A COMPARATIVE PROFITABILITY ANALYSIS BETWEEN AROMATIC AND AMAN RICE IN SOME SELECTED AREAS OF DINAJPUR DISTRICT

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MY BELOVED PARENTS

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CERTIFICATE

This is to certify that thesis entitled, "**A COMPARATIVE PROFITABILITY ANALYSIS BETWEEN AMAN AND AROMATIC RICE IN SOME SELECTED AREAS OF DINAJPUR DISTRICT**" submitted to the faculty of Agribusiness Management, Sher-e-Bangla Agricultural university, Dhaka, in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE IN AGRICULTURAL ECONOMICS, embodies the result of a piece of bona fide research work carried out by Syeda Rowshan Ara Mostofa bearing Registration No. 12-05180 under my supervision and guidance. No part of this thesis has been submitted for any other degree.

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

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ABSTRACT

This study was undertaken to determine the comparative profitability of Aman and Aromatic rice production. The objectives of the present study were to examine socio-demographic profile of Aman and Aromatic rice growers, to assess the profitability of producing Aman and Aromatic rice, to identify factors affecting the yield of Aman and Aromatic rice and to identify the problems faced by the farmers. A total of 60 farmers (30 for Aman rice growers and 30 for Aromatic rice growers) were selected randomly from two upazila namely Hakimpur and Ghoraghat in Dinajpur district. Both Tabular technique and statistical analysis was done to achieve the objectives of the study. The Cobb-Douglas production function was used in this study to determine the effects of different inputs on Aman and Aromatic rice production. The major findings of the study were that the cultivation of Aman and Aromatic rice was profitable from the view point of farmers. The gross returns per hectare for Aman and Aromatic rice were Tk. 109578.13 and Tk. 141222.04, respectively. The total cost of Aman production was Tk. 81697.99 and for Aromatic rice was Tk. 80796.12. Again the net returns of Aman and Aromatic rice were Tk. 27880.14 and Tk. 60425.92, respectively. The undiscounted Benefit Cost Ratio (BCR) was 1.34 and 1.74 for Aman and Aromatic rice production, respectively. The results indicated that Aromatic rice production was more profitable than Aman rice production. Production function analysis suggested that among the variables included in model namely: human labor, MoP, TSP and manure had a positive and significant effect on yield of Aman rice and human labor, gypsum, insecticides and pesticide had a positive and significant effect on the yield of Aromatic rice except for, urea had a negative and significant effect on the yield of Aromatic rice. The study also showed that farmers producing Aman and Aromatic rice faced some problems. It may be concluded that the farmers should be encouraged to grow more Aromatic rice than Aman rice as a means of increasing farm income in the area under study.

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Syeda Rowshan Ara Mostofa

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ABBREVIATIONS AND ACRONYMS

BRRI	Bangladesh Rice Research Institute
BBS	Bangladesh Bureau of Statistics
BCR	Benefit Cost Ratio
BER	Bangladesh Economic Review
DRC	Domestic Resource Cost
et al.	and others
FAO	Food and Agricultural Organization
GR	Gross Return
GDP	Gross Domestic Product
Ha	Hectare
HYV	High Yielding Variety
IOC	Interest on Operating Capital
Kg	Kilogram
MoP	Muriate of Potash
Mt	Metric Ton
NGO	Non-Government Organization
T	Ton
TC	Total Cost
TFC	Total Fixed Cost
TSC	Triple Super Phosphate
TVP	Total Variable Cost

CHAPTER 1
INTRODUCTION

1.1 Background of the study

Bangladesh is an agrarian country. Because of its very fertile land and favorable weather, varieties of crop grow abundantly in this country. Agriculture sector contributes about 14 percent to the country`s Gross Domestic Product (GDP) and employs more than 40 percent of total labor force (BBS, 2018).

Rice is one of the major cultivated crops in Bangladesh. Rice covered around 74.85 percent cultivated areas under crop production in Bangladesh (BBS, 2017). For the year 2016-17, 27184 acres of land was covered by rice cultivation and 33804 metric tons of rice was produced. In 2015-16, 28124 acres of land was covered by rice cultivation and 34710 metric tons of rice was produced. Similarly, in 2014-15 and 2013-14, rice was cultivated in 114.15 lac hectares and 113.72 lac hectares, respectively and produced 347.1 lac metric tons and 343.56 lac metric tons of rice, respectively (BBS, 2017).

There are three types of rice produced in Bangladesh such as Aus, Aman and Boro. Aman is the second largest rice crop in respect to the volume of production in Bangladesh. For the year 2016-17, total area and production of Aman rice were 13797 acres and 13656 metric tons, respectively. Total area and production of Aman were 13814 acres and 13484 metric tons, respectively for the year of 2015-16. For the year 2014-15, total area and production of Aman rice were 55.30 lac hectares and 131.90 lac metric tons respectively. Total area and production of Aman rice were 55.30 lac hectares and 130.23 lac metric tons, respectively for the year of 2013-14 (BBS, 2017).

Dinajpur is one of the leading districts of Aman and Aromatic rice production in Bangladesh. In Dinajpur district, total area under Aman rice production from the year of 2015-16 to 2013-14 were 629293 acres, 300796 acres and 195229 acres, respectively and total production were 636936 metric tons, 339766 metric tons and 166802 metric tons, respectively (BBS, 2017). Most of the Aromatic rice varieties are grown in Aman season and a few are grown in Boro season. The total area under Aromatic rice cultivation in

T. aman season was 12.5% and total production of 1.42 million metric tons (Tama *et al*., 2015). Production of Aromatic rice in Dinajpur district was gaining popularity with its high profit margin and low production cost. Total area under Aromatic rice cultivation in Dinajpur district was 90 thousand hectares (BBS, 2018).

1.2 Importance of rice in the economy of Bangladesh

Rice is the major cereal crop and staple food in Bangladesh. Bangladesh is the fourth largest rice producer in the world following China, India and Indonesia (FAO, 2017).

Table 1.2: Top paddy producing countries in the world 2017

Country	Paddy output (Million M. Tons)
China	212.676
India	168.500
Indonesia	81.382
Bangladesh	48.980
Vietnam	42.763
Thailand	33.383
Myanmar	25.624
Philippines	19.276
Brazil	12.469
Pakistan	11.174

Source: FAO, 2017

About 135 million people of Bangladesh have been taking rice as food. It provides nearly 48% of rural employment, about two-third of total calorie supply and about one-half of the total protein intake of an average person in the country (BER, 2018). Rice covered 74.85 % of total cropped area in Bangladesh (BBS, 2018). Aman is one of the main crops in Bangladesh. The rice which is harvested in the month of November and December is said to be Aman rice. At present it is the second largest crop in the country in respect of the volume of production (BBS, 2018). In rice, aroma or scent is an inherent characteristic. Aromatic rice attracts premium prices because it is highly valued by consumers, who use it for special purposes like feast and religious occasions, like Eid,

Puja, wedding ceremony, and so on. Most of the Aromatic rice varieties are low yielding but its higher price and low cost of production generate higher profit margins (Biswas *et al.*, 2016).

1.3 Characteristics and yield of Aromatic BRRI dhan-34 and Aman Sharna-5 rice varieties

Aromatic rice containing aroma and it is short bold and its plant is long in height and it has also low tillering habit. Non-aromatic rice grain size is medium bold, short in height. Its plant is nitrogen responsive and it has also high tillering habit. It does not contain aroma. Aromatic and Non-aromatic fine rice are those varieties of rice which are short in size and their shapes are bold and round.

BRRIdhan-34 is an aromatic rice variety. It was developed by Bangladesh Rice Research Institute (BRRI) in 1997. It was originated from khaskani. Its plant height is 117 cm. It produced approximately double yield than other local variety, that's why this is the popular Aromatic variety to farmers. Sharna-5 is a non aromatic aman rice variety. It is an Indian variety. Bangladesh Rice Research Institute (BRRI) developed BRRIdhan 93, BRRIdhan 94 and BRRIdhan 95 from sharna-5 variety. Because of its high yield, low price and availability makes it popular among farmers. Characteristics and yield of aromatic BARRIdhan-34 and Aman sharna-5 rice varieties are given below.

Table 1.3: Characteristics and yield of Aromatic BRRIdhan-34 and Aman Sharna-5 rice varieties

Varieties	Season	Size	Potential yield (ton\ha)	Category
BRRIdhan 34	Aman	Short and bold	3.5	Aromatic
Sharna 5	Aman	Medium and bold	6	Non-aromatic

Source: BRRI, 2016.

1.4 Justification of the study

Agriculture of the Bangladesh is rice base. Aman is one of the main crops in Bangladesh. But Aromatic rice has high demand in both home and abroad, especially in festive and special events, such as wedding, eid, puja etc.

