PROFITABILITY ANALYSIS OF AROMATIC RICE PRODICTION IN DINAJPUR DISTRICT OF BANGLADESH

MD. FARUQUE HOSSAIN

DEPARTMENT OF AGRICULTURAL ECONOMICS
SHER-E-BANGLA AGRICULTURAL UNIVERSITY
SHER-E-BANGLA NAGAR, DHAKA-1207

JUNE, 2020

PROFITABILITY ANALYSIS OF AROMATIC RICE PRODICTION IN DINAJPUR DISTRICT OF BANGLADESH

BY

MD. FARUQUE HOSSAIN

Registration no.:13-05677

A Thesis
Submitted to the Department of Agricultural Economics,
Sher-e-Bangla Agricultural University, Dhaka,
in Partial fulfillment of the requirements
for the degree of

MASTER OF SCIENCE (MS)

IN

AGRICULTURAL ECONOMICS

SEMESTER: JANUARY-JUNE, 2020

APPROVED BY:

Professor Dr. Jahangir Alam Khan Supervisor Department of Business & Economics University of Global Village, Barisal	**Md. Sadique Rahman** Associate Professor Co-Supervisor Department of Management & Finance Sher-E-Bangla Agricultural University

Prof. Gazi M.A. Jalil
Chairman Examination committee
Department of Agricultural Economics
Sher-E-Bangla Agricultural University

DEPARTMENT OF AGRICULTURAL ECONOMICS

Sher-E-Bangla Agricultural University

CERTIFICATE

This is to certify that the thesis entitled '**PROFITABILITY ANALYSIS OF AROMATIC RICE PRODICTION IN DINAJPUR DISTRICT OF BANGLADESH**' submitted to the Department Of Agricultural Economics, 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 bonafide research work carried out by **Md. Faruque Hossain**, Registration Number: **13-05677** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

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

Dated:
Dhaka, Bangladesh

……..

Professor Dr. Jahangir Alam Khan
Supervisor
Department of Economics
University of Global Village, Barisal

DEDICATED TO

MY BELOVED PARENTS

PROFITABILITY ANALYSIS OF AROMATIC RICE PRODICTION IN DINAJPUR DISTRICT OF BANGLADESH

ABSTRACT

The purpose of the study was to describe some selected socio-economic characteristics of the aromatic rice cultivars; to estimate the cost and returns of aromatic rice production; to determine the profitability of aromatic rice production in the study areas; to identify the factors affecting profitability of aromatic rice production and to identify the problems faced by farmers in aromatic rice cultivation. The study was undertaken purposively in Chirirbandar under Dinajpur district. Validated and well- structured interview schedule (questionnaire) was used to collect data from 105 aromatic rice cultivars during 5th June, 2019 to 30th June, 2019. Per hectare gross return of aromatic rice cultivation was Tk. 141628. Per hectare gross margin was Tk. 93456 for aromatic rice production. Total net return was estimated Tk. 62904 for aromatic rice production per hectare. Benefit cost ratio (BCR) was 1.80 for aromatic rice production. Cobb-Douglas production function analysis was carried out for examining the factors affecting the profitability of input use. In most of the cases the coefficients of human labor, seeds, urea, gypsum and manure had significant positive effect on production of aromatic rice production, but zinc sulphate showed negative significant effect on aromatic rice cultivation. The values of the coefficient of multiple determination of aromatic rice production was 0.79 which implied that about 79 percent of the total variation in the gross return could be explained by the included explanatory variables of the model. Low price of aromatic rice was the 1st problem followed by high price of fertilizer, lack of quality seed and lack of adequate transportation facilities was the last problem in aromatic rice production.

ACKNOWLEDGEMENT

Alhamdulillah, all praises are due to the almighty Allah for His gracious kindness and infinite mercy in all the endeavors which create that opportunity for the author to successfully complete the research work required for the partial fulfilment of the degree of Master of Science.

The author would like to express his heartfelt gratitude and sincere appreciations to his ***Supervisor Professor Dr. Jahangir Alam Khan****, Vice-Chancellor, University of Global Village, Barisal, for his valuable guidance, advice, encouragement and support throughout the study. Likewise grateful appreciation is conveyed to his* ***Co-supervisor Md. Sadique Rahman****, Associate Professor, Department of Management & Finance, Sher-e-Bangla Agricultural University, Dhaka, for his constant encouragement, constructive criticisms and valuable advice to complete the thesis.*

The author expresses his sincere respect to ***Prof. Gazi M.A. Jalil, Chairman****, Department of Agricultural Economics, Sher-e-Bangla Agricultural University, Dhaka for providing valuable advice and sympathetic consideration regarding this research.*

The author is deeply indebted and grateful to his Parents and siblings who continuously prayed for his success and without their love, affection, inspiration and sacrifice this work would not have been completed.

June, 2020 ***The Author***

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

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

CHAPTER I
INTRODUCTION

1.1 General background of the study

Rice is the staple food of about half of the world's population. Of the three most important cereals produced in the world mainly rice is used for human consumption. Bangladesh, producing about 36 million tons of milled rice annually, is the 3rd largest rice producer in the world. About 10 million hectares, consisting of very small farms, are used annually to produce this rice. The rice sector contributes about 13.35% to the national GDP and offers more than 40% of employment. For income generation, the rural poor spend up to 60% of their time on rice production and processing activities (BRF, 2019).

