in their field due to good grain quality and higher market demand.

Sahjahan (2018) estimated that the average cost of rice cultivation was Tk. 38153 per ha in the study haor area. Farmers' average cost of rice cultivation for land preparation, intercultural operation, seed, fertilizer, irrigation, pesticide, harvesting, threshing, carrying and others were of Tk. 3735, 1 6882, 1913, 6309, 2523, 782, 9277, 3421, 3074 and 237 per hectare, respectively. The Gross Return was Tk. 116684 and 115598 for BARI dhan-29 and BARI dhan-58, respectively. It was also observed that the optimum application of recommended fertilizers gave the higher return as well as soils keep fertile. He also concluded that the haor areas are naturally hazardous relative to those of the other irrigated areas of the country. Boro rice cultivation in the

haor area generally faces the difficulties like a failure of timely crop establishment, cold injury in the reproductive stage of an early crop, hailstorms, flash flood damage at the premature to mature stage of a crop etc.

Shahe Alam, Quayum and M. A. Islam (2009) conducted a farm level research on crop production in haor and showed that the cost of production for MV Boro was 79% higher than that of LV rice. But the return from MV boro was about 82% higher than that of LVs .The yield of MV Boro was 79% higher than that of LVs. Both BRRI dhan-28 and 29 were being the widely adopted rice varieties in haor area. They found some major constraints of modern rice production in haor area like higher price of inputs, lack of short duration modern rice variety and lack of flood control dam. Availability of short duration MV seeds and development of physical infrastructure as well as availability of different agricultural machineries such as power tiller, irrigation equipment, threshing machines, drying machines etc. could be immensely useful for horizontal expansion of cropped area in the haor areas of Bangladesh which would eventually increase the level of food productivity in the country.

CHAPTER 3

METHODOLOGY

3.1 Introduction

Appropriate methodology is an indispensible part and a necessity for a good study. The authenticity of a certain research finding relies to a large extent on the appropriate methodology used in the study. Without proper methodology we could not get perfect result. The process of any survey is predominantly determined by the nature, aims, and objectives of the study. It also rely on the availability and the capacity of necessary resources, materials and time.

There are several methods of collecting data for farm management research. A farm business study usually involves collection of data from individual farmers; collection of data for farm business analysis involves judgment of the analyst in the selection of data collection methods within the limits imposed by the resources available for the work (Dillon and Hardaker, 1993). In this study, "survey method" was employed mainly due to two reasons:

I. Survey enables quick investigations of large number of cases and
II. Its results have wider applicability.

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

3.2 Selection of the Study Area

The area selected for the farm management study must serve the very purpose of the objectives of the study. With this end in sense, a survey was carried out in the Haor areas of Kishoreganj district. Two upazila are selected, namely Mithamain and Austagram. Among BRRI Dhan -29 concentered union councils of Mithamain and Austagram, six union councils were purposively selected. They are Mithamain, Ghagra and Keorjori union councils of Mithamain upazila and Austagram, Bangalpara and khayerpur union councils from Austagram upazila. The major reasons behind the selection of this location were:

- A large number of BRRI Dhan-29 growers in this area
- There is no such study on the context of this study previously
- Co-operation from the respondents, Upazila Agriculture Office and officers etc.
- Less natural calamity during the execution of the survey.
- Researcher himself was fairly well known to the local customs and practices and was able to speak the farmers' language. A good association was expected from the respondents.

3.3 Source of Data

Data required for the present study were collected from primary and secondary sources. Primary data were collected from sample farmers and secondary data were collected from various published sources. Secondary sources were Bangladesh Rice Research Institute (BRRI), Bangladesh Bureau of Statistics (BBS), Bangladesh Economic Review (BER), Department of Agricultural Extension (DAE) and other related agencies in Bangladesh and world.

3.4 Sampling Technique

The main purpose of sampling is to select a small group which will represent a reasonably true picture of the population. The size of the sample relies on a number of factors like variability in local conditions, degree of precision required, the funds, the personnel and the time available for survey. However, two factors need to be considered before selecting a sample.

First one relates to the sample size which should be large enough to allow for adequate degrees of freedom in the statistical analysis. On the other hand, execution of the field research, processing and analysis of data should be manageable within the limitation confined by physical, human and financial resources. So, the selection of sample size was one of the crucial things for the study. A rational sample size of was followed in this study to collect relevant data and information. There are several methods of collecting this basic information. For this study data were collected by the survey method. It is a method of data collection based on communication with a representative sample of individuals.

The main reasons of preferring survey method were:

- Survey through sacrificing a certain details, enables quick investigation of a large number case
- Survey entails much less cost and
- Survey provides quick, inexpensive, and efficient measurement.

Survey method was followed to collect production and efficiency related data while, stratified random sampling technique was used to select the BRRI Dhan-29 growers in haor areas.

3.5 Sample Size

A total of 70 farmers were selected from the selected union councils. Before collecting data a list 70 farmers of the six unions of two upazilas, Mithamain and Austagram, are collected from Upazila Agriculture Officers (AO) of concerned upazilas. 35 samples were selected from Mithamain upazila and 35 samples were from Austagram upazila. 12 samples were from Mithamain, 12 samples from Ghagra and 11 samples from Keorjori union councis of Mithamain Upazila. On the other hand, 12 were from Austagram, 12 from Khayerpur and 11 from Bangalpara union council of Austagram upazila.

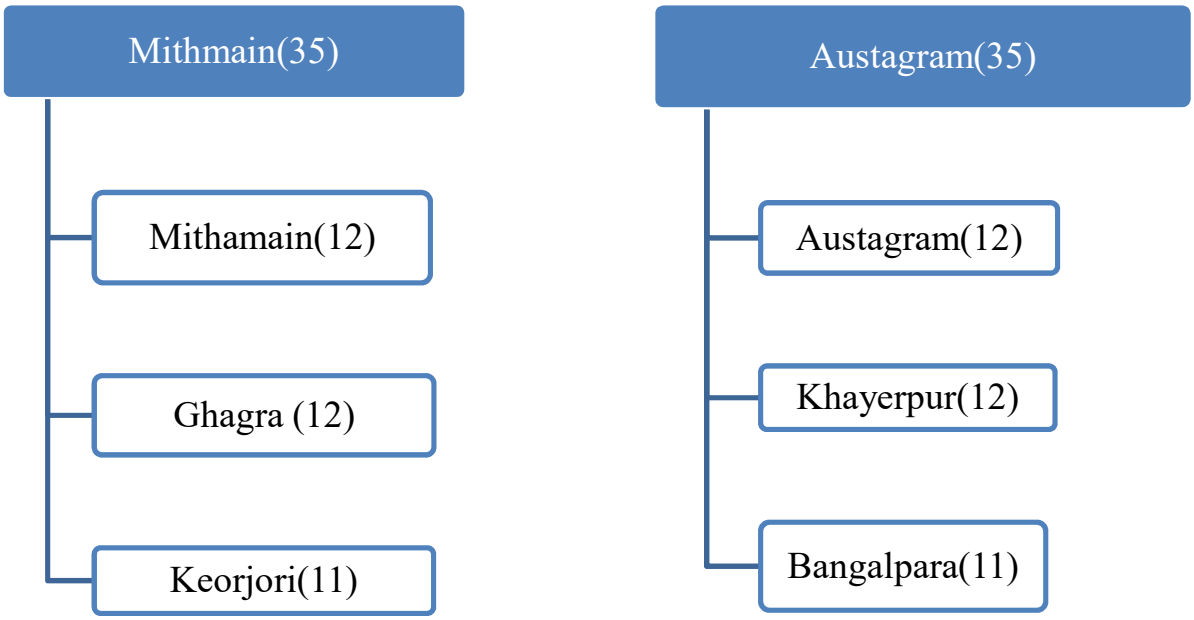


Figure 3.1: Study areas with respective to number of sample selected

3.6 Preparation of Survey Schedule and Pre-testing

In conformity with the objectives of the study, the interview schedule was designed to collect data from the selected BRRI Dhan-29 growers. Having a draft interview schedule prepared it was pretested. On the basis of the pre-test, its applicability and consistency were checked. After then, the final questionnaire were made and logically arranged.

3.7 Period of survey

As BRRI Dhan-29 is a boro season crop it is generally transplanted in December and January and harvested in April in the haor areas. The researcher himself visited several times during boro season in the year 2019 and 2020 and collected data from the farmers.

3.8 Data Collection Accuracy of the Data

The study was based on field level primary data collected by the researcher himself from the previously selected farmers through a direct interview with a interview schedule designed for the research. Researcher frequently visited to the survey location and stayed overnights to collect data and necessary information required. Before of beginning the interview, the objectives of the research were cleared to the farmers and they were made convinced that the data are not to harm them but for academic purpose. At the time of interview, the researcher asked questions systematically and explained whenever felt necessary. The5 data given by the farmer were directly recorded in the interview schedule and in case of any confusion the data were checked before leaving the place. To avoid the errors and for increasing the data authenticity, data were recorded initially in local units and then later converted into standard units.

3.9 Editing of the Data

Having collected of primary data, the filled schedules were manipulated for analysis. These data were verified to eradicate possible errors and inconsistencies. All the collected data were summarized and scrutinized meticulously. For data entry and data analysis, the Microsoft Office Excel programs were used. It might be observed here that information was collected initially in local units and after checking the collected data, it was converted into standard units. Finally, a few relevant tables were prepared according to requirements of analysis to meet the objectives of the study.

3.10 Analysis of Data

Collected data were coded, classified, tabulated and analyzed in terms of the objectives set for the study. Both tabular and statistical analytical techniques were used to get important correlations among the relevant variables.

3.10.1 Tabular Technique

Tabular method was intensively used for its inherent quality of purporting the actual picture of the farm economy in the simplest form. Percentage and arithmetic mean or average were employed to analyze data and to explain socioeconomic characteristics of BRRI Dhan-29 producers, to know input costs and returns of BRRI Dhan-29 production and to calculate undiscounted Benefit Cost Ratio (BCR).

3.10.2 Statistical Technique

A production function analysis is executed to examine the effects of application of the variable inputs in the production of BRRI Dhan-29. Hence the cobb-Douglas Production functions were used to determine the effects of variable inputs.

Specification of Production Function Model

The cobb-Douglas functional form of multiple regression equation is following:

$$Y=a\, x_1^{b1}\, x_2^{b2}\, x_3^{b3}\, x_4^{b4}\, x_5^{b5} e^{u} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(i)}$$

The function is linear used by transforming it into the following logarithm (Double log) form

Or $\text{Ln } Y = \ln a + b_1 \text{Ln } X_1 = b_2 \text{ Ln } X_2 + b_3 \text{Ln } X_3 + b_4 \text{Ln} X_4 + b_5 \ln X_5 + U$ … … …..(ii)

Where,

Y = Return from BRRI Dhan-29 (Taka/ha)

a = intercept value (Taka/ha)

x_1 = costs of human labor(Taka/ha)

x_2 = costs of seeds/seedling (Taka/ha)

x_3 = costs of fertilizers (Taka/ha)

x_4 = costs of pesticides (Taka/ha)

x_5 = costs of irrigation (Taka/ha)

U = error term

b_1,……., b5 = are the co-efficients of respective variables

ln = Natural logarithm

e = base of natural logarithm

3.10.3 Test of significance

T-test is used to test the formulated hypothesis whether it is acceptable or reject able.