The present study will help to find the existing problems and develop a clear understanding on the interrelated aspects of Aman and Aromatic rice cultivation and choice making of the profitable one. The present study will help in providing a picture of the benefits and costs of these two initiatives, which will help individual researchers who will conduct further studies of the similar nature and encourage in conducting more comprehensive and detailed investigation in this particular field of the study. The study may be helpful to learn about various problems related to Aromatic and Aman rice production and to suggest the farmers how to overcome those problems.

However, only a few field level studies conducted in Bangladesh to determine the comparative profitability between Aman and Aromatic rice production. Finally, as far my knowledge, no such kind of study was conducted in the past on the selected areas on the selected topic. So, such kind of study was necessary to help the policy makers for formulating appropriate policy.

1.5 Objectives of the study

The specific objectives of this study are as follows to:

1. To assess the present socio-demographic characteristics of Aman and Aromatic rice growing farmers
2. To estimate and compare the profitability of producing Aman and Aromatic rice
3. To identify the factors affecting the yield of producing Aman and Aromatic rice
4. To identify the problems faced by the farmers producing Aman and Aromatic rice

CHAPTER 2

REVIEW OF LITERATURE

The purpose of this chapter is to provide a selective review of the past research work which are relevant to the present study. Comparative profitability analysis of Aman and Aromatic rice is hardly ever found in this country. Such types of research did not take place in the research area. This study will help in providing a picture of benefits and costs of these two initiatives, which will help individual researchers who will conduct further study of the similar nature and encourage in conducting more comprehensive and detailed investigation in this particular field. However, some relevant studies which are directly or indirectly related to this study are described below:

Tama *et al.* (2018) conducted an experiment to assess the export potential of Aromatic rice in Bangladesh as well as identify the factors affecting gross return from Aromatic rice production. The study suggested that the price of fertilizer, seeds and others inputs should be maintained and marketing and trade related costs and barriers should be minimized to amplify the potential of Aromatic rice production in Bangladesh.

Rashid *et al.* (2017) conducted a study to evaluate the yield performance of seven Aromatic rice varieties of Bangladesh viz. Jirakatari, Chiniatab, Chinigura, Kataribhog, Kalizara, Badsgabhog and BRRIdhan 34. It was observed that the highest grain yield (2.54 t/ha) was obtained from kataribhog and the lowest grain yield (1.83 t\ha) was obtained from kalizara. Among the seven Aromatic rice varieties under North West condition kataribhog and BARRIdhan 34 were suitable in respect of yield.

Tama *et al.* (2015) examined the financial profitability of Aromatic rice production. In this study it was evident that Aromatic rice is a profitable farming venture, because such rice cultivation did not generally require additional expenditure on fertilizer, pesticides and irrigation and gross return from this cultivation was much higher as the product price was higher than any other rice varieties.

Islam *et al.* (2013) examined the performance of local Aromatic rice cultivars viz. Kalijira, Khaskani, Kachra, Raniselute, Morichsail and Badshabhog. The rice cultivars varied considerably in terms of crop growth characteristics as well as yield and yield contributing characters. It was proven that the variety Morichsail produced the highest grain yield and the lowest grain yield was obtained from Kalijira.

Nasrin (2013) conducted a study to examine the financial profitability of Aromatic rice and its impact on farmer livelihood in selected areas of Tangail district. The study revealed that the total cost if Aromatic rice production was Tk. 51299.5 per hectare. The average per hectare gross return of Aromatic rice was Tk. 82666.4. The undiscounted benefit-cost ratio of Aromatic rice production was 1.61 which implies that the Aromatic rice production was profitable. Moreover, the study revealed that the Aromatic rice producer had higher income and better livelihood than those who are producing Non-aromatic rice in the study area.

Ashrafuzzaman *et al.* (2009) examined the growth performance and grain quality of six Aromatic rice varieties BR34, BR38, Kalizira, Chiniatop, Kataribhog and Basmati grown under rainfed conditions. The rice varieties differed significantly with respect to leaf chlorophyll content, plant height, internode length, thousand grain weight and grain and straw yields. Thousand grain weight and grain yield both was highest in BR38. Basmati required shorter days to maturity and Kalizira required longest days to maturity.

Ullah (2008) was conducted a study to estimate the comparative profitability and technical efficiency of Aromatic BRRIdhan 34 and Non-aromatic BR 11 rice varities of Transplanted aman rice in some selected areas of Dinajpur district. Researcher observed that the yield of BRRIdhan 34 rice found lower compared to that of BR11 rice. Gross

returns from BRRIdhan 34 was much higher (Tk. 82467/ha) than that of BR11 rice (Tk. 66455/ha). Gross margin was found higher for BRRIdhan 34 (Tk. 58869/ha) than by BR 11 rice (Tk. 39013/ha). Return over per taka investment (BCR) were 1.87 and 1.37 for BRRIdhan 34 and BR 11 rice, respectively implying that BRRIdhan 34 rice cultivation was more profitable than BR 11 rice cultivation.

Razzaque and Rafiquzzamzn (2007) attempted to measure a comparative analysis of T.aman rice cultivation under different management practice in coastal area. They were found that farmers were found to obtain lower level of yield potentials following poor management practice as a result yield was not satisfactory. They suggested that if farmers would use recommended package like closer spacing, lower number of seedling per hill, use of balance fertilizer, pest control in proper time then they would be able to get optimum yield.

Anik (2003) examined that aromatic rice production is more profitable than fine rice. The study identified some constraints such as high domestic cost of production and higher marketing and trade related costs and barriers which need to be reduced for improving the production environment of Aromatic and fine rice.

Domestic Resource Cost (DRC) ratios showed that Bangladesh had comparative advantage in the production of aromatic and fine rice both from the point of view of export and import substitution, except the nizershail variety which was marginally unprofitable under export proposition. The study also identified some problems faced by the farmers in producing aromatic and fine rice. Finally, some policy guidelines were suggested.

Kabir (2000) conducted a study on an economic analysis of Aromatic and Non-aromatic rice cultivation in some selected areas of Dinajpur district. The result of the study state that Aromatic rice is more profitable than Non-aromatic rice. In the study gross return were found to be TK. 37466.88, TK. 32291.63,TK. 29881.00 and TK. 30860.97 per hectare for kataribhog, kalijira, Sharna and panjam\BR varieties, respectively. Gross return from Aromatic (kataribhog) rice was highest (TK. 37466.88\ha) followed by Non-aromatic (pajam\BR varieties) rice (TK. 30860.97\ha).

CHAPTER 3

METHODOLOGY

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

3.1 Selection of the study area: The area where the selected varieties of the rice have been grown successfully was considered as the study area. The Dinajpur district was selected because it is one of the leading district of Aromatic and Aman rice producing area in Bangladesh. The following considerations were kept on mind for selecting Dinajpur as a study area.

1. There were a large number of Aromatic and Aman rice producers in that particular area.
2. Researcher had an easy access in this area.
3. The locality has easy accessibility and communication facilities.
4. It is less prone to natural calamities.
5. As per my knowledge, no related study was conducted in the past.

3.2 Sampling technique: It was not possible to include all the farmers in the area studied due to limitation of time, money and personnel. A simple random sampling technique was followed in the present study for minimizing cost, time and to achieve the ultimate objectives of the study. Two Upazila namely Hakimpur and Ghoraghat in Dinajpur district were selected. Two lists of farmers, who cultivated Aromatic and Aman rice, were collected with the help of agricultural extension personnel and elderly farmers of the study area. A total number of 60 farmers, 30 (7 from krishnapur moricha, 8 from shalgram, 7 from nikharia and 8 from pathanpara farmers) for Aromatic and 30(8 from krishnapur moricha, 7 from shalgram, 8 from nikharia and 7 from pathanpara farmers) farmers for Aman rice, were randomly selected from the lists. Thus the selected farmers were interviewed to achieve the ultimate objectives of the study**.**

3.3 Preparation of the interview schedule: To achieve the objectives of the study, a preliminary interview schedule was designed for recording data to be obtained from the selected farmers. After preparing a draft interview schedules it was pretested. On the basis of pretest, its consistency and applicability in actual field condition was checked. The necessary adjustments were made and a final survey schedule was developed.

3.4 Period of the study: The data was collected though survey during the months of January to February 2019 by several visits by the researcher herself.

3.5 Methods of data collection: The data were collected by interviewing the selected respondents. As farmers did not keep any written records of their farm activities, it was difficult to collect accurate data. To overcome this problem, farmers were requested to provide correct information so far as they could remember. Before taking interview the aims and objectives of the study were explained to the farmers so that they could understand that the study was purely academic one and was not likely to have an adverse effect.