Bangladesh produces many fine aromatic and non/aromatic rice varieties with excellent eating quality for regular consumption as steamed rice as well as for polao and biryani type preparations. For regular consumption, local varieties such as Kataribhog, Kataktara, Banshful, Bau-pagal, and Nizershail are among the fine varieties that are currently grown. BRRI-developed BR-6, BR-16 (shahibalam), BR-36, BR-38, and BR-39 are the fine, slender grains that have attractive qualities in the export market. Some of them have slightly pleasing aroma. For polao and biryani type preparations, Kalijira, Chinigura, Dolhabhog (BR-5), BR-34 and BR-38 are among varieties that are considered excellent, with small-to-medium sized grains and fine aroma. BR-26 rice is slender and long and has soft and slightly sticky consistency qualities that should have demand in the East Asian markets.

There are other varieties with the desirable qualities that are grown in various locations in Bangladesh but not well known outside those areas. In western and middle-eastern countries, where Bangladeshi communities constitute a significant proportion of population, a major `consumer bank' is already in existence that

could be successfully exploited through proper promotion and marketing incentives. As a food, rice and rice-based preparations are becoming increasingly popular with the non-Asian populations all over the world, including Europeans, Americans and affluent Africans. With proper promotion and marketing support, Bangladeshi fine quality and aromatic rice could find significant markets both at home and abroad. While so many prospects are in sight, achievement of the goal is fraught with a number of productions, marketing and trade related problems. It would therefore be pertinent to examine the relevant issues for assessing the prospect of production and export of aromatic rice in Bangladesh. Some works have been done on production and marketing of aromatic rice, including determination of financial costs and returns or profitability of aromatic rice. However, little works have been done on determination of economic profitability of this variety of rice.

In respect of production of aromatic rice, Dinajpur, Naogaon, Chittagong and Sherpur had 1st, 2nd, 3rd and 4th position respectively in 2002-03 (Talukder, 2004). The demand for coarse and medium rice is much higher in the country. During the seventies and eighties, most of the rice varieties developed in the country fell in the coarse/medium categories. During the nineties, Bangladesh Rice Research Institute (BRRI) developed quite ago od number of fine and aromatic varieties which have high demand in both domestic and foreign markets. In near future, Bangladesh is likely to become a rice exporter if the country can maintain growth in rice production as it has been doing in the past several years. Bangladeshi fine quality and aromatic rice could find significant markets both at home and abroad. In Bangladesh, the very thought of rice exports evokes mixed feelings and sentiments. While so many prospects are insight, achievement of the goal is associated with a number of productions, marketing and trade related problems. Thus, it would be pertinent to examine the relevant issues for assessing the prospect of production of aromatic rice in Bangladesh.

1.2 Objectives of the study

1. To describe some selected socio-economic characteristics of the aromatic rice cultivars;
2. To estimate the cost and returns of aromatic rice production;
3. To determine the profitability of aromatic rice production in the study areas;
4. To identify the factors affecting profitability of aromatic rice production; and
5. To identify the problem faced by farmers in aromatic rice cultivation.

1.3 Justification of the study

Rice is the most important cereal crop in terms of area, production and contribution to the national income and national economic development. Substantial area is devoted to aromatic rice production and millions of farmers have been growing aromatic rice in this country. Despite the fact that aromatic rice is cultivated extensively in Bangladesh, per hectare yield is much lower in comparison with that of other paddy growing countries of the world. In order to meet this deficit, yield per unit area of aromatic rice should be increased. The number of landless laborers, disguised and unemployed population is increasing gradually. Therefore, it is necessary to produce food grain to meet food requirements for the increased population.

Bangladesh is the ninth most populous country in the world. The Government of Bangladesh has given too much emphasis on paddy production. Bangladesh soil is suitable for producing aromatic rice. In the past a few studies have been made on the profitability of aromatic rice in Bangladesh. But there is no exclusive study on the profitability of aromatic rice particularly in the Dinajpur district. As such it was felt that a study on the aromatic rice in Dinajpur district would be of much importance. This is obviously due to the fact that development basically means larger size productive activities in the economy. But we cannot have more of production unless the goods produced are actually sold out and selling depends on

the proper marketing conditions. Besides, the results also would serve as a reference for researchers to embark upon similar or related work in other parts of the country. Some arguments supporting the importance of this study are presented below:

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

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

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

1.4 Limitation of the study

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

i. Most of the respondents were not well educated. They had no previous idea about such a study. They were suspicious about the researcher and therefore did not cooperate and it was therefore difficult to explain the purpose of this research to convince them. At last the respondents were convinced.

ii. Most of the farmers were fearful of imposition of taxes. Their anxiety was that the researcher might use the information against their interest.

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

iv. Sometimes the producer-respondents were not available at their home because they remained busy with their outside work. This is why some times more than two visits were required to get information from them. So, the author had to give extra effort and time to collect the information

v. The respondents always had a tendency not to provide correct data relating to the size of their holding, income and expenditure received from different activities. Because most of the respondents in the study area thought that the investigator was a government officer. They initially hesitated to answer the question relating to their income and expenditure. The respondents thought that new taxes would be imposed on them if correct information was provided. When they understood then they gave relevant data.

vi. Farmers provided data in local units of measures in response to questions which created complexity in analyzing the data.

vii. There was a time limitation so all data and other necessary information was collected within the shortest possible time.