3.10.4 Efficiency Analysis

The resource use efficiency of the farmers was judge on neo-classical criteria. Neo-classical theory states that, to achieve the efficient resource use condition, the Marginal Value Product (MVP) should be equal to Marginal Factor Cost (MFC) under perfect competition. The producer used to select the variable input level that maximizes the profit.

Profit = TR-TC…… …… …… …… …… …… …… …(iii)

Where,

TR= Total Return

TC = Total Cost

Marginal Product Value (MVP)

When value of the marginal product is calculated in monetary terms then it is called Marginal Value Product (MVP). In our model, the estimated co-efficient represented the elasticity of production. As both the dependent and explanatory variables are measured in monetary terms, the MVP would be attained in relation to the additional unit of taka invested each individual inputs. Thus in order to get this Marginal Value Product, the co-efficient of production elasticity is multiplied by the output-input ration of the geometric mean level, which can be shown in the following formula:

$$MVP = \frac{Y}{xi} x\ b_i \ldots\ldots\ \ldots\ldots\ \ldots\ldots\ \ldots\ldots\ \ldots\ldots\ \ldots\ \ldots \text{(iv)}$$

Where,

b_i = regression co-efficient of input x_i

x_i = mean value (Geometric mean) of x_i variable inputs

y = mean value (Geometric mean) of gross return of BRRI Dhan-29 production

Marginal Factor Cost (MFC)

In the model, Marginal factor Cost of all the inputs are measured in terms of additional taka expensed for using individual inputs.

Measurement of Efficiency

To measure the efficiency, we would compare and test the ration of Marginal value Product (MVP) and Marginal Factor Cost (MFC) for them for each of the inputs for its quality to 1(one).

$$\frac{MVP}{MFC} = 1 \ \ldots\ldots\ \ldots\ldots\ \ldots\ldots\ \ldots\ldots\ \ldots\ldots..\ \ldots\ldots\text{(v)}$$

The resource is thought to be efficiently used and profit will be maximized in BRRI Dhan-29 cultivation when the ratio of Marginal value Product and Marginal Factor Cost is equal to 1 or MVP is equal to MFC for each input i.e. MVP=MFC.

In the model, for measuring the ratio of MVP to MFC, the denominator i.e. MFC will always be equal to 1. Therefore, the ratio will be equal to their respective MVP.

If the ratio of MVP/MFC were greater than 1, that is **MVP>1,** it would imply that the farmer was inefficient on their average in using their resources. In this case inputs are underused compared to the optimum level.

If the ratio were equal to 1, that is, **MVP =1**, it meant the resources were optimally and efficiently used.

If the ratio were less than 1, that is, **MVP<1,** it would mean the resources were not efficiently but overused. To get the optimal level farmers were required to lessen the use of resources.

3.10.5 Methods of Evaluating the Cost Items

Hence, an attempt has been made to estimate the costs and returns BRRI Dhan-29. To estimate the net returns of BRRI Dhan-29 rice production, it is a necessity to estimate the actual costs and returns in appropriate processes. Inputs that were used in the study area were both purchased and family supplied. Thus, the total production costs consisted of cash and non-cash expenses farmers had to pay cash for the purchased inputs like hired labor, seeds, fertilizers, insecticides, fertilizers, irrigation charge, etc. It was easy to measure the costs of these items. But, no cash was actually paid for the inputs that were home supplied like family labor, tools and equipment, seeds etc. In these cases, family supplied labor costs were estimated based on the opportunity cost principle. Opportunity cost of an item is defined as an income, which an input is capable of earning in an alternative employment in or outside the farm (Bishop and Toussaint, 1958). The input items were valued at the existing market price in the area during survey period or the prices at which the farmers really used to buy the inputs. A list of cost items and their estimation procedure are following:

(a) Human labor cost

(b) Seed cost

(c) Fertilizer cost

(d) Irrigation cost

(e) Insecticides and pesticides cost 25

(f) Tillage cost

(g) Interest on operating capital and

(h) Land use cost.

3.10.5.1 Human Labor Cost

In the tradition agriculture of Bangladesh, human labor is the major input in rice production. The cost expensed for paying the human labor is called human labor cost. Human labor can be categorized into two items:

a) Family labor, for which no cash payment is required,
b) Hired labor, for which cash or kind payment is required.

Family labor cost was estimated by based on opportunity cost, where the average wage of the hired labor was taken as the opportunity cost of the family labor. Labor requirement is calculated in terms of man-days, which usually considered eight hours working in a day. For woman and children man-equivalent days are used, calculated as follows:

1 adult= 1.5 woman = 2 Children

3.10.5.2 Cost of Seed

In the selected study location, the farmers used to apply home supplied and purchased seeds and seedlings of BRRI Dhan -29. Costs of purchased seed were priced on actual price paid by the farmers in the study area.

3.10.5.3 Costs of tillage/ Land preparation Costs

In the Haor region, lands were prepared by tractor for transplanting seedling. Tractor is used for plowing and laddering. There was a competitive rate for using tractor in the study areas. The farmers paid the charge for power tiller used at a fixed rate prevailing in the study area. Animals are not used for land preparation in the haor area.

3.10.5.4 Cost of Fertilizer

In the selected study area, farmers used 3 kinds of fertilizers for high yielding BRRI Dhan-29 rice. They normally used Urea, Triple Super Phosphate (TSP), Muriate of Potash (MoP). A fertilizer cost is calculated at the actual prices paid by the farmers including all incidental charges. In the haor area manures such as cow dung, ashes were not used.

3.10.5.5 Cost of Irrigation

In the study area farmers mostly used shallow tube well (STW) for irrigation from underwater and rivers. The cost of water was charged at fixed rate for the season on the basis of per unit of irrigated land for shallow tube well and diesel cost.

3.10.5.6 Cost of Insecticides and Pesticides and herbicides

In the study sites, maximum of the farmers used insecticides, pesticides and weedicides for cultivation of BRRI Dhan-29. Commonly used insecticides, pesticides and herbicides were

Thiovit, Furadan, Heptachlor, Dimecrone, Nogos, zeroherb etc. The cost of insecticides and pesticides were the amount of money, which the farmers really paid to buy them.

3.10.5.7 Cost of Land Use

In the studied haor area, cost of land use would vary from land to land, union to union according to the topography, fertility, distance from the home etc. Land use cost include:

a) rental value for a season
b) Interest on the value of land

3.10.5.8 Interest on Operating Capital (IOC)

Interest on operating capital was calculated taking all costs spent on various Operations in the production process of BRRI Dhan-29 rice excluding those for which interests were already calculated. Interest on operating capital was charged at the rate of 10 percent per annum and was estimated for the duration of five months for BRRI Dhan-29 rice in haor area. It was assumed that if the farmers borrowed the money from a NGO, they had to pay interest at the same rate. It was measured by the following formula:

Interest on operating capital = (Operating Capital X interest rate X time considered)/12 ……

… …… …… …… (vi)

The period of crop cultivation was considered from the time of land preparation to harvest. The interest actually means the average operating costs over the period as all the costs were not spent at the same time; rather these were used throughout the production period from land preparation to harvesting.

3.11 Calculation of Returns

3.11.1 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 X Average price of the product) + Price of the byproduct

……(vii)

3.11.2 Gross Margin

The difference between gross return and variable costs is called Gross Margin. Generally, farmers wish to have 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. Per hectare gross margin was obtained by subtracting variable costs from gross return. That is;

Gross margin = Gross return – Variable cost…….(viii)

3.11.3 Net Return

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

Net return = Total return – Total Cost…… ….. …… ….. ……. (ix)

3.11.4 BCR (Benefit Cost Ratio)

The undiscounted benefit cost ratio (BCR) is a relative measure which was used to compare benefits per unit of cost. It helps to analyze the financial efficiency of the farms. BCR was calculated by using the following formula:

$$BCR = \frac{\text{Total Return(Gross Return)}}{\text{Total Cost}} \text{…….. (x)}$$

CHAPTER 4

DESCRIPTION OF STUDY AREA

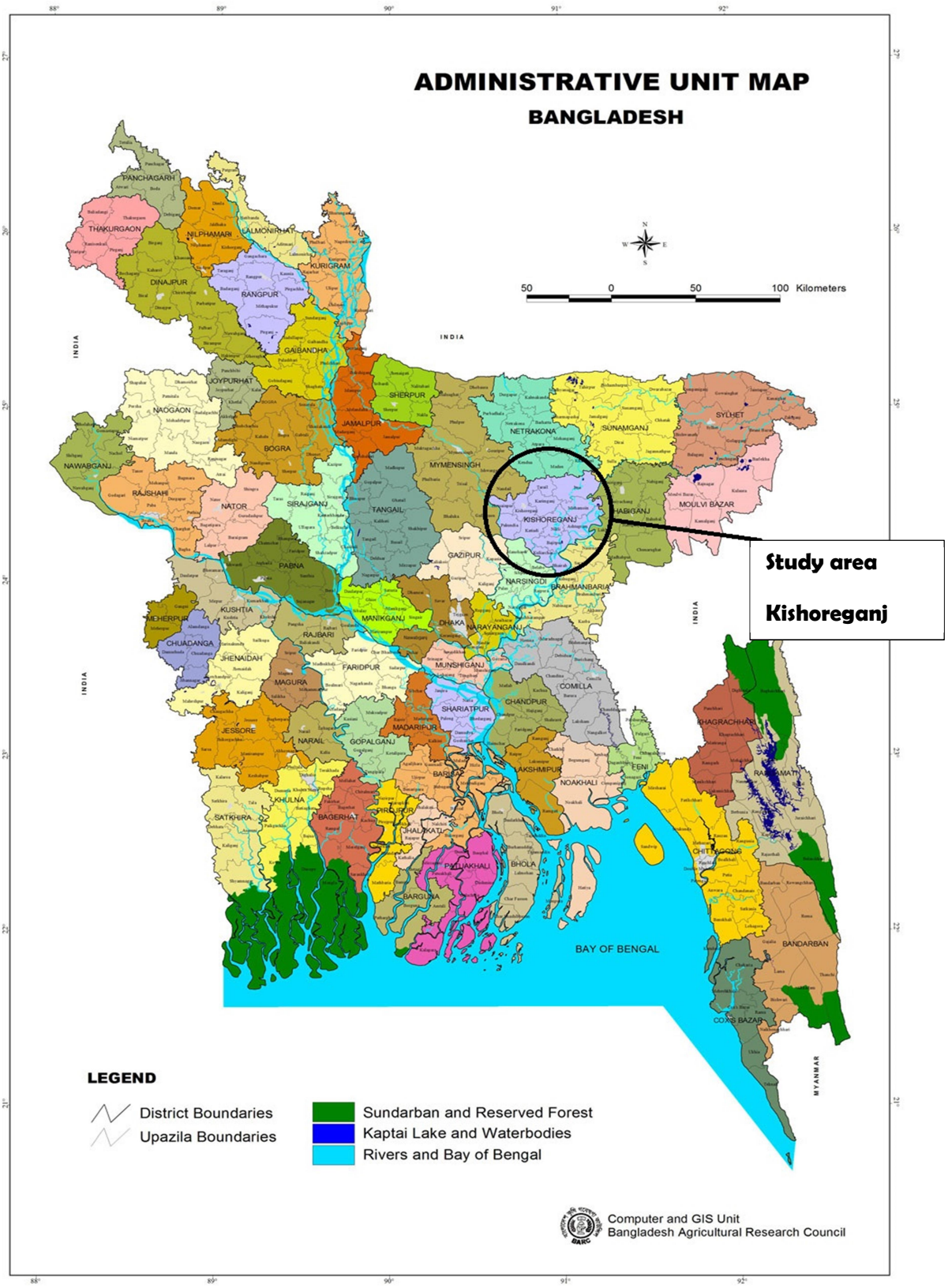
4.1 Introduction

A brief narrative has been given in this chapter about the location of the study. Preconception on the study region is very important to understand the location, physical features and topography, soil type, temperature, rainfall, agricultural and economic condition, population, education and other socioeconomic infrastructures available in the area. This chapter aims to present the above mentioned features of the study area.