3.6 Analytical technique: The collected data were analyzed with the purpose of achieving the objectives of the study. The following two technique of analysis were used:

1. Tabular analysis

2. Functional analysis

3.7 Tabular analysis: Arithmetic mean percentage was used to measure different cost, gross margins and net profit were calculated in the tabular form. Interpretation discussions of the findings were discussed in simple terms. Undiscounted Benefit Cost Ratio (BCR) was also calculated by using different costs.

3.7.1 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*Average price of the product + value of by-product.

3.7.2 Gross margin: Gross Margin is the difference between gross return and variable costs. Such as,

Gross Margin = Gross Return – Variable cost.

3.7.3 Net return: Per hectare net return was determined by subtracting per hectare total cost (variable cost and fixed cost) of production from per hectare total return.

Net return = Total Return- Total Cost (total variable cost + total fixed cost)

3.8 Functional analysis: Besides tabular analysis, Cobb-Douglas production function was used to estimate the effects of key variables. This model was proved the best-fit and more reliable on theoretical and econometric aspects in real world situation.

For Aromatic rice and Aman rice the model specification was as follows:

$$Y_i = \alpha X_{1i}^{\beta 1} X_{2i}^{\beta 2} X_{3i}^{\beta 3} X_{4i}^{\beta 4} X_{5i}^{\beta 5} X_{6i}^{\beta 6} X_{7i}^{\beta 7} X_{8i}^{\beta 8} e^{ui} \quad \text{……..(i)}$$

By taking log in both sides the Cobb-Douglas production function was transformed into the following logarithmic form:

$$\ln Y_i = \ln \alpha + \beta_1 \ln X_{1i} + \beta_2 \ln X_{2i} + \beta_3 \ln X_{3i} + \beta_4 \ln X_{4i} + \beta_5 \ln X_{5i} + \beta_6 \ln X_{6i} + \beta_7 X_{7i} + \beta_8 X_{8i} + ui \quad \text{……(ii)}$$

Where, Y = Yield (Kg/ha)

α = Constant or intercept of the function

X_1 =Amount of seed (Kg /ha)

X_2 = Human labor cost (Tk. /ha)

X_3 = Amount of urea (Kg/ha)

X_4= Amount of MoP (Kg/ha)

X_5 = Amount of TSP (Kg/ha)

X_6= Amount of gypsum (Kg/ha)

X_7= Cost of insecticide and pesticide (Tk. /ha)

X_8= Cost of manure (Tk. /ha)

ln = Natural logarithm

i = 1,2, 3……, n(n=30)

e = Base of natural logarithm

u_i = Error term

β_1, β_2…..... β_8 = Coefficient of respective variables.

3.9 Major cost items: A list of cost items and their estimation procedure has been discussed under the following heads:

(a) Seed cost

(b) Human labor cost

(c) Fertilizer cost

(d) Manures cost

(e) Irrigation cost

(f) Insecticides and pesticides cost

(g) Interest on operating capital and

(h) Land use cost

3.9.1 Seed cost: In the study area, both the home supplied and purchased seed were used. Most of the farmers used purchased seed than home supplied seed. The cost of home supplied seeds was charged at the average market price and the cost of purchased seed was calculated according to the payment made by farmers.

3.9.2 Human labor cost: Human labor was one of the major important inputs used in the production process of both Aman and Aromatic rice. It was classified into two categories; (1) own labor and (2) hired labor. The cost of own labor was estimated at the prevailing wage paid in cash to hired labor. The existing wage rate was considered for computing the cost of hired labor.

3.9.3 Fertilizer cost: In the study area, farmers generally used Urea, Triple Super Phosphate (TSP), Murate of Potash (MoP), Gypsum and Zinc for higher yield of Aman and Aromatic rice. Fertilizer cost represents the actual cost paid by the farmers.

3.9.4 Manure cost: In the study area, cow-dung was mostly used as manure. Cost of manure was estimated by the actual amount paid by the farmers.

3.9.5 Irrigation cost: In the study area, only a small number of farmers used irrigation for the production of Aman and Aromatic rice. Irrigation cost was estimated by the actual payment made by the farmers.

3.9.6 Insecticides and pesticides cost: In the study area, farmers used different insecticides and pesticides for the better production of Aman and Aromatic rice. The cost of insecticides and pesticides represented the amount of money, which the farmers actually paid to buy the items.

3.9.7 Interest on operating capital: Interest on operating capital was charged at the rate of 6 percent per annum and was estimated for the duration of six months for Aman and Aromatic rice production. It was estimated by using the following formula:

Interest on operating capital = AIit

Where, AI= (Total investment)/2

i = Rate of interest

t = Total time period of a cycle

The period of crop cultivation was considered from the time of land preparation to harvest.

3.9.8 Land use cost: Land use cost varied from village to village depending upon the soil type, topography, location and security of the particular crop field. Land use cost may be calculated using one of the following concepts:

a) Interest on the value of land, b) Rental value of land and

c) Forgoing income from the best alternative use.

The second method is the most popular. So, it was used in the present study.

CHAPTER 4

DESCRIPTION OF THE STUDY AREA

A short description of the study area has been presented in this chapter to know the overall features of the study area.

4.1 Location: In this study, sample farmers were selected from four villages namely krisnapur moricha, shalgram belonging to Ghoraghat upazila and nikharia and pathanpara belonging to the Hakimpur upazila of Dinajpur district. This two upazila are 17.4 km away from each other. Hakimpur upazila is located from 71.1 km away from Dinajpur and Ghoraghat upazila is located from 84.1 km away from dinajpur district. The location of the two upazilas of ghoraghat and hakimpur are shown in the figure of 4.1.

4.2 Topography and condition of the soil: Dinajpur is a district of Rangpur division. It is the largest district among all sixteen northern districst of Bangladesh. Dinajpur lies on the punarbhava river at the northeast part of the border of Sikkim state in India. Dinajpur is located on the point where flat alluvial plain intersected by rivers and broken by the slightly elevated barind region. Fertility level of soil is low to medium and organic matter content is low to medium in the soil of Dinajpur district. Amount of medium land is high in both ghoraghat and hakimpur upazila. Amount of doash kind of soil is high in both ghoraghat and hakimpur upazila, about 14312 acre and 14816 acre, respectively. However, both upazila has different kind of soil such as bele, etel and kanker etc (BBS, 2011). The soil of the study area is very fertile and suitable for different crops cultivation.

Table 4.2 Land topography in study areas

Study area	Land type (acre)			Total (acre)
	High	Medium	Low	
Ghoraghat	7765	20188	3106	31059
Hakimpur	5951	17855	0	23806
Dinajpur	211977	446985	79595	738555

Source: BBS, 2011.

4.3 Population and area of the study area: Total area of Dinajpur district is 3444.3 sq. km. According to the population census 2011, per sq. population density is 870 in Dinajpur district. In Hakimpur and Ghoraghat upazila per sq. population density is 927 and 792, respectively. However, total population of Dinajpur district is 2990128 among which number of male is 1508670 and number of female is 1481458.

Table 4.3 Population size of the study areas

Study area	Area (sq. km.)	Population	Male	Female	Population density per sq. km.
Ghoraghat	148.67	117740	59001	58739	792
Hakimpur	99.92	92599	47162	45437	927
Dinajpur	3444.3	2990128	1508670	1481458	870

Source: BBS, 2011.

4.4 Climate conditions of the study area: Tropical hot, wet and humid climatic condition has seen in Dinajpur district. Annual average temperature and precipitation is 25^0C and 1795.6 mm, respectively. Climate of Ghoraghat upazila is tropical and summer has a good deal of rainfall than the winter. Average temperature of Ghoraghat upazila is 28.9^0C. Annually precipitation falls about 1902 mm. Most of the precipitation falls in july averaging 408 mm which is very helpful for aman and aromatic rice cultivation. Climate of Hakimpur upazila is warm and temperate. Average temperature and rainfall in Hakimpur upazila is about 25.2^0C and 182 mm, respectively.