1.5 Outline of the Study

This thesis contains a total of eight chapters which have been organized in the following sequence. Chapter 1 includes introduction. The review of literature is presented in Chapter 2. Methodology of the relevant study is discussed in Chapter 3. Chapter 4 contains the socio- economic characteristics of the aromatic rice farmers. Chapter 6 deals with the profitability of aromatic rice cultivation. Chapter 6 describes the factors affecting profitability of aromatic rice cultivation. Chapter 7 presents problems faced by the farmers in aromatic rice cultivation. Finally, Chapter 8 represents the summary, conclusion and policy recommendations to increase aromatic rice production.

CHAPTER II

REVIEW OF LITERATURE

2.1 Introduction

This chapter presents the review of relevant literature with a view to understand the method and cause-effect relationship of past and present research work on rice cultivation. This would help in narrowing down the problem correctly and in selecting the most appropriate technique of analysis. A large number of studies were conducted on production of rice in Bangladesh. But review of literature was not only limited to works done in Bangladesh but also was extended to other countries for having a broader view.

2.2 Literature Review

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

Anik & Talukder (2002) conducted a study to evaluate the economic and financial profitability of aromatic and fine rice production, using both primary and secondary data. Forty farmers who cultivated both Kataribhog and Chinigura, and fifteen farmers each producing Pajam and Nizershail were selected from Dinajpur district. For the Kalijira variety, thirty farmers were selected from Sherpur district. Among the aromatic and fine rice varieties Pajam had the maximum per hectare

yield. But net returns per hectare for the aromatic varieties were higher due to the higher market prices and less production cost of the varieties. Domestic Resource Cost (DRC) ratios showed that Bangladesh had comparative advantage in the production of aromatic and fine rice both from the point of view of export and import substitution, except the Nizershail variety which was marginally unprofitable. The study also identified some problems faced by the farmers in producing aromatic and fine rice. Finally, some policy guidelines were suggested.

Bunthan, et al. (2017) conducted a study on cambodian rice farming: comparative analysis on aromatic and non-aromatic rice farming in voatkor commune, battambang province and the result of the study showed that aromatic rice was not commonly used for home consumption, and that more than 80% of the production was for sale, considering greater demand from international market. On the other hand, the non-aromatic rice was mainly used for home consumption and domestic market. The costs of aromatic rice production were higher on material and labor costs, but farmers were able obtain higher yield in comparison with the non-aromatic rice. Despite higher production costs, aromatic rice was found to be more profitable in gross value added, gross margin and net profit, thanks to higher yield and favorable paddy price. In addition, this study also identified non-economic factors affecting the farmers' decision-making on varieties. Finally, some recommendations are offered.

Islam et al. (2017) conducted a study on Profitability and productivity of rice production in selected coastal area of Satkhira district in Bangladesh. The study found that the small farmers (Tk. 10292.89) got higher net returns than the medium (Tk. 6894.39) and large (Tk. 4798.70) farmers per hectare, respectively. The undiscounted BCR was 1.38, 1.23 and 1.15 for small, medium and large farmers respectively. It is found that the coefficient of seed, fertilizer, power tiller, irrigation cost and human labor have significantly impact on gross return.

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/Chinigura, Shama and Pajam/BR varieties respectively. Gross return form aromatic (Kataribhog) rice was highest (Tk. 37466.88 per hector) followed by the non-aromatic (Pajam/BR varieties) rice (Tk. 30860.97 per hectare).

Khan (2002) conducted a study to find out the level of input uses and input output relationship with respect to Aromatic and HYV Aman rice cultivation. The result showed that the amount of human labour, animal labour, and fertilizer used per hectare of Aromatic were 197.17 man-days, 43.38 pair-days and 321.22 kg and for HYV Aman were 153.68 man days, 44.13 pair-days and 176.14 kg respectively, per hectare real cost of seed, irrigation, and pesticides of Aromatic were Tk 1818.93, Tk4591.33, and Tk 536.34 respectively. Human labour and animal labour are positively significant but irrigation cost is negatively significant in case of Aromatic rice production. On the other hand, human labour is negatively but animal labour and seed are positively significant for HYV Aman rice production. For achieving maximum efficiency, the use of human labour, animal labour, seed and fertilizer of Aromatic, animal labour, seed and pesticide of HYV Aman should be increased, pesticide of Aromatic should be decreased and the additional use of the irrigation water of Aromatic, human labour and fertilizer of HYV Aman should be decreased.

Mustafi et al. (2000) in their study titled "Production and Export Potential of Fine Rice in the Barind Tract Area" showed that the gross returns of Basmoti (grown in Aromatic season) and C'hiniatab (grown in T. Aman season) were Tk.54513 and Tk. 38903 per hectare, respectively and the production cost of Basmoti and

C'hiniatab were Tk. 26040 and Tk.12337 per hectare. The average yield of Basmoti and C'hiniatab were 4.3 ton/ha and 2.14 ton/ha in the Barind Tract area.

Nasrin (2013) conducted a study on the financial profitability of aromatic rice production and its impacts on farmers' livelihood in selected areas of Tangail district. Total costs for aromatic rice was estimated at Tk. 51299.5 per hectare. The average per hectare gross return of aromatic rice was Tk. 82666.4. In the study area, gross margin for aromatic rice was estimated at Tk. 37269.6 per hectare. Thus, the net return was estimated at Tk. 31366.9 for aromatic rice. The undiscounted benefit -cost ratio of aromatic rice production was 1.61 implying that the aromatic rice production was profitable. Moreover, the result of partial budget analysis revealed that aromatic rice production has higher income and better livelihood than those who are producing non-aromatic rice in the study area. It is evident that average annual income of aromatic rice farmers was Tk. 177606.6. Cobb-Douglas production function analysis was done to determine the effects of variables mainly human labor, power tiller, seed, fertilizer, irrigation, insecticides and insecticides on gross returns of aromatic rice production. Estimated values of the relevant coefficients revealed that among the included variables human labor, seed, fertilizer, power tiller and irrigation had significant impact and insecticides had insignificant impact on the per hectare output of aromatic rice production. The study also identified some problems faced by the farmers' in producing aromatic rice and probable solutions relating to those problems. Finally, some policy recommendations based on the findings of the study were suggested.