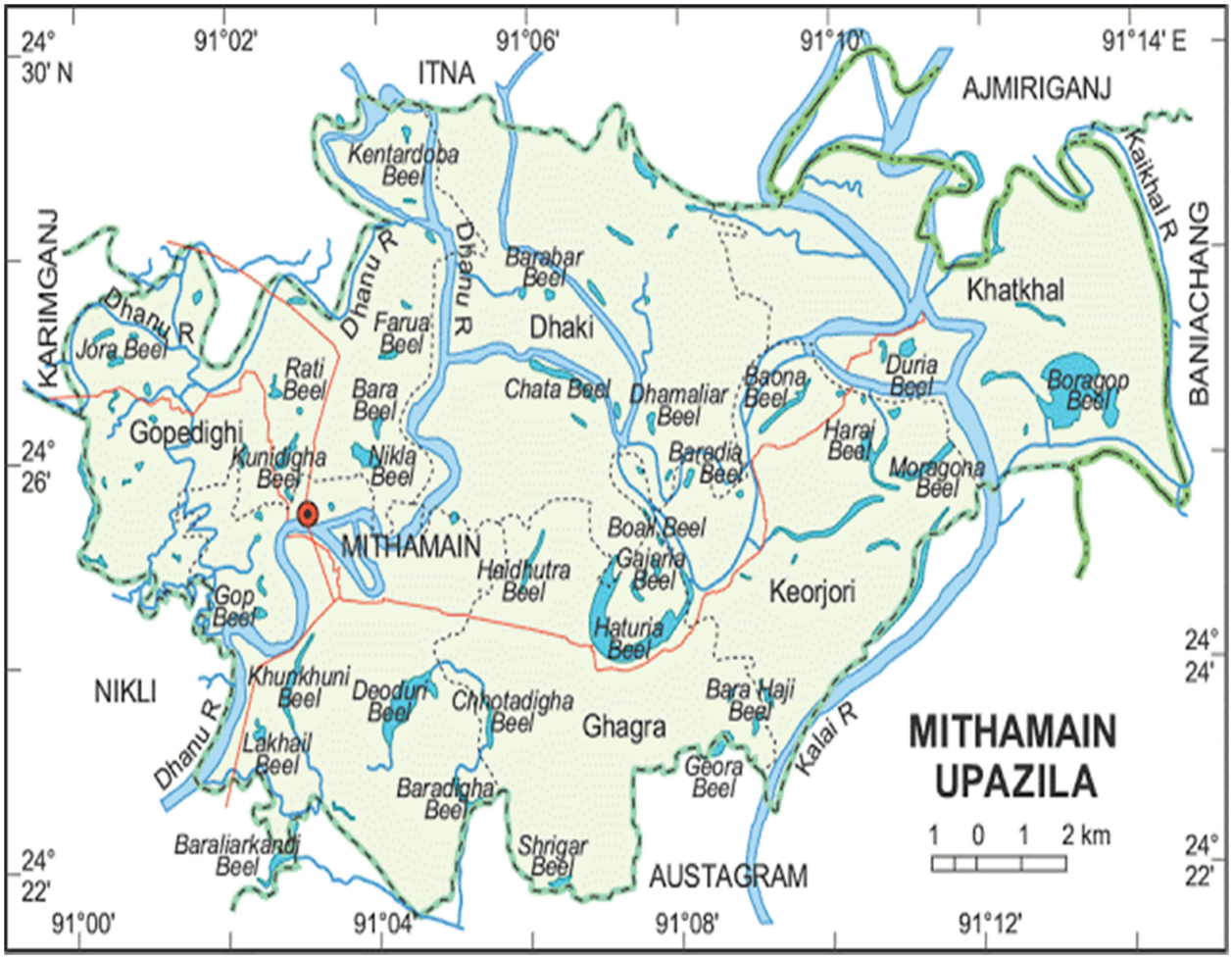
4.2 Location

The study was conducted in the haor areas of Kishoreganj district. Six union councils are selected from the two upazilas namely, Mthamain and Austagram, of the district. Three union councils are selected from Mithamain and they are Mithamain, Ghagra and Keorjori. Other three union councils are from Austagram and they are Austagram, Bangalpara and khayerpur.

Kishoreganj District (area 2731.21 sq. km, located in between 24°02' and 24°39' north latitudes and in between 90°35' and 91°15' east longitudes. It is bounded by Netrokona and Mymensingh districts on the north, Narshindi and Brahmanbaria districts on the south, Sunamganj and Habiganj districts on the east, Gazipur and Mymensingh districts on the west.



Map 4.1: Map of Bangladesh



Map 4.2: Mithamain Upazila

Map 4.3: Austagram Upazila

4.3 Physical features, Topography and Soil Type

The study area belongs to the Agro-Ecological Zones of Lower Meghan Estuaries Floodplain (AEZ-19). Most part of Kishoreganj district is lower plain land. The eastern part of the district is lower land which is called haor. Haor is a bowl-shaped large tectonic depression. It receives surface runoff water by rivers and khals, and consequently, a haor becomes very extensive water body in the monsoon and dries up mostly in the post-monsoon period.

In its original form, the haor basin comprising the floodplains of the Meghan tributaries would have consisted of a rich mosaic of permanent and seasonal lakes and ponds with abundant aquatic vegetation. But through gradual sedimentation, the basin becomes shallower leading to the formation of reeds and sedges. This resulted in providing enough food and shelter for fish and other aquatic, fauna and attracted the migratory birds which, in their turn, added to the fertility of the water bodies by their excreta promoting rich growth of phytoplankton and macrophytes thus partly contributing to the process of eutrophication.

The seasonal wetlands being floodplains of the rivers are covered with sandy, or silty, or silt mixed sandy soils. It has some clay soils at patches, carried and deposited by the rivers. But, the all season wetlands have thick deposit of clay mixed organic soils. This happens because of carrying finer particles and clay soils from distant sources, and accumulating in deep inland, away from the rivers. The all season wetlands also accumulate suspended organic solids, and have deposition of the fossils of aquatic plants.

4.4 Non-Government Organization

At present, a number of important non-government organization (NGOs) such as BRAC, Proshika, Caritas, ASA, CARE, Grameen Bank, Nari Udyog etc. are operating in the study area in recent years. NGOs were help to providing technical training on poultry and cattle rising, handicraft, livestock rearing and homestead gardening to the people of the study area. They also provide bank loans to poor women and landless farmers (BBS, 2018).

4.5 Transportation, Communication and Marketing Facilities

Transportation is an important factor in agricultural and economic development of a country. Without well development communication infrastructure, it is impossible to the rural people to enjoy the facilities of modern technology. Marketing facilities are crucial to the modem economic activities and play a significant role in rural development. The marketing facilities of villages of the study area were not good but very backward. Formal marketing system locally called ‘Hat’ or ‘bazar’ was present there. Total number of hats and bazars were 20. The villagers were generally buy and sell their agricultural products and also purchased all other daily necessaries from these markets.

CHAPTER 5

SOCIO-ECONOMIC CHARACTERISTICS OF BRRI DHAN-29 PRODUCERS

5.1 Socio-Economic Characteristic of Sample Farmers

Socio-economic characteristic affect the farmers production activities. An endeavor has been undertaken to describe briefly some of the socio-economic features of the BRRI Dhan-29 producer. Socio-economic characteristics can be looked into from versatile point of view relying on a number of parameters. The parameters were household composition, pattern of tenancy or the ownership of the land, ownership of poultry and livestock etc.

5.1.1 Household Composition

Age: Age of the BRRI Dhan-29 producers' farm family members was estimated since their birth to the interview time. In the present study, family members were classified into three categories of age: bellow 15 years, 15 to 50 years and above 50 years. It can be seen from the table 5.1 that 22 percent family members belonged to the age group below 15 years, 61 percent family members were in the age group between 15 -50 years and only 17 percent of the family members were above 50 years of age.

Table 5.1: Distribution of Family Members by Age Groups

Age groups (years)	**Farm family members**	
	Number	**Percent (%)**
Bellow 15	94	22
16-50	249	61
Above 50	69	17
Total	**412**	**100**

Source: Field survey, 2019-20

In BRRI Dhan-29 rice farm families, the highest number of family members was in the age group between 16 to 50 years and the lowest number of family members belonged to the age group of above 50 years (Table 5.1).

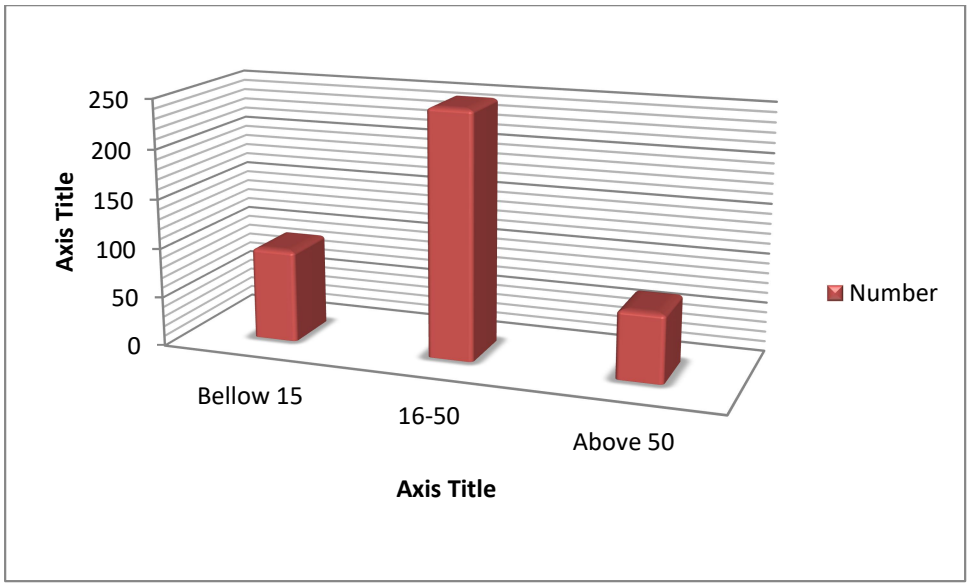


Figure 5.1: Farm family members' age distribution (Field survey, 2019-20)

5.1.2 Family Size

In the present study, a family was defined as the number of person living together under the control of one head and taking food from the same kitchen. The present study found the average family size was 6.1 per household, whereas the national level household size was 3.14 (BBS, 2019)

Table 5.2: Family size distribution

Family Type	Small Family	Big Family	Average Household size in study area	Average Household size at National level
No. of family	27	43	6.10	3.14
Family Size	4.8	8.1		