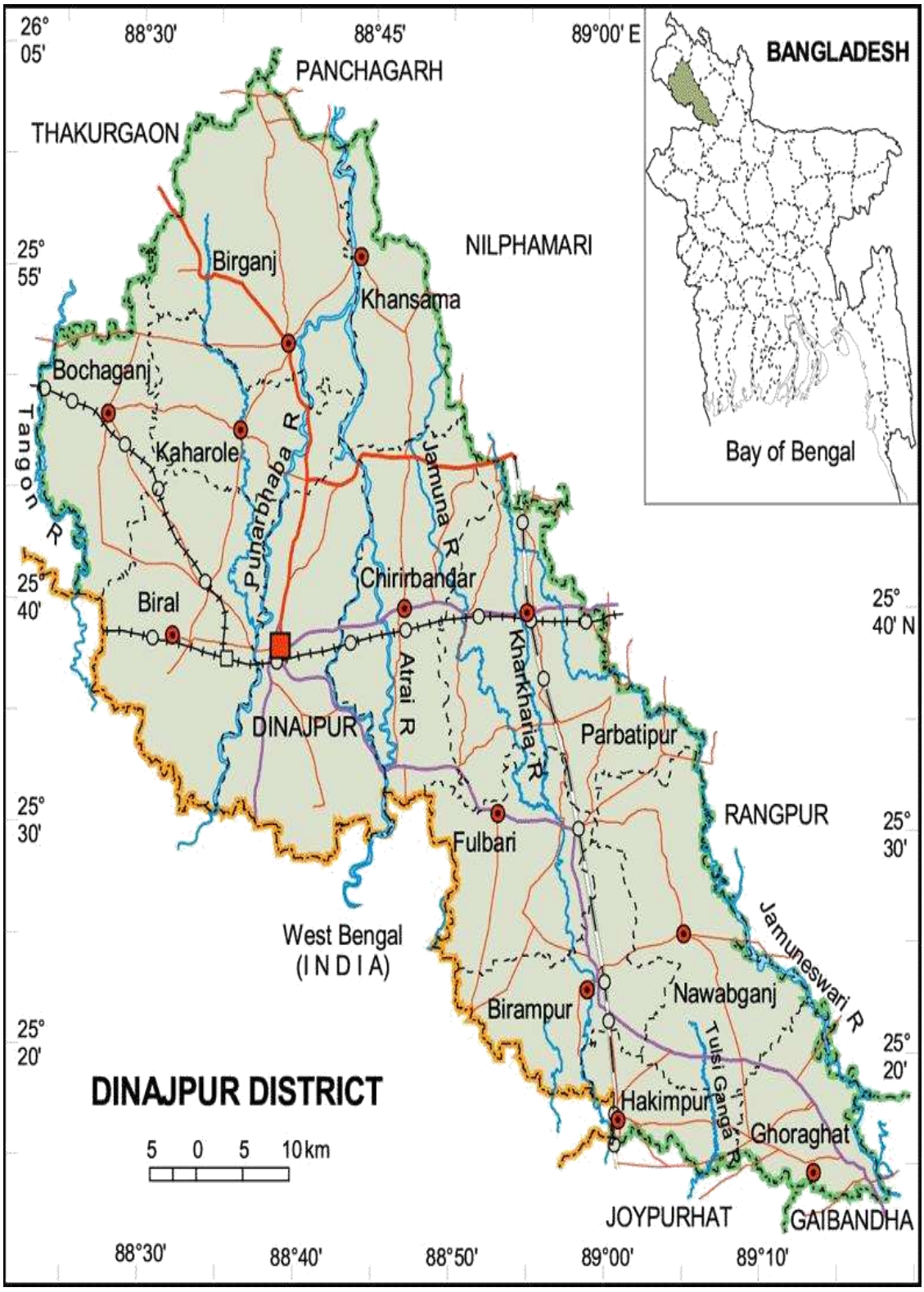

Figure 4.1: Map of Dinajpur district.

Table 4.4 Climatic condition of the study area

Years	Temperature (centigrade)		Rainfall (millimeter)	Humidity (%)
	Maximum	Minimum		
2008	34.1	9.9	1787	77.0
2009	33.0	12.1	1994	74.0
2010	33.5	10.1	1453	60.3
2011	20.8	9.2	1632	75.8

Source: BBS, 2011.

4.5 Economic and agricultural conditions of the study area: Economy of the Dinajpur district mainly depends on agriculture**.** There is a well known proverb about Dinajpur - 'paddy piled up high, sheds full of cows, ponds brimming with fish'. Dinajpur is famous for the production of 'Katarivog' and lychee**.** A large number of people of Dinajpur district depends upon agri based products. Dinajpur is also rich in natural resources like coal. Rice processing mill is the main industry in Dinajpur. Different types of crops grown in this district such as rice, wheat, maize, potato, brinjal and tomato. Different types of fruits are also grown such as lychees, mangoes, bananas and jackfruits (BBS, 2011).

4.6 Educational structure of the study area: Average literacy rate in Dinajpur district is 45.7%. Literacy rate of male and female is 51% and 40%, respectively. This district contains 1 university, 118 colleges, 617 secondary schools, 1713 primary schools, 29 NGO schools and 351 madrashas. Average literacy rate in Ghoraghat upazila is 26.1%. Literacy rate of male and female is 32.8% and 19.2%, respectively. This upazila contains 8 colleges, 18 secondary schools, 53 primary schools, and 34 madrashas. Average literacy rate in Hakimpur upazila is 47.2%. Literacy rate of male and female is 52.5% and 41.6%, respectively. It has 5 colleges, 1 textile institute, 38 secondary schools, 162 primary schools and 28 madrashas (BBS, 2011).

4.6 Transport system and communication: Transport and communication system of a country is an important infrastructure for the development of the economy as well as agriculture by providing the marketing facilities. Study areas are communicated with pucca road, semi pacca road. Anyone can reach the study area by van, by cycle, motor cycle and also by car. Products are mainly carried by van. Some local bazaar and big hats are located around the study area. Hats are organized twice a week on different days. Farmers can sell their product directly to those markets and hats.

CHAPTER 5

SOCIO-DEMOGRAPHIC PROFILE

The general socio-demographic characteristics of the sample farmers such as their age, educational level, farming experience, family size, farm size, agricultural informational source, income from agriculture and non- agriculture sector are discussed here.

5.1 Age: The selected BRRIdhan-34 and Sharna-5 rice growers of the study area were categorize into 3 groups and presented in Table 5.1.

Table 5.1 Distribution of farmers according to age level

Age groups (years)	Aromatic rice grower		Aman rice grower		Total	
	(No.)	(%)	(No.)	(%)	(No.)	(%)
(<18)	6	20%	8	26.68%	14	23.33%
(18 to 55)	13	43.33%	14	46.64%	27	45%
(Above 55)	11	36.64%	8	26.68%	19	31.67%
Total	30	100	30	100	60	100

Source: Field Survey, 2019.

From Table 5.1 we can see that highest number of farmers both Aman and Aromatic rice belongs to the age group of (18 to 55). In this group, around 45% of total sample farmers belong.

5.2 Educational status of the farmers: Educational status was categorized into three groups such as primary, secondary and higher secondary and above which are presented in table 5.2. From the table 5.2 we can see that highest number of farmers belong to the primary groups that is 26 (43.33%). And 26.66% farmers belong to the secondary educational group and rest 30% farmers belong to the higher secondary and above group.

Table 5.2 Educational status of the selected farmers

Educationl groups	BRRIdhan-34 rice		Sharna-5 rice grower		Total	
	(No.)	(%)	(No.)	(%)	(No.)	(%)
Upto primary	13	43.33	13	43.33	26	(43.33%)
Upto secondary	10	33.34	6	20	16	(26.67%)
Higher Secondary and above	7	23.33	11	36.67	18	(30%)
Total	30	100	30	100	60	100

Source: Field survey, 2019.

5.3 Farming experience: The selected farmers of the study area were categorized into three groups according to their farming experience. They were low level of farming experience (up to 10 years), medium level of experience (11 to 20 years) and higher level of experience (above 20 years).

Table 5.3 Farming experience of the farmers

Farming experience	BRRIdhan 34 rice growers		Sharna 5 rice growers		Total	
	(No.)	(%)	(No.)	(%)	(No.)	(%)
Up to 10 years	2	6.67	4	13.33	6	10
11 -20 years	12	40	11	36.67	23	38.33
Above 20 years	16	53.33	15	50	31	51.67
Total	30	100	30	100	60	100

Source: Field survey, 2019.

From Table 5.3 we can see that highest number of farmers belong to the group of higher level of experience. About 51.67 % selected farmers belong to the group of higher level of farming experience and 38.33% farmers belong to the group of medium level of farming experience and finally only 10% farmers belong to the low level of farming experience.

5.4 Farm size

Based on own operated land holdings farmers were classified into three categories (BBS, 2008). These categories were:

1. Small (having 0.02 -1.0 hectare of own operated land)
2. Medium (having 1.01-3.0 hectare of own operated land)
3. Large (having above 3.0 hectare of own operated land)

Table 5.4 Farm size distribution pattern of the growers

Farm categories	BRRIdhan34 rice grower		Sharna 5 rice grower		Total	
	(No.)	(%)	(No.)	(%)	(No.)	(%)
Small	11	36.67	11	36.67	22	36.67
Medium	10	33.33	10	33.33	20	33.33
Large	9	30	9	30	18	30
Total	30	100	30	100	60	100

Source: Field survey, 2019.