Omar et al. (2019) conducted a study on Supply Chain Analysis of Kataribhog (Aman Season) Rice at Dinajpur District in Bangladesh. The findings of this study revealed that the yield of Kataribhog rice was 1250 kg/acre and gross return was 51,200 Tk./acre. The cost of cultivation of Kataribhog rice was 38045.75 Tk./acre.

On full and current cost basis the Benefit Cost Ratio (BCR) was found 1.35 and 2.05, respectively.

Sammy et al. (2015) conducted a study on profitability and household level efficiency of aromatic rice production in Dinajpur district of Bangladesh. Data were collected from in Chirirbander upzilla under Dinajpur district of Bangladesh during 2012-2013. Both descriptive statistics and functional analysis was done to achieve the objectives of the study. The findings of the study suggested that the total cost of aromatic rice production was Tk. 51093.3 per hectare of which 52.4% was variable cost. Net return and BCR was found to be Tk. 34544.1 per hectare and 1.66 respectively. Urea and TSP had positive and significant effect on the yield of aromatic rice. Farmers in the study area usages different input inefficiently. Farmers in the study area also faces some constraints like high price of inputs, low price of aromatic rice etc. regarding aromatic rice production. Efforts like financial support, crop management training need to be taken to increase the production of aromatic rice in the study area.

Sujan et al. (2017) conducted a study on financial profitability and resource use efficiency of boro rice cultivation in some selected area of Bangladesh. Result based on Farm Budgeting model showed that per hectare variable cost and total cost of production was BDT (Bangladeshi Taka) 57,583 and BDT 71,208 respectively. Average yield was found 4.112 ton which was more than the previous year's national average yield of 3.965 ton. The average gross return, gross margin, and net return were BDT 86,548, BDT 28,965 and BDT 15,340 respectively. Benefit-Cost ratio (BCR) was found 1.22 and 1.50 on full cost and variable cost basis. Cobb-Douglas production function analysis showed that the key production factors, that is, human labour, irrigation, insecticide, seed and fertilizer had statistically significant effect on yield. MVP and MFC ratio analysis showed that growers allocated most of their resources in the rational stage of production.

Toma et al. (2015) conducted a study on financial profitability of aromatic rice production in some selected areas of Bangladesh. Total costs for aromatic rice was estimated at Tk. 64446.51 per hectare and per hectare gross return of aromatic rice was Tk. 114243.71. Gross margin for aromatic rice was estimated at Tk. 59999.29 per hectare. Thus, the net return was estimated at Tk. 49797.20 for aromatic rice production. The undiscounted Benefit Cost Ratio on the basis of total cost was 1.77 implying that the aromatic rice production was highly profitable.

2.3 Concluding remarks

The above-mentioned discussion and review indicate that most of the studies dealt with cost, return and profitability of aromatic rice production. Some studies also determine the factors affecting the profitability. Maximum studies examined parameters, which influence production, more than a decade ago. Within this period changes might have taken place in production process, and owing to these changes, the validity of those factors needs to be looked into again. Side by side the influence of other factors identified by the researchers of other countries is needed to study in the context of Bangladesh. Very limited integrated studies were conducted on profitability of aromatic rice production in Bangladesh. Therefore, this study is expected to be conducted taking into account those aspects. The review of literature was helpful to re-design methodological aspects with a view to overcome the limitations of previous studies. From the above studies the researcher felt the need of conducting and analyzing the profitability of aromatic rice production in Bangladesh within the current development context, which will help the policy makers to understand the current situation and take programmes to increase aromatic rice production and improving the livelihood of people in Bangladesh. On the other hand, this researcher believed that the findings of this study would provide useful updated information, which would help the policy makers and researcher for further investigations.

CHAPTER-III
METHODOLOGY

3.1 Introduction

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

3.2 Selection of the study area

The area where the selected varieties of rice has been grown successful was considered as the study area. Dinajpur district was purposively selected for the study because of the fact that it is one of the leading aromatic rice producing areas of Bangladesh. Chirirbandar Upazila under Dinajpur district area 308.68 sq km, located in between 25°31' and 25°48' north latitudes and in between 88°42' and 88°53' east longitudes. It is bounded by khansama upazila on the north, phulbari upazila and west bengal state of India on the south, parbatipur and saidpur upazilas on the east, Dinajpur sadar upazila on the west. The researcher had an easy access to this area, on the other hand, the following considerations were kept in mind for selecting Dinajpur as a study area. Keeping in mind the main objectives of the present study Chirirbandar upazila under Dinajpur district was selected for collecting data.