Source: Field survey, 2019-20 and BBS, 2019

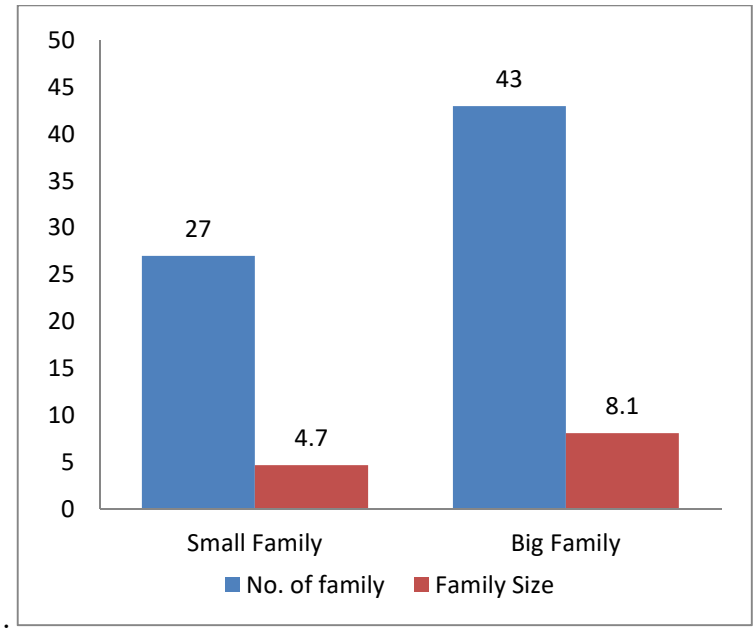


Figure 5.2: Family size distribution (Field survey, 2019-20)

In case of 43 big families, where the family members were more than 5 persons the average family size (more than 5 members) was found 8.1. On the other hand, In case of 27small families, where the family members were 5 persons or less, the average family size was found 4.7 (table 5.2).

5.1.3 Education

The average number of schooling years was found 8.50 years whereas the national average years of schooling were 11.2 years (UNDP, 2020). It was found in table 5.3 that Maximum farm family members (about 33%) were in the primary education category and second highest about 27% members were in higher secondary education category. From the figure 5.2 we can see that only 2.4% farm family had completed graduation.

The male members and female members of the large farms had the highest number schooling years. On the other hand, the male and female members of small farm had the lowest number of schooling years.

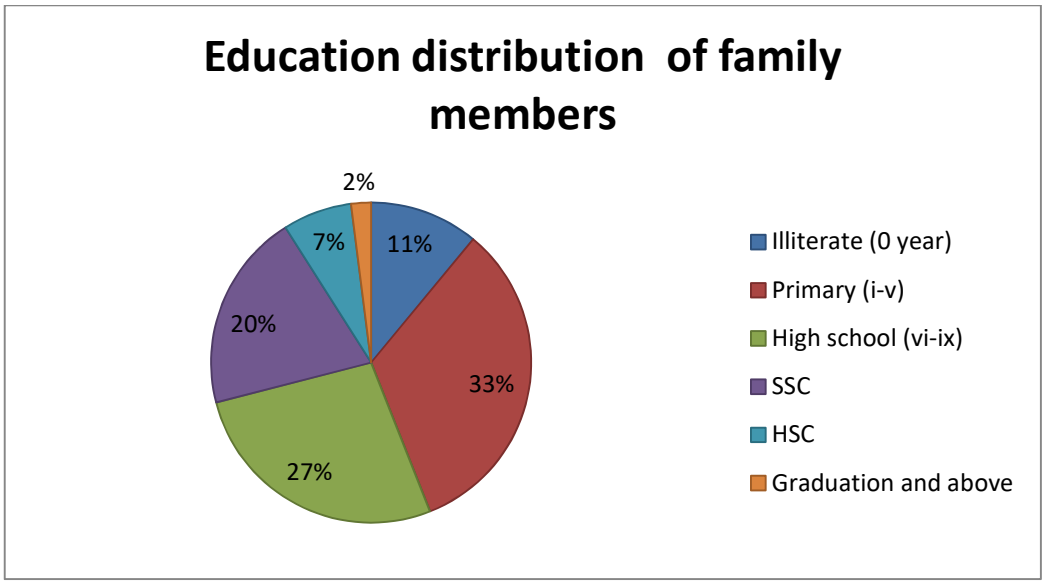


Figure 5.3: Distribution of education among the family members (Field survey, 2019-20)

Table 5.3: Distribution of education among the family members in units and percent

Education	No. Of family members	Percent (%) of Total family members
Illiterate (0 year)	46	11.30
Primary (i-v)	139	32.3
High school (vi-ix)	114	27.0
SSC	84	20..0
HSC	30	7.0
Graduation and above	8	2.40
Total	**421**	**100**

Source: Field survey, 2019-20

5.1.4 Income distribution of the farmers:

In haor areas, farming activities usually concentrated in boro rice cultivation in boro season. In the rest period of the year farmers have almost no income related activities. They used to sit idle and wait for the next boro season. But some of them especially the small farmers used to migrate to other places of the district or to Dhaka for earning through physical labor. The large farmers earned the higher non-farm income, which was on an average 56,345 tk/year (Figure 5.3). On the other hand, small farmers earned low non-farm income, which was on an average 5742 tk/year (Figure 5.3).

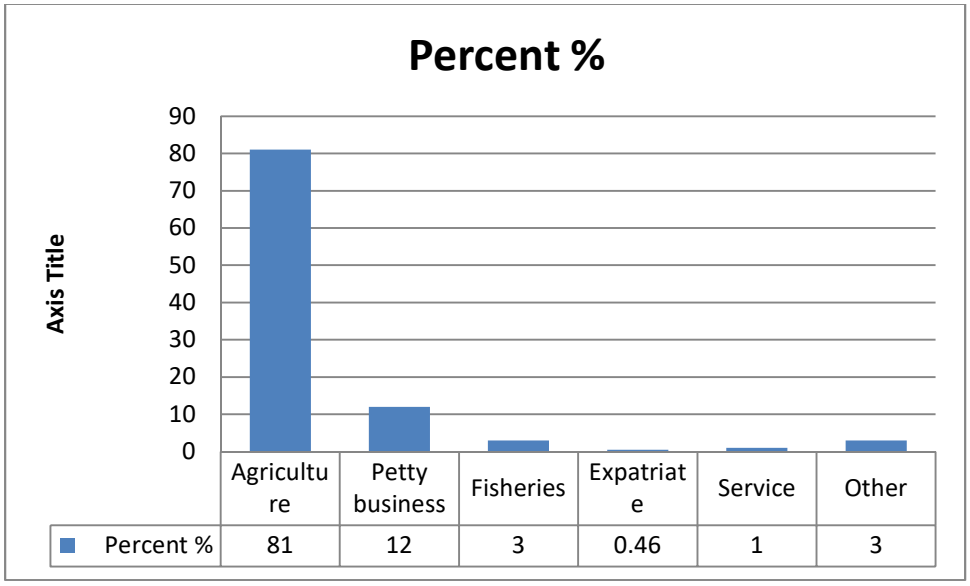


Figure 5.4: Occupation of sample farmers in percent adapted from (Field survey, 2019-20)

5.1.5 Land Ownership

Agricultural development in an agrarian economy largely depends on the existing nature of man-land relationship. Crop-sharing is one of the earliest forms of production organization in agriculture. It is still a matter of considerable importance in present agriculture in many regions of the country. Both land lord and tenant are utilizing inputs belonging to other party. Each party may consider the inputs contributed by the other party to have a zero price. In this case, there will be a tendency to use the other person's input up to the point where the value of the marginal product is zero. For example, the tenant's labor has no price to the landlord. The landlord tends to push the use of the tenant's labor, in so far as he is able to reach the point where additional labor brings no return. That is, land lord would like to see enough labor used so that the value of the marginal product of labor would be zero. The tenant on the other hand, considers the price of land zero. He has incentive to use additional land as long as the value of the marginal product of the land greater than zero. But the land has a cost to the landlord. For this reason a conflict of interest may develop. The crucial problem of growth in agriculture in Bangladesh is how to

increase the output per unit of input. One way of approaching this problem of improving agricultural production efficiency is to examine whether the present pattern of ownership and use of resources is efficient or inefficient. Due to natural hazards, crop share tenants do not usually take the risk of extra investment in their farm business. A crop share tenant is quite unable to seek any technological improvement in organizing his farm business. Resource use and production under different tenure groups of farms in Bangladesh, especially in haor regions has been a controversial issue. One of the focuses of this study is to measure and compare the resource use efficiency and land productivity of growers, crop share tenant and cash tenant farmers. Share renting can be an efficient means of farm production. To avoid almost inevitable conflicts between landlords and tenants, variable costs, such as seed and fertilizer should be shared in the same proportion as returns.

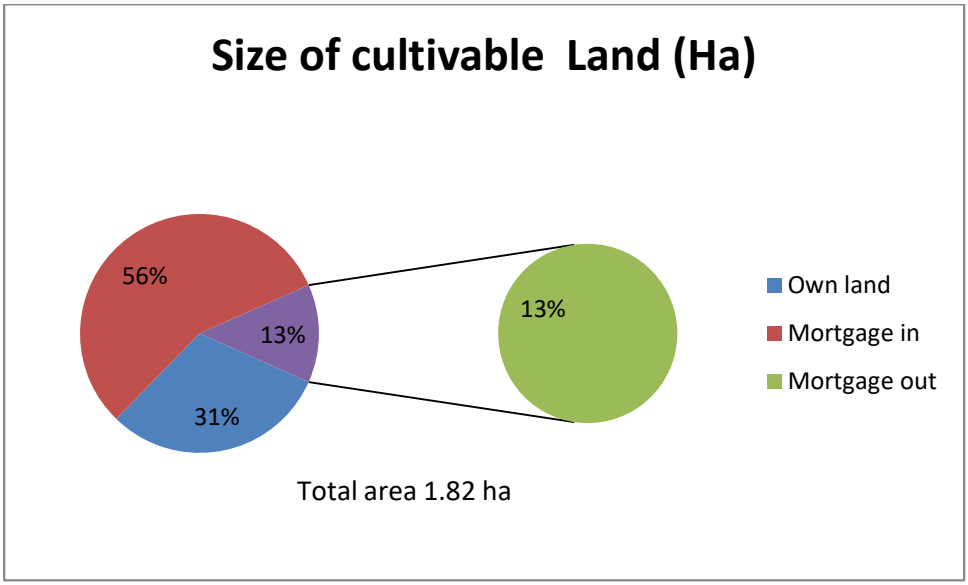


Figure 5.5: Acquisition of cultivable land (Field survey, 2019-20)

In the studied haor area, about all the farmers (99%) belong to their own land. About 76.3% of the samples of the BRRI Dhan-29 growers were small farmers having their own cultivable land of 0.76 hectares. But these small farmers leased others land for cultivation purpose, thus their average cultivable land were 1.82 hectares. Renting in, renting out, mortgage in, mortgage out were the prevailing in the haor area where the study was conducted. Farm size can be measured by using the following formula:

Farm Size = Own Land + Rented in + Mortgaged in - (Rented out + Mortgaged out)……..

…… …. ….. ….. … (xi)

5.1.6 House Ownership

It was observed that in the study area almost 100% farmers have their own house. It was also found that, only 18.8% of the farmer had building and 77.2% of the farmers have tin-shed and half-building house.