From the table 5.4 we can see that the highest number of farmers belong to the group of small farm category that is 36.67%. 33.33% farmers belong to the group of medium farm category. 30% farmers belong to the group of large farm categories.

5.5 Family composition of the respondent farmers on the basis of gender

In this study, the family size was defined as the total number of persons living together and taking meals from the same kitchen under the administration of a single head of the

Table 5.5 Family composition of the respondent farmers on the basis of gender

Family composition	BRRIdhan 34 rice grower		Sharna 5 rice grower		Total	
	(number)	(%)	(number)	(%)	(number)	(%)
Male	89	59.33	75	53.57	164	56.55
Female	61	40.67	65	46.43	126	43.45
Total	150	100	140	100	290	100

Source: Field survey, 2019.

5.6 Family size of the respondent farmers: The selected farmers of the study area were categorized into three groups. There are small (2-4), medium (5-6), large (above 6) based on their number of family member. It was examined that 28.33% respondent farmers belong to small family, 55% farmers belong to medium family and 16.66% farmers belong to large family. Average family size of the respondent farmers was 4.84 which was greater than national average family size 4.06. (BBS, 2016)

Table 5.6 Family size of the respondent farmers

Family size	BRRIdhan 34 rice grower		Sharna 5 rice grower		Total	
	(number)	(%)	(number)	(%)	(number)	(%)
Small (2-4)	8	26.66	9	30	17	28.33
Medium (5-6)	16	53.33	17	56.66	33	55
Large (above 6)	6	20	4	13.33	10	16.66

Source: Field survey, 2019.

5.7 Source of income of the sample farmers

Agriculture was the main source of income of the people in the selected area. It was evident that 78.33% of the total respondents were involved in agriculture for their main income among which all people involved in crop cultivation, 51.06% involved in livestock and 10.63% involved in fisheries. 21.67% farmers involved in non-agriculture sector for their income among which 11.67% involved in business and 10% involved in service. Source of income of the farmers presented in table 5.6:

Table 5.7 Source of income of the sample farmers

Occupation	Aromatic rice grower		Aman rice grower		Total	
	(No.)	(%)	(No.)	(%)	(No.)	(%)
Agriculture	22	73.33	25	83.33	47	78.33
Crop	22	16.67	25	6.67	47	100
Livestock	13	59.09	11	44	24	51.06
Fisheries	2	9.09	3	12	5	10.63
Non agriculture	8	26.67	5	16.67	13	21.67
Business	5	16.67	2	6.67	7	11.67
Service	3	10	3	10	6	10

Source: Field survey, 2019.

CHAPTER 6

COMPARATIVE PROFITABILITY ANALYSIS

The costs, returns and profitability of Aman and Aromatic rice production are presented in this sector. For calculating the costs and returns of Aman and Aromatic rice production, the costs items were classified into two groups:

1. Variable cost and
2. Fixed cost

Variable cost included the cost of seed, human labor, fertilizer, manure, irrigation and insecticide and pesticide. Fixed cost was calculated for land use cost and interest on operating capital. In this chapter, gross margin, gross return, net return and Undiscounted Benefit Cost Ratio (BCR) were determined.

6.1 Variable cost

6.1.1 Cost of human labor:

Human labor was the most important and extensively used input for producing Aman and Aromatic rice. It shared a large portion of total cost of Aman and Aromatic rice production. It can be seen from the table 6.1.1a that the amount of human labor used for Aman rice production was 141 man-days per hectare. While this was 140 man-days per hectare for Aromatic rice cultivation (Table: 6.1.1b). Total cost of human labor for Aman rice cultivation was estimated Tk. 42300/ha and for Aromatic rice cultivation the cost was Tk. 42000/ha.

From the table it was found that the highest percentage of human labor was invested for harvesting and carrying for both Aman and Aromatic rice cultivation.

6.1.2 Cost of seed: Cost of seed of Aman and Aromatic rice depends on the quality and quantity of the seeds. It can be seen from the table 6.1.2a that per hectare ues of Aman seed was 30.97 kg and average cost of Aman seed per hectare was estimated Tk. 748.87. Per hectare use of Aromatic rice was 11.15 kg and average cost of Aromatic rice seed per hectare was estimated Tk. 1066 (Table 6.1.2b). It was clear that cost of seed of Aromatic rice was relatively higher than that of Aman rice.

Table 6.1.1a Operation wise per hectare human labor cost of Aman rice production

Operations	Total labor (man/days)	Total cost(Tk. /ha)	Percentage of total cost
Seedbed preparation	8	2400	5.68
Mainland preparation	19	5700	13.48
Uprooting & transplanting	20	6000	14.19
Manure and fertilize	8	2400	5.68
Weeding	10	3000	7.09
Irrigation	1	300	0.70
Pest management	9	2700	6.38
Harvesting and carrying	56	16800	39.71
Threshing and storing	10	3000	7.09
Total	141	42300	100

Source: Field survey, 2019

6.1.3 Cost of fertilizer: Commonly used fertilizers were Urea, TSP, MOP, Gypsum and $ZnSO_4$. It can be seen from the table 6.1.2a that the per hectare use of urea, TSP, MOP, Gypsum and $ZnSO_4$ for Aman rice production were 148.3 kg, 140.23 kg, 106.5 kg, 35.84 kg, 1.76 kg and whose costs were estimated at Tk. 2427.7, Tk. 3354.5, Tk. 1604.5, Tk. 711.37and Tk. 176, respectively. Per hectare use of urea, TSP, MoP, Gypsum and $ZnSO_4$ for Aromatic rice production were 67.57 kg, 104.9 kg, 84.8 kg, 17.1 kg, 0.54 kg and whose costs were estimated at Tk. 1100.89, Tk. 2509.13, Tk. 1272.41, Tk. 315.17 and Tk. 54, respectively (Table 6.1.2b).

Table 6.1.1b Operation wise per hectare human labor cost of Aromatic rice production

Operations	Total labor(man/days)	Total cost(Tk.)	Percentage of total cost
Seedbed preparation	8	2400	5.68
Mainland preparation	18	5400	12.85
Uprooting & transplanting	19	5700	13.50
Manure & fertilizer	9	2700	6.39
Weeding	10	3000	7.10
Irrigation	1	300	0.71
Pest management	10	3000	7.10
Harvesting & carrying	54	16200	38.38
Threshing & storing	11	3300	7.81
Total	140	42000	100

Source: Field survey, 2019

6.1.4 Cost of manure: In the present study area cow dung was used as manure. The cost of manure for Aman and Aromatic rice production was Tk. 2675.3 and Tk. 2905, respectively (Table 6.1.2a and 6.1.2b).

6.1.5 Cost of irrigation: It can be seen from the table 6.1.2a and table 6.1.2b that the per hectare cost of irrigation for Aman and Aromatic rice production was Tk. 192.07 and Tk. 136.07, respectively. Irrigation was rarely used in the study area.

6.1.6 Cost of insecticides and pesticides: It was found that per hectare cost of insecticides and pesticides for Aman and Aromatic rice production were Tk. 3089.3 and Tk. 3096.07 (Table 6.1.2a and Table 6.1.2b).

6.2 Fixed costs

6.2.1 Interest on operating capital: Interest on operating capital was calculated by taking into account all the operating costs during the production period of Aman and Aromatic rice. Per hectare interest on operating capital was Tk. 1718.38 and Tk. 1641.384 for Aman and Aromatic rice production, respectively (Table 6.1.2a and Table 6.1.2b).

6.2.2 Land use cost: Average rental value of land per hectare for the study year was considered as land use cost. Per hectare value was estimated at Tk. 24700 for both Aman and Aromatic rice production (Table 6.1.2a and Table 6.1.2b).

6.3 Total cost: From the table of 6.1.2a and 6.1.2b it can be seen that the per hectare total cost of production of Aman and Aromatic rice were Tk. 81697.99 and Tk. 80796.12, respectively.

6.4 Gross return: Per hectare gross return of Aman and Aromatic rice was Tk. 109578.13 and Tk. 141222.04, respectively (Table 6.1.2a and Table 6.1.2b). Per hectare gross return of Aromatic rice was higher than Aman rice.

6.5 Gross margin: Gross margin is the gross return over variable cost. Per hectare gross margin was calculated Tk. 52298.46 and Tk.86767.3 for Aman and Aromatic rice, respectively (Table 6.1.2a & Table 6.1.2b). Gross margin was higher than that of Aman rice.