Figure 3.1 Map of Dinajpur district showing Chirirbandar upazila

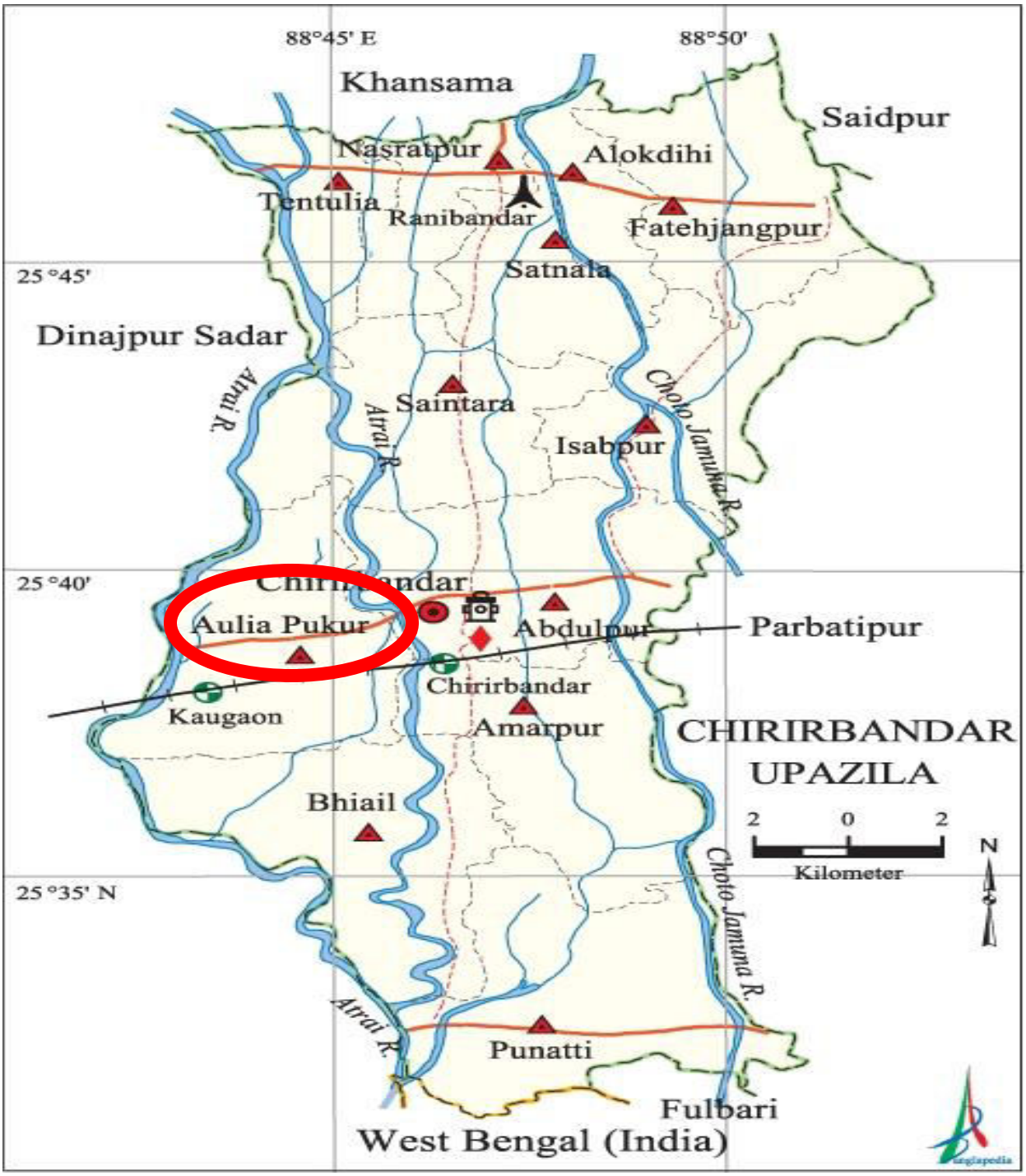

Figure 3.2 Map of Chirirbandar upazila showing the study area

3.3 Sampling techniques and data collection procedure

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

3.4 Sampling technique

All the aromatic and non-aromatic rice growers in Dinajpur district were not possible to include in this study because of the paucity of resources and time constraint. A reasonable sample survey, which would represent the population, was required in order to meet up the purpose of the study. Simple random sampling technique was adopted in this study. After purposively selecting Dinajpur district, one upazila namely, Chirirbandar upazila was selected randomly from 13 upazila. Subsequently, five villages from each upazila were also selected randomly. Therefore, a list of aromatic rice producers were constructed with the help of village leaders and field level extension personnel. After preparing the sampling frame 105 farmers were selected randomly for primary data collection.

Table 3.1 List of villages with sample size

Upazila	Union	Villages	Sample size
Chirirbandar	Aulia pukur	Borogram	21
		Bosontopur	21
		Indrapara	21
		Krisnopur	21
		Majhina	21
Total			**105**

3.5 Preparation of the interview schedule

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

3.6 Study and survey period

The data were collected through survey during the period of 5th June, 2019 to 30th June, 2019.

3.7 Collection of data

A farm management study usually involves collection of information from individual farmers. There are various methods of collecting information from the farmers. For the present study Farm survey method was adopted for collecting data.

There are three main methods through which farm survey data can be gathered (Dillion and Hardaker, 1993). These are

1) Direct observation
2) Interviewing respondents.
3) Records kept by the respondents.

To satisfy the objectives of the study, necessary data were collected by visiting each farm personally and by interviewing them with the help of a pretested interview schedule. Usually most of the respondent does not keep records of their activities. Hence it is very difficult to collect actual data and the researcher has to rely on the memory of the respondent. Before going to an actual interview, a brief introduction of the aims and objectives of the study was given to each respondent.