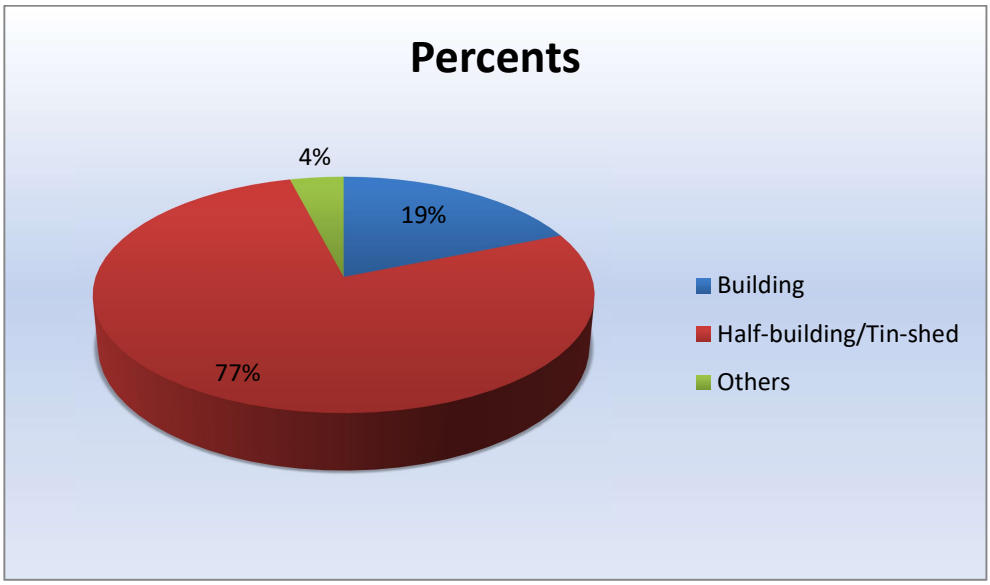


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Figure 5.6 : Types of house own by sample farmers (Field survey, 2019-20)

5.1.7 Farming Experience of sample BRRI Dhan-29 growers

Agriculture especially boro rice cultivation is the main occupation for the people of haor areas in Kishoreganj. Since, their childhood, the people involved in the agricultural activities. Thus, they gain a good farming experience of many years. In the study, it was found that, 7% sample BRRI Dhan-29 growing farmers have 0 to 10 years of experience, 26% sample have 11 to 20 years of experiences and 67 % sample farmers have more than 21 to 50 years of farming experience.

Table 5.4: Farming Experience of sample BRRI Dhan-29 growers

Years of Experiences	Percent
0-10	7%
11-20	26%
21-50	67%

Source: Field survey, 2019-20

5.2 Cropping Pattern in the Study Area of Haor

Cropping pattern may be defined as the arrangement of crops cultivated in a piece of land in a year. In other words, cropping pattern may be defined as the yearly sequence of crop production in an area or the way crops are grown in a piece of land in the course of a year . There are three cropping season in Bangladesh- Rabi, kharif-1 and Kharif-2. But there is only one season, called Rabi season or boro season in the study area of haor region of Kishoreganj.

In Rabi season, boro rice is the main crop but few farmers cultivate some vegetables too in the study area. Some vegetables like tomato, chili, khira etc. But very recently farmers are growing maize. 100% of the farmers follow the cropping pattern given bellow:

Table 5.5: Cropping Pattern in the Study Area of Haor

Cropping Pattern	Farmers (%)	Cropping intensity
Boro-fallow-fallow	100	100

Source: Field survey, 2019-20

5.3 Concluding Remarks

The haor areas studied were very backdated and poor localities comparative to rest of the country. Poor literacy rate and very fragile communication system are thought to be the main reason behind this. Agriculture is the main occupation and mostly influential factor for development there. The government must try to develop this area and agriculture by taking necessary steps immediately. The present government has already taken some steps to improve the conditions. They are establishing some major weather roads over the haor. But these are not yet enough. These initiatives will earn appreciation from the local people if these can be carried on.

CHAPTER 6

COST, RETURN AND PROFITABILITY ANALYSIS

6.1 Introduction

This chapter aims to estimate the costs of inputs used, returns from the product output and the profitability for the production of BRRI Dhan-29. Profitability is one of the major parameters for taking the decisions for growing any crop in farm level. It could be calculated based on net return, gross margin and benefit cost ration etc. The costs of all the inputs used in producing BRRI Dhan-29 are calculated to find the total cost of production. And return can be found from the calculation of the values of the products and by-products.

6.2 Profitability of BRRI Dhan-29

6.2.1 Variable Costs Calculation

6.2.1.1 Cost of Land Preparation

Land preparation is one of the vital steps in the production process. In the study area, land preparation included ploughing and laddering. Tractor is used for the purpose of ploughing and laddering to prepare the land in BRRI Dhan-29 production. Average land preparation cost of BRRI Dhan-29 production was found to be Tk. 4146.74 per hectare, which was 12% of total variable cost and 8.0% of total cost (Table 6.1).

6.2.1.2 Cost of Hired Labor

Agriculture in the haor area is very much human labor induced process. Despite of introducing mechanization in rice cultivation, human labor is still a major component of boro rice production in haor area, so is to say for BRRI Dhan-29 cultivation. So, human labor is a big cost component for BRRI Dhan-29 production. On an average 39 man-days are required for mainland preparation, transplanting, weeding, irrigation, spraying insecticides etc. The quantity of human labor required for BRRI Dhan-29 cultivation is variable, depends on using tractors and combined harvesters. So, the average costs of human labor for per hectare BRRI Dhan-29 production is Tk. 15122.8, which was 43.3% of total variable cost and 29% of total cost (Table 6.1).

6.2.1.3 Cost of Seed/Seedling

Without seed or seedling, rice production is zero. So, Seed cost is the compulsory cost for BRRI Dhan-29 production. The cost varied according to the quality and availability of seed or seedling. The recommended seed rate of BRRI Dhan-29 is 25 kg to 30 kg per hectare varied based on location. In study area applied seed rate was 28 kg/ha. Average value of a 10 kg seed-bag was estimated 370 tk. On an average, in the study area, seed cost is found 1041 tk/ hectare (Table 6.1: showing all per hectare costs), which 3% was of total variable cost and 2% of total cost (Table 6.1).

Table 6.1: Per hectare cost of BRRI Dhan-29 in Haor area

Input variables	Cost (Taka/ha)	Percent of total variable cost	Percent of total cost
Variable Cost (VC)			
Land preparation cost	4146.74	12.0	8.0
Hired labour	15122.8	43.3	29.0
Seed cost @28.1kg/ha	1040.90	3.0	2.0
Fertilizer cost	5644.71	16.2	10.9
Insecticides, pesticides and herbicides cost	860.69	2.5	1.7
Irrigation cost	8056.05	23.3	15.5
A. Total variable cost (TVC)	**34576.0**	-	-
Fixed Cost (FC)			
Rental value of land	**11115**		
Interest on operating capital @6% for 5 months	871.8		
Family Labour	5155		
B. Total Fixed Cost (TFC)	**17142.4**		
C. Total Cost (TC) (B+C)	**52013.43**		

Source: Field survey, 2019-20

6.2.1.4 Cost of fertilizer

For BRRI Dhan-29 production in haor area, farmers used to apply Urea, Triple Supper Phosphate (TSP) and Muriate of Potash (MoP). In the studied haor area, no manure was found to be used for rice production. Total fertilizer cost of BBRI Dhan-29 production in haor area was estimated to be Tk. 5645 per hectare which was 16.2% of total variable cost and 10.93% of total cost (Table 6.1).

Cost of Urea

On an average, farmers used Urea 197 kg/ hectare but the applied seed rate was 216-230kg per hectare. The price of urea was 16 taka per kilogram. So, on an average, per hectare total cost of urea in BRRI Dhan-29 production in study area is Tk. 3152.

Cost of TSP

Per hectare average application TSP in the study area for BRRI Dhan-29 was 68 kg. The average price of TSP was 22 tk./ kg. So the total cost of TSP in a hectare of BRRI Dhan-29 production was estimated to be 1496 tk. /ha.

Cost of MoP

The application of Muriate of Potash (MoP) was found lower than any other fertilizer used in BRRI Dhan-29 production. Per hectare average rate of MoP was estimated to be 65 kg/ha. And price was 15 Tk. / Kg. So, total cost of MoP was found to be 996 taka per hectare, on average.

Total cost of fertilizer was calculated as follows:

Total fertilizer cost = (cost of urea + cost of TSP + Cost of MoP)

So, per hectare total fertilizer cost was found 5645 tk. for BRRI Dhan-29 production.

6.2.1.5 Cost of Insecticides

BRRI Dhan-29 growers used various types of insecticides pesticides and herbicides to keep their crop free from diseases and weeds. It was found that per hectare cost of insecticides and pesticides for BRRI Dhan-29 variety production were Tk. 861, which 2.5% of total variable cost and 1.7% of total cost (Table 6.1).

6.2.1.6 Cost of Irrigation

BRRI Dhan-29 is a rice variety that grows in boro season. So, a heavy irrigation is required for this variety. Irrigation is considered as the leading input of rice production. Right doses application of irrigation water help to increase number of tillering, number of leaves, flowering, fruiting and plant height etc. It appears from Table 6.1 per hectare cost of irrigation of BRRI

Dhan-29 rice production was Tk. 8056.5 which was 23.3% of total variable cost and 15.5% of total cost (Table 6.1).

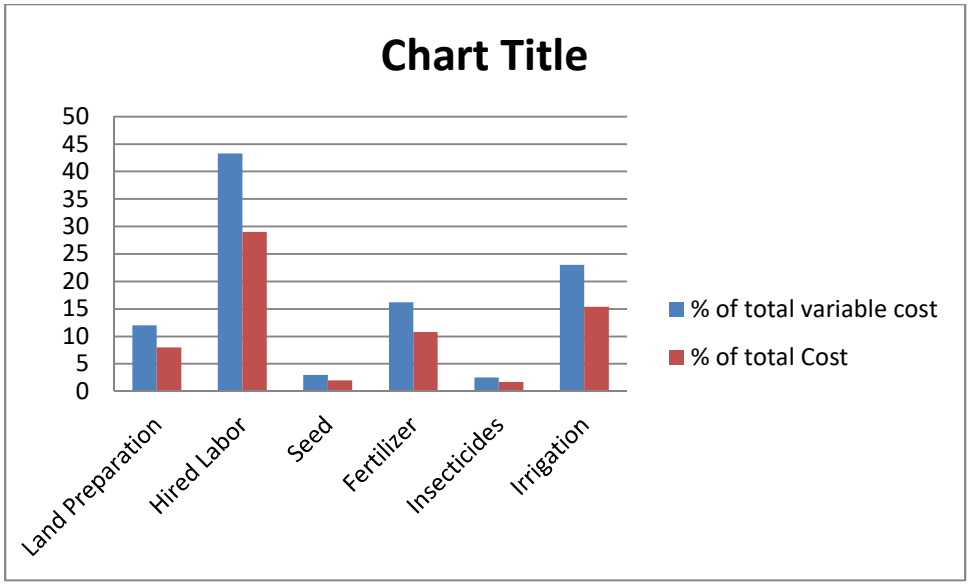

Figure 6.1: Percentage of costs of variable input to total operating cost, total variable cost and total cost (Field survey, 2019-20)

6.2.1.7 Total Variable cost

Therefore, from the above cost items, it was transparent that the total variable cost of BRRI Dhan-29 was Tk. 34576 per hectare, which was 67% of total cost of production (Table 6.1).