6.6 Net return: Per hectare net return of Aman and Aromatic rice were Tk. 27880.14 and Tk. 60425.92, respectively (Table 6.1.2a & Table 6.1.2b).

6.7 Benefit cost ratio (Undiscounted): Undiscounted Benefit Cost Ratio of Aman and Aromatic rice production was estimated 1.34 and 1.74, respectively, which implies that Tk. 1.34 and Tk. 1.74 will be achieved by expending every Tk. 1.00 (Table 6.1.2a and Table 6.1.2b).

6.8 Comparative profitability of Aman and Aromatic rice: From the Table 6.1.2a and Table 6.1.2b it was evident that both Aman and Aromatic rice productions were profitable. However, Aromatic rice cultivation was more profitable than Aman rice cultivation.

Table 6.1.2a: Per hectare cost and return of aman rice

Cost items	Quantity(kg/ha)	Price(Tk./kg)	Value(Tk./ha)	Percentage of Total
A.Gross Return			109578.13	100
Product	5278.24	18.6025	98188.4596	89.61
By product			11389.67	10.39
B. Total Variable Cost			57279.61	67.51
Seed	24.17	30.97	748.87	0.88
Human Labor	141	300	42300	49.86
Total Fertilizer			8274.07	9.75
Urea	148.3	16.30	2427.7	2.86
TSP	140.23	23.71	3354.5	3.95
MOP	106.5	15.08	1604.5	1.89
Gypsum	35.84	15.83	711.37	0.84
$ZnSO_4$	1.76	100	176	0.21
Manure			2675.3	3.15
Irrigation Cost			192.07	0.23
Insecticides & Pesticides			3089.3	3.64
C. Total Fixed Cost			24418.38	32.37
Interest on Operating Capital @ 6% for 6 Months			1718.38	3.38
Land Use Cost			24700	29.11
D. Total Cost (B+C)			81697.99	100
E. Gross Margin (A-B)			52298.46	
F. Net Return (A-D)			27880.14	
G.BCR (Undiscounted)			1.34	

Source: Field survey, 2019

Table 6.1.2b: Per hectare cost and return of Aromatic rice

Cost items	Quantity(kg/ha)	Price(Tk./kg)	Value(Tk./ha)	Percentage of Total
A.Gross Return			141222.04	100
Product	3234.67	40.41	130713.01	92.56
By product			10509.03	7.44
B. Total Variable Cost			54454.74	66.60
Seed	11.15	95.84	1066	1.29
Human Labor	140	300	42000	51.44
Total Fertilizer			5251.6	6.39
Urea	67.57	16.31	1100.89	1.34
TSP	104.9	23.71	2509.13	3.05
MOP	84.8	15.08	1272.41	1.55
Gypsum	17.1	18.43	315.17	0.38
$ZnSO_4$	0.54	100	54	0.07
Manure			2905	3.54
Irrigation Cost			136.07	0.17
Insecticides and Pesticides			3096.07	3.76
C. Total Fixed Cost			26341.38	33.40
Interest on Operating Capital @ 6% for 6 Months			1641.384.	3.33
Land Use Cost			24700	30.07
D. Total Cost (B+C)			80796.12	100
E. Gross Margin (A-B)			86767.3	
F.Net Return (A-D)			60425.92	
G. BCR (Undiscounted)			1.74	

Source: Field survey, 2019

CHAPTER 7

FACTORS AFFECTING THE YIELD

Cobb-Douglas production function has been chosen to determine the effects of selected variables. Estimated value of the coefficient and related statistics of the Cobb-Douglas production functions of Aman and Aromatic rice are given in Table 7.1.

7.1 Interpretation of the Result of Aman rice:

Amount of seed (X_1): It can be seen from Table 7.1 that the regression coefficient of seed quantity was 0.2319 with a positive sign and it was insignificant.

Human labor cost (X_2): From Table 7.1 the regression co-efficient of human labor cost was 0.7501 which was positive and was significant at 1 percent level, which indicated that an increase in one percent of human labor cost, remaining other factors constant, would result in an increase in yield by 0.7501 percent.

Amount of Urea (X_3): From Table 7.1 that the regression coefficient of urea quantity was 0.2459 with a negative sign and it was insignificant.

Amount of MoP (X_4): From Table 7.1 the regression coefficient of MoP quantity was 0.9721 with a positive sign and it was significant at 1 percent level, which indicated that an increase in one percent of MoP quantity, remaining other factors constant, would result in an increase in yield by 0.9721 percent.

Amount of TSP (X_5): From table 7.1 the regression coefficient of TSP quantity was 0.5216 which was positive and was significant at 1 percent level, which indicated that an increase in one percent of TSP quantity, remaining other factors constant, would result in an increase in yield by 0.5216 percent.

Amount of Gypsum (X_6): From Table 7.1 it can be seen that the regression coefficient of gypsum quantity was 0.15137 which had a positive sign and it was insignificant.

Insecticides and pesticides cost (X_7): From the Table 7.1 it can be seen that the regression coefficient of insecticides and pesticides cost was 0.7621 which was positive and it was insignificant.

Manure cost (X_8): It can be seen from Table 7.1 that the regression coefficient of manure cost was 0.2831 with a positive sign and it was significant at 1 percent level, which indicated that an increase in one percent of manure cost, remaining other factors constant, would result in an increase in yield by 0.2831 percent.

Coefficient of adjusted multiple determinations (R^2): From Table 7.1 it was examined that the value of the adjusted multiple determination (R^2) was 0.67 which indicated that about 67 percent of the variations of the yield were explained by the explanatory variables included in the model.

Goodness of Fit (F- value): The F value (7.42) of the estimated function was significant at 1 percent level, which implies good fit of the model.

7.2 Interpretation of the result of aromatic rice

Amount of seed (X_1): It can be seen from Table 7.1 that the regression coefficient of seed quantity was 0.0363 with a positive sign and it was insignificant.

Human labor cost (X_2): From Table 7.1 it can be seen that the regression co-efficient of human labor cost was 0.2513 which was positive and was significant at 1 percent level, which indicated that an increase in one percent of human labor cost, remaining other factors constant, would result in an increase in yield by 0.2513 percent.

Amount of Urea (X_3): It can be seen from Table 7.1 that the regression coefficient of urea quantity was –0.17112 with a negative sign and it was significant at 1 percent level which indicated that an increase in 1 percent of urea quantity, remaining other factors constant, would result in a decrease of yield by 0.17112 percent.

Amount of MoP (X_4): It can be seen from Table 7.1 that the regression coefficient of MoP quantity was 0.04628 with a negative sign and it was insignificant.

Amount of TSP (X_5): From the table 7.1 it can be seen that the regression coefficient of TSP quantity was 0.05433 which had a negative sign and was insignificant.

Table 7.1: Estimated value of coefficient and related statistics of Cobb-Douglas production function

Exploratory variables	Aman rice		Aromatic rice	
	Estimated Coefficient	p-value	Estimated Coefficient	p-value
Constant	2.14	0.563376	7.382925***	0.00961
Amount of Seed (X_1)	0.2319	0.3729	0.036323	0.73152
Human Labor Cost (X_2)	0.7501***	0.0031	0.251375***	0.00315
Amount of Urea (X_3)	-0.2459	0.3465	-0.17112***	0.00427
Amount of Mop (X_4)	0.9721***	0.0033	-0.04628	0.33827
Amount of TSP (X_5)	0.5216***	0.0010	-0.05433	0.82503
Amount of Gypsum (X_6)	0.15137	0.64376	0.251377***	0.0033
Insecticides and Pesticides Cost (X_7)	0.7621	0.3431	0.20453***	0.01342
Manure cost (X_8)	0.2831***	0.0096	-0.03935	0.14866
Adjusted R^2	0.67		0.592	
F-Value	7.42***		3.59***	

Source: Field survey, 2019

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

Amount of Gypsum (X_6): From Table 7.1 it can be seen that the regression coefficient of gypsum quantity was 0.2513 which was positive and it was significant at 1 percent level which indicated that an increase in 1 percent of gypsum quantity, remaining other factors constant, would result in an increase of yield by 0.2513 percent.

Insecticides and pesticides cost (X_7): From Table 7.1 it can be seen that the regression coefficient of insecticides and pesticides cost was 0.20453 which was positive and was significant at 1 percent level, which indicated that an increase in one percent of insecticides and pesticides cost, remaining other factors constant, would result in an increase in yield by 0.20453 percent.

Manure cost (X_8): It can be seen from Table 7.1 that the regression coefficient of manure cost was -0.03935 with a negative sign and it was insignificant.

Coefficient of adjusted multiple determinations (R^2): From the Table 7.1 it was examined that the value of the adjusted multiple determination (R^2) was 0.59 which indicated that about 59 percent of the variations of the yield were explained by the explanatory variables included in the model.