It was narrated to the farmers that the study was purely academic. Farmers also stated the usefulness of the study in their farm business context. The question was asked systematically in a very simple manner and the information was recorded on the interview schedule. When each interview was over the interview schedule was checked and verified to be sure that information to each of the items had been properly recorded. In order to minimize errors, data were collected in local units. These were subsequently converted into appropriate standard unit.

In order to obtain reliable data, the researcher initially visited for several times to introduces himself with the people of the study areas during the season. Secondary information sources make the present study additional value. Secondary data were collected through literature and different publications from Bangladesh Bureau of Statistics, Ministry of Finance.

3.8 Editing and tabulation of data

After collection of primary data, the filled schedules were edited for analysis. These data were verified to eliminate possible errors and inconsistencies. All the collected data were summarized and scrutinized carefully. For data entry and data analysis, the Microsoft Excel programs and SPSS software 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 necessity of analysis to meet the objectives of the study.

3.9 Procedure for computation of costs

The farmers producing aromatic rice had to incur cost for different inputs used in the production process. The input items were valued at the prevailing market price and sometime at government price in the area during survey period, or at the priced at which farmers bought. Sometimes, the farmers purchased hired labor,

seed, fertilizer, manure and insecticide from the market and it was easy to pricing these items. But farmers did not pay cash for some input such as family labor, manure etc. So, it was very difficult to calculate the cost of production of these inputs. In this case opportunity cost principle was used. In calculating the production cost, the following components of cost were considered in this study area:

- Human labor
- Land preparation/Mechanical power cost
- Seed
- Manure
- Fertilizer
- Irrigation
- Pesticides cost
- Interest on operating capital and
- Land use

3.9.1 Cost of human labor

Human labor cost was one of the most important and largest cost items of aromatic rice production in the study area. It is required for different farm operations like land preparation, weeding, application of fertilizer and insecticide, harvesting and carrying etc. Mainly two types of human labor used in the study area; such as family labor and hired labor. Family labor includes the operator himself, the adult male and female as well as children of a farmer's family and the permanently hired labor. To determine the costs of unpaid family labor, the opportunity cost concept was used. In this study the opportunity cost of family labor was assumed to be market wage rate, i.e., the wage rate that the farmers actually paid to the hired labor. The labor that was appointed permanently was considered as a family labor in this study. In computing the cost of hired labor, actual wages were paid

and charged in case where the hired labors were provided with meals; the money value of such payment was added to the cash paid. The labor has been measured in a man-day unit, which usually consisted of 8 hours a day.

In producing aromatic rice human labor were used for the following operations:

- Land preparation/ploughing/laddering
- Fertilizing, weeding and irrigation
- Pest control
- Harvesting, storing and marketing

3.9.2 Cost of power tiller and laddering

Human labor and mechanical power were jointly used for land preparation. Power tiller and laddering cost was the summation of hired draft power and human labor. Hired power tiller and laddering cost were calculated by the prevailing market prices that were actually paid by the farmers.

3.9.3 Cost of seeds

The costs of seed were calculated at the actual price paid by the farmers. It may be marked here that there was a variation in the cost of per kilogram (kg.) seed in the study area.

3.9.4 Cost of manure

Manure may be used from through purchased. The value of purchased cow dung was calculated at the prevailing market price.

3.9.5 Cost of fertilizer

It is very important for aromatic rice cultivation to use the fertilizer in recommended dose. In the study area, farmers used mainly three types of chemical fertilizer i.e., Urea, TSP (Triple Super Phosphate), MP (Muriate of Potash) for

growing aromatic rice cultivation. Fertilizer cost was calculated according to the actual price paid by the farmers.

3.9.6 Cost of pesticide

Most of the sample farmers used Vittaku, Sunforan, Rijent, Dithane M-45, Thiovit 80wp and Rovral 50wp for aromatic rice. The cost of these insecticides was calculated by the prices paid by farmers.

3.9.7 Cost of irrigation

The cost of irrigation included the rental charge of machine plus the costs of fuel. Someone rent/borrow only water from the shallow tube well (STW) owners by paying some charge.

3.9.8 Interest on operating capital

Interest cost was computed at the rate of 9% per annum. It was assumed that if farmers would take loans from a bank, they would have to pay interest at the above mentioned rate. Since all expenses were not incurred it the beginning of the production process, rather they were spent throughout the whole production period the cost of operating was, therefore, computed by using the following formula:

$$\textbf{Interest on operating capital} = \frac{\text{Operating Capital} * \text{Rate of interest x Time}}{2}$$

This actually represented the average operating costs over the period because all costs were not incurred at the beginning or at any fixed time. The cost was charged for a period of 6 months at the rate of Tk. 9 per annum.

3.9.9 Land use cost

The price of land was different for different plots depending upon location and topography of the soil. The cost of land used was estimated by the cash rental

value of land. In calculating land use cost, average rental value of land per hectare for a particular year. In computing rental value of land of the land used cost (LUC), it was calculated according to farmer's statement.

3.10 Analytical techniques

Both tabular and statistical tools was used for analyzing the data. Tabular tools will be used for calculating profitability, average, percentage, total etc. For multiple regression analysis, Cobb-Douglas production function was also used to estimate the effects of key variables (Dillion and Hardaker, 1993). Because in Cobb-Douglas production function, the regression co-efficient directly shows production elasticity and as all the sum of the production elasticities indicate whether the production process as an increasing, constant, or decreasing returns to scale.