6.2.2 Fixed Cost Calculation

6.2.2.1 Rental Value of Land

The principle of opportunity cost was used to estimate the land use cost or the rental value of land. The cost is calculated for the cropping period. BRRI Dhan-29 is a boro rice variety which requires approximately 5 months. So, the rental value was calculated for 5 months it was found to be Tk. 11,115 per hectare (Table 6.1).

6.2.2.2 Interest on Operating Capital (IOC)

It is noteworthy to say that the interest on operating capital was estimated by taking into account all the operating costs expensed at the time of whole production period of BRRI Dhan-29. Per hectare interest on operating capital was Tk.871.8 for 5 months (Table 6.1).

6.2.3 Total Cost of BRRI Dhan-29 Production

To estimate total cost per hectare all the resources used in BRRI Dhan-29 production has been summed together. It can be seen from Table 6.1 that total cost of production of BRRI Dhan-29 was Tk. 52013.43 per hectare.

6.2.4 Return of BRRI Dhan-29 production

6.2.4.1 Yield per Hectare

As haor area belongs to a lower basin type land, in the harvesting season usually the ripen paddy field get water logged. As a result, farmer could not collect the straws; they only used to harvest the rice by cutting the paddy panicles remaining rest of the plant on field. So, in haor area, the by-product value is very low.

Table 6.2 : Per hectare returns of BRRI Dhan-29 in Haor area

Product items	Value (Taka)
Main Product	80439.92
By-product	7641.79
Total Returns (TR)	**88081.71**

Source: Field survey, 2019-20

6.2.4.2 Gross Return / Total Return

Total return or Gross Return was estimated by adding value of straws with value of rice. Total Value of rice was found by multiplying total production with price per kg. In study area, per hectare value was found to be 80439.9 Tk. and straw value was 7641.7 Tk. Finally Gross Return was found for a hectare to be 88081.7 tk (Table 6.2).

6.2.4.3 Gross Margin

Gross Margin is the gross return over the variable cost. Gross Margin was estimated by deducting Total Variable Cost (TVC) from Gross Return. On the basis of the data collected, Gross Margin (GM) was calculated to be Tk. 53210.5 per hectare production of BRRI Dhan-29 (Table 6.2).

6.2.4.4 Net Return

Net Return or profit of BRRI Dhan-29 grower was found by subtracting total Production cost from gross return. So, Net Return was estimated to be Tk. 36068.28 per hectare production of BRRI Dhan-29 in haor area (Table 6.2).

Table 6.3: Per hectare profitability, Gross Margin, Net Margin and BCR of BRRI Dhan-29

Particulars	Values (Taka)
a. Gross Return	88081.71
b. Gross Margin	53210.5
c. Net Return	36068.28
d. Undiscounted Benefit cost Ratio (BCR)	
1. BCR on variable cost basis	2.54
2. BCR on total cost basis	1.69

Source: Field survey, 2019-20

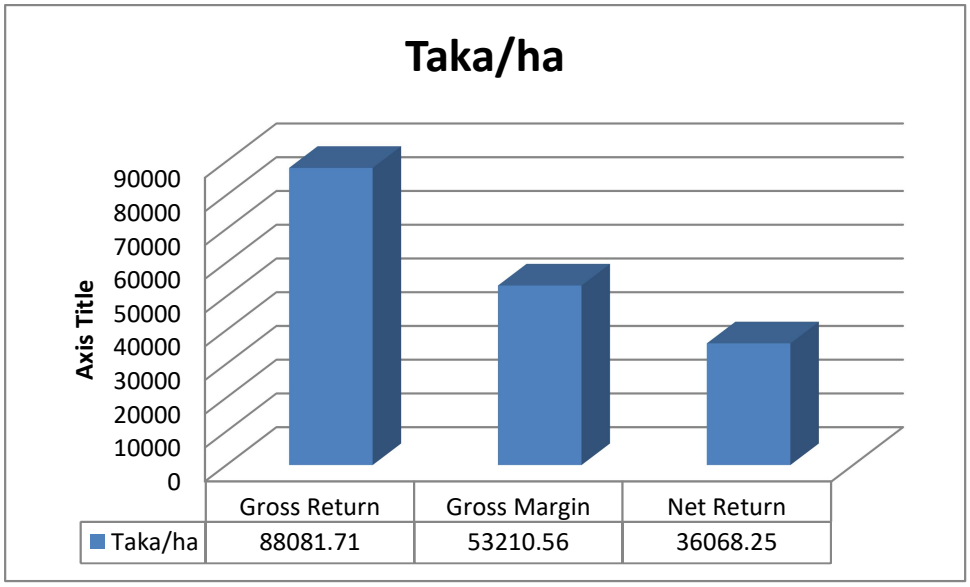

Figure 6.2: Gross Return, Gross Margin and Net Return (Field survey, 2019-20)

6.2.4.5 Undiscounted Benefit Cost Ratio (BCR)

Benefit cost ratio (BCR) is a relative measure, which is used to compare benefit per unit of cost. In the study area based on the collected data, undiscounted benefit cost ration on variable cost basis was estimated to be 2.54, implies that a farmer can generate Tk 2.54 by investing operating capital Tk. 1 in BRRI Dhan-29 in haor area of kishoreganj (Table 6.2). On the other hand, undiscounted benefit cost ration on total cost basis was estimated to be 1.69, which implies that a farmer can generate Tk 1.69 by investing total capital Tk. 1 in BRRI Dhan-29. So it means, BRRI Dhan-29 production is profitable in haor area of Kishoreganj.

CHAPTER 7

RESOURCE USE EFFICIENCY

7.1 Introductory remarks

In this chapter, an endeavor has been undertaken to identify major variables as well as the level of impact of these variables, which can affect the production and profitability of BRRI Dhan-29. For this purpose, Cobb-Douglas production function was chosen as multiple regression model to determine the contribution of key variables on the production process of BRRI Dhan-29 in haor areas of Kishoreganj.

7.2 Estimated Values of the Cobb-Douglas Production Function

Estimated values of the coefficients and related statistics of the Cobb-Douglas production functions for BRRI Dhann-29 are shown in Table 7.1. I found the presence of heteroskedasticity in the given data since the value of R^2 were 79.02 that were significant at one percent level. Therefore, the robust standard error had been used in the study.

The following features were noted:

1. F-value was used to measure the goodness of fit for different types of inputs
2. The coefficient of multiple determinations (R2) indicates the total variations of output explained by the independent variables included in the model
3. Coefficients having sufficient degrees of freedom were tested for significance level at 1 percent, 5 percent and 10 percent levels of significant
4. Stage of production was estimated by returns to scale which was the summation of all the production elasticity of various inputs

7.2.1 Seed (X_1)

The magnitude of the regression coefficient of seed was 0.97 (Table 7.1), which was positive and significant at 5 percent level. It indicates that one percent increase in the cost of seed would increase the gross returns by 0.97 %.

7.2.2 Human Labour (X_2)

The value of regression coefficient of human labor was -0.45(Table 7.1), which was significant at 1 % level. It means that if farmer of BRRI Dhan-29 increase the cost of human labor by 1%, then gross return would decrease by 0.45 %.

7.2.3 Fertilizer (X_3)

Regression coefficient of fertilizer was estimated to be 0.69 (Table 7.1), which was positive but non-significant.

7.2.4 Insecticides (X_4)

The magnitude of regression coefficient of insecticide was found to be 0.95 (Table 7.1), which was positive but non-significant.

7.2.5 Irrigation (X_5)

The value of regression coefficient of irrigation was estimated to be 0.49 (Table 7.1), which was positive and significant at 5% level of significance. It means if the farmer increase cost of irrigation by 1%, then the gross return will be increased by 0.49%.

7.2.6 F Statistic

The F-value was 33.7 (Table 7.1), which meant the equation was highly significant. It implied that the included variables were important for explaining the variation of returns of BRRI Dhan-29 cultivation.

7.2.7 Return to Scale

Summation of the coefficient is called Return to scale. In this analysis, it was estimated to be 2.64, which was positive. So, it could be concluded that the production function showed increasing return to scale. In this case of haor area, if all the input variables specified in the production function for BRRI Dhan-29 were enhanced by one percent, gross return would increase by 2.64 percent (Table 7.1).

Table 7.1: Estimated parameters of the Co-efficient of Cobb-Douglas stochastic Production Function Model

Explanatory Variables	Parameters	Co-efficient	Standard errors	p-value
Intercept x_0	B_0	10.63	5.405	0.031
Seed x_1	B_1	0.97**	2.015	0.016
Human labour x_2	B_2	-0.45*	0.146	0.003
Fertilizer x_3	B_3	0.69 ^{nl}	0.698	0.328
Insecticides x_4	B_4	0.95 ^{nl}	28.68	0.763
Irrigation x_5	B_5	0.48**	1.06	0.049

F-Value	3.72
R-squire	0 .71
Adjusted R-squire	0.69
Return to scale	2.64

***P<0.01, **P<0.05 and *P<0.1 indicates level of significance at 1%, 5%, 10% and nl indicates non-significance.

Source: Field survey, 2019-20

7.3 Measurement of Resource Use Efficiency (RUE)

From the above analysis of the regression equation, we can estimate the ability of farmers to allocate resources in BRRI Dhan-29 production. In order to test efficiency, the ratio of Marginal Value Product (MVP) to the Marginal Factor Cost (MFC) for each input is computed and tested for its equality to 1, i.e.

$$RUE = \frac{MVPxi}{MFCxi} = 1 \quad \text{…… …… …….. ……. ……. (Xii)}$$

In order to test Resource Use Efficiency, it was considered that a ratio equal to 1 indicated the use of that factor was at optimum level and a ratio more than 1 indicated that the yield could be increased by using more of the resources. A value of less than unity indicated the unprofitable level of resource use, which should be decreased to minimize the losses because farmers over used this variable. The negative value of MVP indicated the indiscriminate and inefficient use of resource. The ratio between MVPs and MFCs are shown in Tables 7.2.

Seed: Seed were underutilized. Farmers required using more quality seed at higher seed rate to increase efficiency.

Human Labour: Human labors were over utilized. Farmers required using less cost on human labor to get efficiency in resource use.

Fertilizer: Fertilizer was underutilized. Farmers are required to applying more fertilizer to increase efficiency.

Insecticides: Insecticides were very much underutilized. Farmers are required to use much more insecticides to increase resource use efficiency.

Irrigation: Irrigation was underutilized. Farmers are required to give more irrigation to increase resource use efficiency.

Table 7.2: Resource use efficiency of BRRI Dhan-29

Variables	GM	Coefficients	MVP	MFC	MVP/MFC	Comments
Seed	77.2	0.97	74.9	1	74.9	Underutilized
Human labour	4.01	-0.45	-1.80	1	-1.80	Over utilized
Fertilizer	14.25	0.69	9.89	1	9.89	Underutilized
Insecticides	93.5	0.95	88.8	1	88.8	Underutilized
Irrigation	10.0	0.48	4.80	1	4.80	Underutilized

GM= Geometric Mean Source: Field survey, 2019-20

MVP= Marginal Value Product

MFC= Marginal Factor Cost

7.4 Concluding Remarks

Estimated Cobb-Douglas production function model expressed that the salient variables included in the model were individually or jointly responsible for variation in gross return of BRRI Dhan-29. It also found that BRRI Dhan-29 producers allocated their resources in the zone of decreasing returns, which indicated that they were operating BRRI Dhan-29 production in the irrational zone of production.