Goodness of Fit (F- value): The F value (3.59) of the estimated function was significant at 1 percent level, which implies good fit of the model.

CHAPTER 8

PROBLEMS FACED BY FARMERS

The nature and extend of the problems faced by the farmers are discussed below:

8.1 Low price of output: It can be seen from Table 8.1 that low Price of output was the top most problem for rice growers. About 91.66 percent farmers of Amon and Aromatic rice faced this problem. It was 1st ranking problem faced by rice growers.

8.2 Absence of government declared price at market: About 83.33 percent farmers of Aman and Aromatic rice growers faced this problem (Table 8.1). It was 2nd ranking problem faced by Aman and Aromatic rice growers.

8.3 High amount of pest attack: We could see from Table 8.1 that it was the most faced problem by the Aromatic and Aman rice producers around 63.33 percent. It was 3rd ranking problem faced by Aman rice growers and Aromatic rice growers.

8.4 Lack of human labor at critical stage: Shortage of human labor at the critical stage is a seasonal problem and it occurs at the pick period of Aman and Aromatic rice production. About 60.55 percent of Aman and Aromatic rice growers faced this problem (Table 8.1). It was 4th ranking problem faced by respondent rice growers.

8.5 High wage of human labor: Labor wage was another problem faced by the farmers. About 51.66 percent farmers of both Aman and Aromatic rice producers faced this problem (Table 8.1). It was 5th ranking problem faced by Aman rice growers and Aromatic rice growers.

Table 8.1 Problems faced by the farmers in producing Aman and Aromatic rice production:

Problems	Farmers		Rank
	No	%	
Low price of output	55	91.66	1st
Absence of government declared price at market	50	83.33	2nd
High amount of pest attack	38	63.33	3rd
Lack of human labor at critical stage	33	60.55	4th
High wage of human labor	31	51.66	5th
Lack of storage facility	25	41.66	6th
High cost of transportation	23	38.33	7th
High distance of market	21	35	8th

Source: Field survey, 2019

8.6 Lack of storage facility: From Table 8.1 we could see that around 41.66 percent farmers of Aman and Aromatic rice producers, respectively faced this problem. It was 6th ranking problem faced by Aman rice and Aromatic rice growers.

8.7 High cost of transportation: About 38.33 percent farmers of Aman and Aromatic rice growers faced this problem (Table 8.1). It was 7th ranking problem faced by respondent rice growers.

8.8 High distance of market: About 35 percent farmers of aman and aromatic rice growers, respectively, faced this problem (Table 8.1). It was 8th ranking problem faced by aman and aromatic rice grower in the study area.

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8.2 Suggested solutions: The rice growing farmers were asked to suggest solutions to the above mentioned problems. They pointed out some suggestions to solve the problems which were given below:

Table 8.2 Farmers suggestions to overcome problems

Suggestions	Farmers respondent(number)	Farmers respondent (%)	Rank
Ensuring better government monitoring system for fair and stable price of output	55	91.67	1st
Invention of pest resistance variety	42	70	2nd
Ensuring better storage facility and	15	25	3rd
Improving transportation facility	14	23.33	4th

Source: Field survey, 2019

CHAPTER 9
SUMMARY, CONCLUSION & RECOMMENDATIONS

9.1 Summery and conclusion

There are three categories of rice produced in Bangladesh. They are Aman, Aus and Boro. Yield of Aman rice is higher than that of Aromatic rice. On the other hand, market price of Aromatic rice is almost double than that of Aman rice. Dinajpur region is one of the best Aromatic rice growing areas of Bangladesh.

Two selected upazilas namely Hakimpur and Ghoraghat under Dinajpur district were the study area. A total of 60 samples were randomly selected for primary data collection. Data were collected by comprehensive interview schedules. Simple statistical techniques as well as Cobb-Douglas production function were used to process and analyze the data to achieve the objectives of the study.

In case of socio-demographic characteristics, it was found that the highest percentage of farmers was in the age group of 18 to 55. It was also found that the highest percentage of both Aman and Aromatic rice growers had primary level education which was 43.33 percent. It was evident that 78.33% of the total respondents were involved in agriculture as their main occupation. While only 11.67% of the total respondents were involved in business as their main occupation and 10% of the total respondents were involved in service as their main occupation.

Profitability depends on the costs of production and returns from its product and by products. Per hectare variable cost of Aman rice was Tk. 57279.61 and for Aromatic rice was Tk. 54454.74. Per hectare fixed cost of Aman rice was Tk. 24418.38 and per hectare fixed cost for Aromatic rice was Tk. 26341.38. Per hectare total costs of Aman and Aromatic rice were Tk. 81697.99 and Tk. 80796.12, respectively. Per hectare gross margins of Aman and Aromatic rice were Tk. 52298.46 and Tk. 86767.3. Per hectare net returns of Aman and Aromatic rice were Tk. 27880.14 and Tk. 60425.92, respectively. Calculated BCR (Undiscounted) was higher for Aromatic rice (1.74) than that of Aman rice (1.34).

Cobb-Douglas production function was used on the basis of the best fit and the significant effects of resources on gross returns.

For both rice enterprise five explanatory variables were taken into account to explain variations in production. The coefficient of multiple determinations (R^2) was .67 in case of Aman production function. This indicates that 67 percent of the variation of output of Aman was explained by the explanatory variables included in the model. The F-value (7.42) of the equation was significant, which indicates good fit of the model. The coefficient of multiple determinations (R^2) was 0.59 in case of Aromatic rice production function. The present study also identified some problems of Aman and Aromatic rice production. The major problems faced by the farmers were low price of output, high price of labor, lack of labor, lack of storage facility, high price of fertilizer and pesticides, inadequate government monitoring system for fair price etc.

The present study revealed that Aromatic rice cultivation was more profitable than Aman rice cultivation. Moreover, the government should take necessary steps to overcome these problems and to expand the production of Aromatic rice in different areas of Bangladesh.

9.2 Recommendations: The following recommendations are drawn on the basis of findings of the study to the policy makers and researchers in order to adopt all sort of potential measures to improve the present situation:

1. From the present study it was seen that Aromatic rice production was more profitable. So government should take necessary steps to motivate farmers to increase the production of Aromatic rice in order to increase their income level.
2. Lower price was observed at the harvesting period in the study areas. Government procurement price should be ensured by the concerned authority and monitoring system should be developed, so that the rice growers would get their expected returns from rice.
3. Shortage of human labor and pest resistance variety were major problems for Aman and Aromatic rice producers in the study areas. Necessary steps should be taken by the concerned authority to motivate farmers to use capital intensive mechanical material for lessen this problem.
4. Storage facility should be increased so that farmers can store their product during the time of low market price and can get the fair price for their product.

REFERENCES

Anik, A. R. (2003). Economic and Financial Profitability of Aromatic and Fine Rice Production in Bangladesh**,** MS Thesis, Department of Agricultural Economics, Bangladesh Agricultural University, Mymensingh, Bangladesh.

Ashrafuzzaman, M., Islam, M. R., Ismail, M. R., Shahidullah, S. M. and Hanafi, M. M. (2009). Evaluation of Six Aromatic Rice Varieties for Yield and Yield Contributing Characters, *International Journal of Agriculture & Biology, Vol. 11, No. 5, 2009.*

BBS, (2008), *Census of Agriculture 2008, Structure of Agriculture holding and livestock population*. Bangladesh Bureau of Statistics, Statistics and Informatic Division, Ministry of Planning, Government of the People's Republic of Bangladesh , Dhaka, Bangladesh.

BBS, (2011), *Statistical Pocket Book of Bangladesh*. Bangladesh Bureau of Statistics, Statistics and Informatic Division, Ministry of Planning, Government of the People's Republic of Bangladesh , Dhaka, Bangladesh.

BBS, (2016), *Statistical Pocket Book of Bangladesh*. Bangladesh Bureau of Statistics, Statistics and Informatic Division, Ministry of Planning, Government of the People's Republic of Bangladesh , Dhaka, Bangladesh.

BBS, (2017), *Statistical Pocket Book of Bangladesh*. Bangladesh Bureau of Statistics, Statistics and Informatic Division, Ministry of Planning, Government of the People's Republic of Bangladesh , Dhaka, Bangladesh.

BBS, (2018). *Statistical Yearbook of Bangladesh*. Bangladesh Bureau of Statistics, Statistics and Informatic Division, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka.

BER (2018), *Bangladesh Economic Review 2018*, Department of Finance, Ministry of Finance, Government of the People's Republic of Bangladesh, Dhaka.