The Cobb-Douglas production frontier model was used for estimating profitability of aromatic rice production in the study areas and the model is given below:

$$Y= aX_1^{b1}\ aX_2^{b2}\ aX_3^{b3}\ aX_4^{b4}\ aX_5^{b5}\ aX_6^{b6}\ aX_7^{b7} aX_8^{b8}\ aX_9^{b9} e^{ui}$$

To identify the factors affecting the gross return on aromatic rice production, the Cobb-Douglas production function has used:

$$\ln Y=\ln a+b_1\ln X_1+b_2\ln X_2+b_3\ln X_3+b_4\ln X_4+b_5\ln X_5+b_6\ln X_6+b_7\ln X_7+b_8\ln X_8+ b_9\ln X_9+\ldots.+b_n\ln X_n+ u_i$$

Where,

ln = Natural logaritham

Y= Gross yield (Tk./ha);

X_1 = Cost of human labor (Tk./ha);

X_2= Cost of seed (Tk./ha);

X_3= Cost of land preparation (Tk/ha);

X_4 = Cost of urea (Tk./ha);

X_5 = Cost of TSP (Tk./ha);

X_6 = Cost of MP (Tk./ha);

X_7 = Cost of gypsum (Tk./ha);

X_8 = Cost of zinc sulphate (Tk./ha);

X_9 = Cost manure (Tk/ha)

a = Constant or intercept term;

b1, b2, b3, b4, b5, b6, b7, b8, b9 = production coefficient of the respective input variable to be estimated; and

u_i = error term

3.11Profitability analysis

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

3.11.1 Calculation of gross return

Per hectare gross return was calculated by multiplying the total amount of product their respective per unit prices.

Gross Return= (Quantity of the product * Average price of the product) + Average byproduct

3.11.2 Calculation of gross margin

Gross margin is defined as the difference between gross return and variable costs. Generally, farmers want maximum return over variable cost of production. The argument for using the gross margin analysis is that the farmers are interested to get returns over variable cost. Gross margin was calculated on TVC basis. Per hectare gross margin was obtained by subtracting variable costs from gross return. That is, Gross margin = Gross return – Total Variable cost.

3.11.3 Calculation of net return

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

Net return = Gross return – Total cost.

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

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

Where, π = Net profit/Net return from aromatic rice cultivation (Tk. /ha);

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

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

P_f = Per unit price of other relevant aromatic rice (Tk./ha);

Q_f = Total quantity of other relevant aromatic rice (Tk./ha);

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

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

TFC = Total fixed cost (Tk.) and

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

3.11.4 Undiscounted benefit cost ratio (BCR)

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

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

3.12 Problems faced in collecting data

The researcher had to face following problems in the field during the collection of data.

- ✓ The farmers did not keep records of their farming activities. Therefore, the researcher had to depend upon their memory. It was difficult to get information from memory.

- ✓ Most of the farmers in the study area thought that the investigator was a government officer. So, they initially hesitated to answer the questions relating to their income and expenditure. Some were afraid of imposition of new taxes.

- ✓ Sometimes, the farmers were not available at their home because they remained busy with outside work. That is why sometimes more than two visits were required to get information from them.

CHAPTER IV
SOCIO-ECONOMIC CHARACTERISTICS OF THE AROMATIC RICE FARMERS

4.1 Introduction

In this chapter the findings of the study and its interpretation are presented according to the objectives of the study. This section deals with the selected characteristics of the aromatic rice farmers.

4.1.1 Age distribution of the farmers

The age score of the aromatic rice farmers ranged from 30 to 55 with an average of 43.09. Considering the recorded age farmers were classified into three categories namely young, middle and old aged following (MoYS, 2012).

Table 4.1 Distribution of the farmers according to their age

Categories (years)	**Farmers**		Mean
	Number	Percent	
Young aged (30-35)	32	30.48	43.09
Middle aged (36-50)	59	56.19	
Old aged (above 50)	14	13.33	
Total	**105**	**100**	

Source: Field Survey, 2019

Table 4.1 indicates that the majority (56.19 percent) of the respondents was middle-aged category while 30.48 percent and 13.33 percent of the respondents were young and old aged categories respectively.

4.1.2 Education status of the farmers

Educational qualification of the respondents had been categorized as done by Poddar (2015). Education of the farmers ranged from 0 to 10 years of schooling having an average of 5.22 years. On the basis of their education, the respondents were classified into five categories as shown in Table 4.2.

Table 4.2 Distribution of the farmers according to their education

Categories	Farmers		Mean
	Number	Percent	
Illiterate (0)	13	12.38	5.22
Can sign only (0.5)	28	26.67	
Primary education (1-5 class)	45	42.86	
Secondary education (6-10 class)	33	31.43	
Total	**105**	**100**	

Source: Field Survey, 2019

Data contained in Table 4.2 indicates that 42.86 percent of the farmer's had primary level of education. About 31.43 percent of the farmers had secondary level of education, 12.38 percent was illiterate and 26.67 percent could sign only.

4.1.3 Family size of the farmers

To describe the family size of the respondents, the category has been followed as represented by Poddar (2015). Family size scores of the farmers ranged from 2 to 9 with an average of 5.00. According to family size, the respondents were classified into three categories as shown in Table 4.3.

Table 4.3 Distribution of the farmers according to their family size

Categories	Farmers		Mean
	Number	Percent	
Small family (2-3)	27	25.71	5.00
Medium family (4-5)	60	57.14	
Large family (above 5)	18	17.15	
Total	**105**	**100**	

Source: Field Survey, 2019

Data contained in Table 4.3 indicates that (57.14%) of the farmers had medium family while 17.14 percent of them had large family and 25.71 percent of them had small family. Thus, about two third (74.29%) of the farmers had medium to large family.