CHAPTER 8

PROBLEMS BRRI Dhan-29 PRODUCTION IN HAOR

8.1 Introduction

In haor area of Kishoreganj Farmers faced a lot of problems in producing BRRI Dhan-29. The problems were related to geographical, social and cultural, financial, communicative and technical. This chapter aims at representing some of the problems of producing BRRI Dhan-29 in the study area. The problems faced by the farmers were identified according to opinions given by them. The salient problems and constraints in BRRI Dhan-29 cultivation are described below:

8.1.1 Natural Calamities

In haor area agriculture is a challenge due to natural event. It was found that BRRI Dhan-29 growers faced some acute problems relating to the nature in their production process. Natural calamities such as flashflood before harvest, hail storm, excessive rainfall, and caused substantial damage to the crop in the field. Haor generally get logged under water during May and April. But, frequent years flood occurred during the ripening period of BRRI Dhan-29. As a result, ripen rice field flashed by flood water and production get damaged fully or partly. In this situation, farmers have to pay higher labor cost for harvesting paddy panicles from water. Table 8.1 shows that 100 percent BRRI Dhan-29 producers reported this problem as one of the major problems of rice production in their locality. Besides, Hailstorm is also a dangerous problem, as it destroys panicles and thus production gets loosed.

Table: 8.1: Problems of BRRI Dhan-29 production in haor area

Problems	Percent	Rank
Natural Calamities	100	1
Low Price of Output	85	2
Lack of Operating Capital	80	3
Attack of Pest and Diseases	77	4
Inadequate Extension Service	71	5
Lack of Scientific Knowledge of Farming and training	63	6
Long Duration Variety	61	7
Poor storage facility	59	8
Lack of Quality seed	58	9
High price of fertilizers	42	10

Source: Field survey, 2019-20

8.1.2 Long Duration Variety

BRRI Dhan-29 is a long duration variety. The variety takes almost 160 days to harvest. Planting time of BRRI Dhan-29 is between late November and mid-October. And harvesting time is late April to early May. Due to this long duration flood used to damage the crop in the early days of May.

8.1.3 Lack of Quality Seed

Lack of quality seed of BRRI Dhan-29 was one of the most important constraints in the study area. From Table 8.1 it is evident that about 62 percent BRRI Dhan-29 growers reported this problem. Farmers told that they were cheated by buying from so called local vendors, markets and from the seed dealers. The farmers themselves store BRRI Dhan-29 seed to use for next season, but they are not at standard level.

8.1.4 Lack of Scientific Knowledge of Farming and Training

A large number of fanners have no adequate knowledge of right doses and methods of using modern inputs and technologies of producing their BRRI Dhan-29. In the study area 63.33 percent BRRI Dhan-29 growers were encountered this problem.

8.1.5 Inadequate Extension Service

During the survey time, about 86 % farmers claimed that they did not get any extension services regarding improved method of BRRI Dhan-29 cultivation from the Upazila agricultural offices and block supervisors or from officials of the Department of Agricultural Extension (DAE). But in the study area about 71 percent BRRI Dhan-29 growers (Table 8.1) reported that they hardly had any association from the block.

8.1.6 Communication

Communication and transportation infrastructure in haor area of Kishoreganj is most poor and lagging behind than any other part of the country. So farmers didn't get any help in need, if they were badly needed to go anywhere. They didn't get fair price for their rice due to communication. But they had to incur higher cost for their inputs. Moreover, due to the lack of transportation, extension services about modern seed, advanced method didn't reach to them. Furthermore, maximum time of the year, the haor area remains under water. So it becomes harder for the extension officers to reach to the farmers.

8.1.7 High Price of Inputs

Non-availability of inputs like seeds, fertilizers, insecticides, human labour etc. at fair price was a problem in the way of producing enterprises. During the production period price of some inputs tend to rise due to their scarcity. It appears from Table 8.1 that 80 percent garlic and 96.66 percent boro growers reported that they had to purchase some inputs at a high price during the production period.

8.1.8 Attack of Pest and Diseases

BRRI Dhan-29 is very much prone to blast and other pest and diseases. The growers of BRRI Dhan-29 were also affected by the problem of attack by pests and diseases. Pests and diseases attack reduce crop yield and increase cost of production. In the study area, 77 percent BRRI Dhan-29 growers reported this problem (Table 8.1).

8.1.9 High Cost of Irrigation

BRRI Dhan-29 is a boro season crop that heavily requires irrigation. Yield of BRRI Dhan-29 varies with the application of irrigation water. Availability of irrigation water was not a problem in the study area because of availability of shallow tube well. But farmers reported that they had to pay higher charge for irrigation water. They also used to bear the cost of diesel. High price of fuel is a problem. Generally, electricity is not available everywhere to set motor pump for irrigation. Cost of irrigation by motor pump is lower than that of by shallow tube well. Table 8.1 shows that 28 percent BRRI Dhan-29 growers reported this problem.

8.1.10 Lack of Operating Capital

The farmers of the haor area had capital constraints. For cultivation of BRRI Dhan-29 a huge amount of cash money was required to incur the variable costs like purchasing various inputs, human labour, seed, fertilizers, pesticides, etc. In the study area 80.67 percent BRRI Dhan-29 farmers reported that they did not have sufficient amount of money for purchasing the required quantity of inputs for the relevant enterprises (Table 8.1). They had to lend money from NGOs, local lenders and relatives. About, 79 percent farmer lends money from NGOs at high rate. In cases of crop damaged due to flood, they had to sell livestock or even land to pay the lender. Because, in the remaining period of the year, they have no other source of income, so that they can earn and pay the loan.

8.1.11 Low Price of Output

Farmers used to sell their rice just after threshing. In the harvesting season, price of rice was low, Low price of output was considered as another important problem reported by 85 percent of BRRI Dhan-29. Most of the farmers had to sell their products at home or at field at lower price for transportation problem. Another reason for selling the rice in field at harvesting season at lower price is that, they need money to pay back the lender and to incur the operating cost.

8.1.12 Poor Storage facilities

In the agricultural sector, Storage is an important marketing activity to get better output price. But, as in the study area, the farmers are poor and only 19% of the sample farmers belong to building house, they badly lack storage facilities. So, the farmers cannot sale their rice at a latter period to get higher price. Farmers usually have to sell their paddy just after the harvest. It was also found that public storage facility was also not adequate but nominal.

8.2 Concluding Remarks

Haor area is a lagged behind zone in our country. Farmers are also illiterate. Moreover, agricultural extension services do not reach to them adequately. So the farmers also remain lagged behind. They faces many problems in producing BRRI Dhan-29 , but they cannot face them efficiently and cost efficiently. Natural calamities create challenges farmer to grow BRRI Dhan-29. Flood is devastating in haor area for BRRI Dhan-29. Government needs to take appropriate steps to remove the problems.

CHAPTER 9

SUMMARY, CONCLUSSION AND RECOMMENDATIONS

9.1 Introduction

The chapter focuses on the summery of salient findings of the present study conducted in some selected haor areas of Kishoreganj district of Bangladesh. The researcher also recommended some of his ideas based on the study and the problems identified on the aspects of BRRI Dhan-29 production in selected haor areas. These results of the study and the recommendations may be useful for the farmers, policy planners, and concerned author and also for future researchers.

9.2 Summary

Bangladesh is an agricultural country. The Economy of this country still based on agriculture in this year of 2020. Because, among the other sectors it is agriculture, which supplies 38.58 percent (BBS, 2018/2019) employment of the total labor force of our country. It is the single largest portion of employment related to agricultural sector. Agricultural sector also contribute 13.65% (BBS-2018/19) of total gross domestic Product (GDP) of the country. So, agricultural economy is very primary pillar of our macro economy.

Boro season is the one of three agricultural seasons of Bangladesh. Boro is a winter season. In the boro season rice is planted in December-January and harvested during May-June. The largest portion of our total rice production is supplied through boro rice. In the year 2019, our total boro rice production of our country was 19.561 lac m. tons (BBS, 2018/19) which is 45% of our total rice production.

BRRI Dhan-29 is a high yielding rice variety (HYV) for boro season. The variety was introduced by Bangladesh Rice research Institute (BRRI) in 1994. The variety is very popular to the farmers of our country. It is also popular in haor regions of Bangladesh, especially to the farmers of haor areas of Kishoreganj. Yield of BRRI Dhan-29 prospected to 7.5 tons per hectare. High yield and good grain quality of this variety attracts the farmer to cultivate. But this is a long duration variety taking 160 days to harvest. This feature makes the farmers to face a challenge by natural calamities like floods especially in the haor areas.

Haor is a basin like landscape, which remains under water during the rainy season and get dried in winter. Most of the region of haor area is suitable for a single crop called boro rice as the region remains under water during the rest of the season of that year. The general cropping pattern in haor area is Boro-Fallow-Fallow and the cropping intensity of haor areas in study area is 127. In the study area, farmers generally cultivate BRRI Dhan-28 and BRRI Dhan-29 rice varieties.

BRRI Dhan-29 production in haor area was found profitable. So the farmers prefer this variety to cultivate in their land. The findings about costs and returns based on the study are summarized below.

Farmers were required to spent costs on the variable inputs like land preparation, seed, fertilizer, irrigation, pesticides, insecticides, herbicides and human labor and interest on operating capital. On the other sides, they incurred fixed cost like rental value of land.

It were estimated that;

- Per hectare land preparation cost was found to be Tk.4416 per hectare, which was 12% of total variable cost and 8% of total cost
- per hectare hired labor cost of BRRI Dhan-29 production is Tk. 15122.8, which was 43.3% of total variable cost and 29% of total cost
- per hectare seed cost was found to be 1041 tk./ hectare, which 3% of total variable cost and 2% of total cost
- Per hectare fertilizer cost of BBRI Dhan-29 production in haor area was estimated to be Tk. 5645 per hectare which was 16.18% of total variable cost and 10.8% of total cost
- Per hectare cost of insecticides and pesticides for BRRI Dhan-29 variety production was Tk. 861, which was 2.57% of total variable cost and 1.7% of total cost
- Per hectare cost of irrigation of BRRI Dhan-29 rice production was Tk. 8056.8, which was,23 % of total variable cost and 15..4% of total cost.
- Per hectare total variable cost of BRRI Dhan-29 was Tk. 34871, which was 67% of total cost of production
- Per hectare total rental value was calculated for five months and it was found to be Tk. 11,115
- Per hectare total cost of production of BRRI Dhan-29 was 52013 tk..

It were also estimated that;

- Per hectare value was found to be 80439.9 Tk. and straw value was 7641.7 Tk.

Finally;

- Gross Return (GR) was found for a hectare to be 88081.7 tk.
- Gross Margin (GM) was calculated to be Tk. 53210 per hectare production of BRRI Dhan-29
- Net Return was estimated to be Tk. 36068 per hectare production of BRRI Dhan-29 in haor area.
- Undiscounted benefit cost ration on variable cost basis was estimated 2.54 implies that a farmer can generate Tk. 2.54 by investing Tk. 1 operating capital in BRRI Dhan-29 in haor area of kishoreganj and BCR on the basis of total cost was 1.69,

implies that farmer could get 1.69 taka return by investing tk 1 total capital. So it means, BRRI Dhan-29 production is profitable in haor area of Kishoreganj.