Biswas, T., Paul, S.K., Sarker, M.A.R. and Sarker, S.K. (2016). Intregrated use of poultry manure with prilled urea and urea super granules for improving yield and protein content of aromatic rice (cv. BRRI dhan50). *Progress. Agric. 27 (2):86-93.*

BRRI (2016). A Handbook of Modern Rice Cultivation, Bangladesh Rice Research Institute, Gazipur-1701.

FAO (2017). Production Yearbook. FAO Statistical Series. Food and Agriculture Organization of the United Nations, Rome, Italy.

Islam, N., Kabir, M. Y., Adhikary, S. K. and Jahan, M. S. (2013). Yield Performance of Six Local Aromatic Rice Cultivars, *IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS), Vol. 6, Issue* 3 *(Nov.- Dec. 2013),* PP 58-62.

Kabir, M. A. (2000). An Economic Analysis of Aromatic and Non-Aromatic Rice Cultivation in Some Selected Areas of Dinajpur District. MS Thesis, Department of Agricultural Economics, Bangabandhu Sheikh Mujibur Rahman Agricultural University,Gazipur-1706.

Nasrin, J. (2013). Financial Profitability of Aromatic Rice Production and Its Impacts on Farmers Livelihood in Selected Areas of Tangail District, Department of Agricultural Economics, Bangladesh Agricultural University, Mymenshing-2202.

Rashid, M. M., Ghosh, A. K., Roni, M. N., Islam, M. R. and Alam, M. M. (2017). Yield Performance of Seven Aromatic Rice Varities of Bangladesh, *International Journal of Agriculture and Environmental Research,vol:03,issue:02'March-April 2017.*

Razzaque, M. A. and Rafiquzzaman, S. (2007). A Comparative Analysis of T. Aman Rice Cultivation Under Different Management Practice in Coastal Area in Bangladesh, *J Agric Rural Dev 5(1&2), 64-69, June 2007.*

Tama, R. A. J., Alam, M. J. and Islam, S. (2015). Financial Profitability of Aromatic Rice Production in Some Selected Areas of Bangladesh. *International Journal of Innovation and Applied Studies, ISSN 2028-9324, Vol. 12 No.1, July 2015, pp. 234-242.*

Tama, R. A. Z., Dhar, A. R. and Begum, I. A. (2018). An Economic Perspective of the Export Potentiality of Aromatic Rice in Bangladesh, *American Journal of Economics and Business Administration 2018, Volume 10:22.30.*

Ullah, A. M. (2008). A Comparative Profitability And Technical Efficiency of Aromatic And Non- Aromatic Aman Rice Production in Dinajpur District,MS Thesis, Department of Agricultural Economics, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur,1706.

APPENDICES

Department of Agricultural Economics

Sher-e-Bangla Agricultural University

An Interview Schedule on

A Comparative Profitability Analysis Between Aromatic and Aman Rice in Some Selected Areas of Dinajpur District

Sample No……..

1 .Identification of the farmer:

Name: ……

Gender: ……

Father's Name: ……

Age ……Years

Education: Primary / secondary / Higher secondary and above

Village …….. Thana ……

2. Farming Experiences:

How long you have involved in farming…….Years

3. Family type: nuclear family/ joint family

4. Family size:

What is the number of your family members included yourself?

Total members……Adult male……..

Effective labor ……Permanent Labor ……

5. Educational status of the family

Members	Number	Educational qualification		
		Primary	Secondary	Higher secondary & above
Infant(0-6)				
Male				
Female				

6. Farm size

Please indicate the area of your land in your possession

Types of land	Area (acres)
a. Own Cultivated Land	
b. Rented In	
c. Rented Out	
d. Mortgaged In	
e. Mortgaged Out	
Total=(a+b+d-c-e)	

7. Farmers Occupational sources

Please mention your annual income according to occupational source

Occupation		Amount (Taka)
Agriculture	Crops	
	Livestock	
	Fisheries	
	Forestry	
Non agriculture	Business	
	Service	
	Others	

8. Profitability Analysis

a. Human Labor Requirement (man/day)

Please mention of your Human Labor requirement

Name of items	Aman rice				Aromatic rice			
	No. of labor		Taka/ labor	Total (Tk)	No. of labor		Taka/ labor	Total (Tk)
	Own	Hired			own	Hired		
Seedbed preparation& Sowing								
Main land Preparation (tillage & laddering)								
Uprooting & transplanting								
Manure & fertilizer								
Weeding								
Irrigation								
Pest management								
Harvesting								
Carrying ,threshing & storing								
Winnowing, sunning & drying								
Total								

b. Cost of animal or mechanical powers used

Please mention your cost of animal or mechanical powers used

Name of practice	Aman rice				Aromatic rice			
	Name of Machine/ Animal	**No. of machine/ animal**	**Rent per machine/animal (Taka)**	**Total (Tk.)**	**Name of Machine/ Animal**	**No of machine/ animal**	**Rent (Tk.)**	**Total (Tk.)**
Tillage								
Weeding								
Spraying								
Threshing								
Total								

c. Materials inputs used

Please mention about material input used

Inputs	Unit Price	Aman rice		Aromatic rice	
		Amount (kg)	Taka	Amount (kg)	Taka
Seed					
Manure					
Fertilizer					
a. Urea					
b. TSP					
c. MP					
d. Gypsum					
e. Zinc					
Pesticide					
Irrigation					
Others					
Total					

9. Amount of rice production and disposal

Please mention about rice production and disposal

Rice variety	Total Production (monds)	Unit Price (Tk.)	Total taka	Straw production	Unit price (Tk.)	Total Taka	Grand Total Taka
1	2	3	4	5	6	7	(4+7)
Aman rice							
Aromatic rice							

10. Please mention the problems faced by you in rice cultivation

a)……..

b)……..

c)……..

d)……..

e)……..

11. What are your suggestions to overcome the above problems?

a)……

b)……..

c)……..

d)……..

e)……..

Thank you for your kind co-operation

Date…….. **Signature of the interviewer**

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.650311
R Square	0.695718
Adjusted R Square	0.674153
Standard Error	0.191349
Observations	30

ANOVA

	Df	*SS*	*MS*	*F*	*Significance F*
Regression	8	0.104319	0.011915	7.424767519	0.000787
Residual	21	0.165238	0.006345		
Total	29	0.178557			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	2.148213	3.8581	0.5570	0.563376	-5.87424	10.172	- 5.8742	10.172
ln x1	0.2319959	0.2460	0.9103	0.372968	-0.28765	0.7355	-0.2876	0.7355
lnx2	0.750122	0.4130	6.1782	0.00310	4.217807	11.453	4.2178	11.453
lnx3	-0.245939	0.143229	1.025899	0.3465727	-0.15092	0.4448	-0.15092	0.4448
lnx4	0.972167	0.356878	-0.2737	0.0033087	-0.83985	0.6444	-0.83985	0.6444
lnx5	0.521654	0.25573	2.831034	0.00100	0.192161	1.2558	0.192161	1.2558
lnx6	0.15137	0.277672	-0.61716	0.6437214	-0.74882	0.4060	-0.74882	0.4060
lnx7	0.762154	1.752964	4.472406	0.34315674	4.217806	11.453	4.217806	11.453
lnx8	0.283154	0.0646	2.8465	0.009657	0.498263	0.3172	0.4982	0.3172

Regression Statistics	
Multiple R	0.8416672
R Square	0.7084037
Adjusted R Square	0.5973194
Standard Error	0.0624287
Observations	30

ANOVA

	df	SS	MS	F	Significance F
Regression	8	0.198832	0.024854	3.517717233389914	0.0003076
Residual	21	0.0818441	0.0038973		
Total	29	0.2806761			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	7.3829	2.59162	2.8487	0.00961	1.99334	12.772	1.99334	12.772
lnx1	0.0363	0.104464	0.3477	0.731525	-0.1809	0.2535	-0.1809	0.2535
lnx2	0.2513	0.074723	3.3617	0.00315	0.09715	0.4055	0.09715	0.4055
lnx3	-0.1711	0.053421	-3.203	0.00427	-0.28221	-0.060	-0.2822	-0.060
lnx4	-0.0462	0.04722	-0.979	0.338269	-0.1444	0.0519	-0.1444	0.0519
lnx5	-0.0543	0.242684	-0.223	0.825033	-0.5590	0.450363	-0.5590	0.450363
lnx6	0.2513	0.074723	3.3666	0.003302	0.0971536	0.4055963	0.097154	0.4055963
lnx7	0.2045	0.0757618	2.6996431	0.0134205	0.0469745	0.3620852	0.046974	0.3620852
lnx8	-0.0393	0.0262451	-1.499364	0.1486633	-0.0939306	0.0152287	-0.093930	0.0152287