So from the above calculation it is transparent to say that in the study area BRRI Dhan-29 production is profitable.

But it was found that farmers of haor area were rational in using resources for the production of BRRI Dhan-29. Cobb-Douglas production function is very popular multiple regression function, especially in the agricultural sector. This stochastic regression function was also run in this study. The results of the estimated regression function were;

- Regression coefficient of seed was 0.97 which was positive and significant at 5 percent level,
- The value of regression coefficient of human labor was -0.45, which was significant at 1 % level,
- Regression coefficient of fertilizer was estimated to be 0.69, which was positive but non-significant.
- Regression coefficient of insecticide was found to be 0.95, which was positive but non-significant.
- Regression coefficient of irrigation was estimated to be 0.48, which was positive but significant at 5% level.

And the resource use efficiencies are not at optimum level at all. From the analysis it was found that human labor was over utilized but the other entire variables are underutilized in the study area. Farmers of the study area should reduce using human labor and Increase cost on quality seed, fertilizer, and irrigation and most importantly on pesticides.

9.3 Conclusion

The present study was conducted in haor area of kishoreganj. The farm families in the haor area are poor comparative to the national standard. Education facilities are not available in this area. As a result, literacy rate and years of schooling in those areas are lower than national level. Due to the lack of education, the people are not enough conscious about their family planning. As a result, family size and fertility rate was found higher than the macroeconomic standard. Average income was also found lower than any other part of the county.

Farmers would not get enough training about the modern agricultural technology, modern seed and advanced production technology. This resulted inefficient resource use efficiency in BRRI Dhan-29.

In the haor area agriculture is basically concentrated in boro season. The cropping pattern in haor area was like boro-fallow-fallow. The production of boro rice in haor area contributes a significant amount to the total production. BRRI Dhan-29 was preferred by the farmers in haor

area due to its high production and good grain quality. The cultivation of BRRI Dhan-29 was profitable but farmers did not use input resources efficiently. They face many problems like as early flood, shortage of capital, pests and diseases, lack of adequate extension services, low price of rice and high price of inputs etc.

9.4 Recommendation

The present study reveals that BRRI Dhan-29 is profitable in haor area. As haor area is an extensive area of our country for the surety of food security, more intensive care should be taken to increase the productivity and resource use efficiency. Based on the findings of the present study, some recommendations are given bellow. These should be taken under consideration to resolve the problems, to take steps to increase profitability, profit and efficiency.

- Literacy level of the farmers should be improved, which will help the farmers to increase the productivity and efficiency
- For the purpose of increasing productivity, ease access and availability of all necessary inputs of production should be ensured
- To minimize the irrigation cost electricity should be made available. This will reduce dependency on high cost diesel based irrigation
- Most of the farmers should be given training on production process, input application, fertilizer and pesticide application etc. to increase resource use efficiency. Resource use efficiency in BRRI Dhan-29 production in haor area were found very irrational
- Different government organization like Department of Agricultural Extension and other non-government organization should increase their extension services in haor area to reach them with advance agriculture
- Cooperation from the block supervisor should be ensured
- Communication facility should be increased so that farmers can supply their product to any market to get higher price
- Embankment should be established to prevent early flood

9.5 Recommendation for Further research

Though the present study provides some beneficial information for the researchers, farmers and planners, it is not free from criticism. These research findings and the weaknesses of the research open new window for further research.

- A further study can be conducted by taking into consideration about different farm sizes to assess the impact of profitability of BRRI Dhan-29 on income and employment opportunity
- An in-depth study in this aspect may be considered for better comprehension not only to study relative profitability of BRRI Dhan-29 enterprise but also with other crops
- More profitability and resource use efficiency should be taken under consideration to justify the reliability of the findings of the present study.

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APPENDIX

SUMMARY OUTPUT								
ression Statistics								
Multiple R	0.8627991							
R Square	0.7144223							
Adjusted R S	0.6944553							
Standard Err	8070.8796							
Observation	70							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	5	1.2E+10	2.43E+09	37.28261	1.03E-17			
Residual	64	4.2E+09	65139098					
Total	69	1.6E+10						
	Coefficient	*Standard*	*t Stat*	*P-value*	*Lower95%*	*Upper95%*	*Lower95%*	*Upper95%*
Intercept	10.636078	54750.6	2.307933	0.024246	16983.82	235737.8	16983.82	235737.792
Seed	0.9782257	2.01516	2.366178	0.021012	0.742483	8.793969	0.742483	8.79396868
Human Labo	-0.449843	0.14626	-3.07557	0.003089	-0.74204	-0.15765	-0.74204	-0.1576482
Fertilizer	0.6875533	0.69831	0.984594	0.328531	-0.70748	2.082591	-0.70748	2.0825914
Pesticides	0.9562542	28.6817	0.302024	0.763613	-48.6357	65.96076	-48.6357	65.9607613
Irrigation	0.4861478	1.06333	0.457192	0.049081	-1.63811	2.610403	-1.63811	2.61040294

A. Socio-Economic aspects of farmers:

1. Identification of farmer:

Name: Union: Mobile:

Village: Upazila:

2. Family Composition:

Sl. no	Relation to HH	Sex	Age	Education	Farming Experience (year)	Occupation	Training	Annual income from off-farm/ non-farm
1								
2								
3								
4								
5								
6								
7								
8								

Education code: 0= Illiterate, 1=Just literate, 2=Primary level passed, 3=High school passed, 4=Graduate, 5= Post graduate, 6=Child (age<12)

Sex code: 1= Male, 2= Female

Training: 1=Yes, 2=No

3. Land Holding and tenancy Area in Bigha (1 bigha= 0.33 decimal)

(1kani=.35 dec; 1 bigha= 3.00 kani)

Category	Own cultivated land	Leased-in	Leased-out	Rented in	Rented out	Mortgage in	Mortgage in	Total operated land(2+3+5+7-4-6-8)

1	2	3	4	5	6	7	8	9
Cultivable land								
Homestead								

4. Information about annual family source of income:

Agriculture	Total amount	Present value (Tk)	Family consumption		Amount of remainder (tk)
			Amount (kg)	Value (tk)	
Farm income					
Rice (mound)					
Fisheries: i. Capture					
ii. Cultivation					
Livestock: i.Milk					
ii. No of Animal: a. Cow					
b. Goat/Sheep					
Poultry					
Other					
Non-farm income					
Service					
Day labor on others farm					
Business/Trade					
Foreign source					
Shops					
Handicraft					
Boat sailing					
Other:					

Farmer's occupation during off-agricultural season

Occupation	Yes/No
Fisheries	
Livestock	
Poultry rearing	
Business	
Day Labor	
Migration	

5. Primary utilization pattern of haor Boro rice:

Total production of Boro (mound)	Paid as kind (Harvesting and threshing) (mound)	Used for family consumption (mound)	Used as seed(mound)	Sold (mound)

Pattern of Boro rice sold by farm households

Items	Sale before harvest	Sale within 0-1 month of harvest	Sale within 2-5 month of harvest	Stored for sale after 5 months
Amount (mound)				
Price Tk/md				

To whom rice crop is sold?

Item:

Directly to millers: ……..

Middleman ……..

Govt. procurement centre ……..

Directly to nearby market ……..

Directly to neighbor ……..

Farmers to farmers exchange ……

Do you usually store boro rice to sale after 5 months (yes/no), if yes why?

If no, Why don't you store Boro rice to sale after 5 months?

6. Availability of cash capital for farming operation

Yes	No

7. Sources of seed: Owned (%)……. Purchased (%)……..

8. If loan is needed, institutional loan is available or not,

Yes	No

9. Plot wise information about variety grown in last season:

Sl no	Name of variety	Plot area (dec)	Plot yield (mound)	Yield (t/ha)
1				
2				
3				
4				
5				

10. Varieties grown during last 5 years in Boro season

Name of the previously grown variety	Name of currently grown variety

11.Local or Deshi varieties grown during last 5 years

Name of the previously grown variety	Name of currently grown variety

12.Reasons for cultivating existing 5 major varieties including deshi/local, if any

Sl no	Variety	Positives traits	Negative traits

13. COST AND RETURN OF RICE PRODUCTION AT FARMER'S FIELD

i. Variable cost
ii. Fixed cost
iii. Total cost (a+b)

i. Variable cost calculation

Input use pattern of boro rice crops

Items	
Name of variety	
Size of plot (decimal)	

i.a. Human labor requirement (Man-days)

Practices	Own labor (tk)	Hired labor (tk)		Contract payment (tk)(if any)
		With meal	Without meal	
Seed bed preparation and sowing				
Mainland preparation (Ploughing and laddering)				

Uprooting and transplanting				
Fertilizer and top dressing				
Manuing				
Weeding				
Pest management				
Irrigation				
Harvesting				
Carrying & Threshing				
Winnowing, Sunning, drying and storing				

i.b. Animal/ mechanical power used

Operation	Machine (tk)		Animal (tk)	
	Own /Family	Hired	Own/Family	Hired
Ploughing/Laddering				
Weeding				
Spraying				
Threshing				

i.c. Material input used

Inputs	Quantity used	Price (tk/kg)	Cost (tk)
Seeds/seedling (kg)			
Urea: Basal (kg)			
1st dose (Kg/plot)			
2nd dose (Kg/plot)			
3rd dose (Kg/plot)			
TSP(Kg)			
SSP(Kg)			
DAP(Kg)			
MOP(Kg)			
Gypsum(Kg)			
$ZnSO_4$ (Kg)			
Manure (md) : a. Home			
b. Bought			
Ashes (md)			
Pesticides:			
1st dose (ml/plot)or (Kg/plot)			
2nd dose (ml/plot)or (Kg/plot)			
3rddose (ml/plot)or (Kg/plot)			
4th dose (ml/plot)or (Kg/plot)			

Other			
Irrigation/ Supplementary Irrigation			
Other			

Fertilizer price (tk./50 kg): Urea……., TSP……., MOP……,

Gypsum……., Zinc…….. Sulphate……., DAP……,

Farmyard manure…… Ashes…….

ii. Fixed cost calculation

Land use value calculation

Item	Tk/acre
Rental value	
Leasing value	
Mortgage Value	
Total	

14.Credit information

a. Have you borrowed any capital for this crop cultivation?

Yes…….. No……

If yes, please mention the source and amount of credit received

Source	Cash	Kind	Amount received	Interest rate
Local Farmer				
Friends and relatives				
Bank				
NGO				
Money Lender				
Other				

b. Please mention the purpose the credit was spent

Purpose	Amount (tk)
Buying fertilizer	
Buying seed/seedling	
Buying Insecticides	
Paying Lobor wage	
Paying irrigation cost	

Paying Bullock	
Others	

15.Grain and by-product yield

Item	Plot size	Good seasonal weather	Normal seasonal weather	Bad seasonal weather
Grain Yield (Mound/plot)				
By-product (mound/plot)				

16. Grain and By-product price

Item	within 1 month of harvest	within 2-5 months of harvest	After 5 months of harvest
Paddy price (Tk/mound)			
Rice price (Tk/mound)			
By product value (tk/plot)			

17.Rank five major constraints of rice production in haor area

	Rank

18. Five recommendations

Sl no	
1	
2	
3	
4	
5	

Name of Enumerator……

Date……