4.1.4 Farm size of the farmers

Land possession of the respondents varied from 0.15 to 4.57 hectare and the average being 1.44 hectare. Depending on the land possession the respondents were classified into three categories according to DAE (1999) as appeared in table 4.4.

Table 4.4 Distribution of the farmers according to their farm size

Categories (hectare)	Farmers		Mean
	Number	Percent	
Small land (up to 0-1 ha)	65	61.90	1.44
Medium land (1.01-3 ha)	25	23.81	
Large land (above 3 ha)	15	14.29	
Total	**105**	**100**	

Source: Field Survey, 2019

Similar result was observed by Nasreen et al. (2013) where highest respondents were small farm sized. Data contained in table 4.4 indicates the 61.90 percent of the farmers had small land while 23.81 percent of them had medium and only 14.29 percent of them had large farm size.

4.1.5 Land under aromatic rice cultivation

Land under aromatic cultivation of the farmers varied from 0.06 to 3.27 hectare. The average land under aromatic cultivation was 1.34 hectare. Based on land under aromatic cultivation, the farmers are classified into four categories as shown in Table 4.5.

Table 4.5 Distribution of the farmers according to their aromatic rice cultivation land

Categories (ha)	Farmers		Mean
	Number	Percent	
Marginal (up to .20 ha)	11	10.48	1.34
Small (0.21-1 ha)	54	51.43	
Medium (1.01-3 ha)	35	33.33	
Large farm (above 3 ha)	5	4.76	
Total	**105**	**100**	

Source: Field Survey, 2019

Data contained in Table 4.5 indicates that the largest proportion (51.3 percent) of farmers had small aromatic rice cultivation land compared to 33.33 percent having medium, 10.43 percent had marginal aromatic rice cultivation land and only 4.76 percent of the farmers had large farm size.

4.1.6 Experience in aromatic rice cultivation

The experience score of the aromatic rice farmers ranged from 1 to 18 with an average of 4.61. Considering the recorded age farmers were classified into three categories as shown in Table 4.6.

Table 4.6 Distribution of the farmers according to their experience

Categories (years)	Farmers		Mean
	Number	Percent	
Low experience (1-5)	34	32.38	4.61
Medium experience (6-10)	58	55.24	
High experience (above 10)	13	12.38	
Total	**105**	**100**	

Source: Field Survey, 2019

Table 4.6 indicates that the majority (55.24 percent) of the respondents had medium experience in aromatic rice cultivation while 32.38 percent and 12.38 percent of the respondents had low and high experience in rice cultivation respectively.

4.1.7 Annual family income

The annual family income of the farmers ranged from Tk. 121 thousand to Tk. 372 thousand with an average of Tk. 215.67 thousand. Based on the annual income, the farmers were divided into three categories as shown in Table 4.7.

Table 4.7 Distribution of the farmers according to their annual family income

Categories ('000' Tk.)	Farmers		Mean
	Number	Percent	
Low income (up to 150)	16	15.24	215.67
Medium income (151-250)	71	67.62	
High income (above 250)	18	17.14	
Total	105	100	

Source: Field Survey, 2019

From the Table 4.7 it was observed that the highest portion (67.62 percent) of the farmers had medium annual family income compared to 15.24 percent having low and 17.14 percent of the farmers had high annual family income.

4.1.8 Family expenditure

The family expenditure of the farmers ranged from Tk. 87 thousand to Tk. 175 thousand with an average of Tk. 126.05 thousand. Based on the annual income, the farmers were divided into three categories as shown in Table 4.8.

Table 4.8 Distribution of the farmers according to their annual family expenditure

Categories ('000' Tk.)	Farmers		Mean
	Number	Percent	
Low expenditure (up to 100)	19	18.09	126.05
Medium expenditure (101-150)	23	21.90	
High expenditure (above 150)	63	60.00	
Total	105	100	

Source: Field Survey, 2019

From the Table 4.8 it was observed that the highest portion (60.00 percent) of the farmers had high family expenditure compared to 21.90 percent had medium and 18.09 percent of the farmers had low family expenditure.

4.1.9 Training in aromatic rice cultivation

The score of training of the farmers ranged from 0 to 1, the mean being 0.69. Based on observed range, the farmers were classified into two categories as shown in Table 4.9.

Table 4.9 Distribution of the farmers according to their training

Categories (days)	Farmers		Mean
	Number	Percent	
Yes training (1)	73	69.52	
No training (0)	32	30.48	0.69
Total	**105**	**100**	

Source: Field Survey, 2019

Data contained in Table 4.9 indicates that 69.52 percent of the farmers had training in aromatic rice cultivation and 30.48 percent of the farmer's had no training in aromatic rice cultivation.

4.1.10 Organizational participation

The score of organizational participation of the farmers ranged from 0 to 1, the mean being 0.54. Based on observed range, the farmers were classified into two categories as shown in Table 4.10.

Table 4.10 Distribution of the farmers according to their organizational participation

Categories (Scores)	Farmers		Mean
	Number	Percent	
No participation (0)	81	77.14	
Yes participation (1)	24	22.86	0.54
Total	**105**	**100**	

Source: Field Survey, 2019

Data contained in Table 4.9 indicates that 77.14 percent of the farmers had no participation and 22.86 percent of the farmers had organizational participation.

4.2 Concluding remarks

This chapter analyzed the socioeconomic attributes of the sample farmers. The findings of analysis clearly indicate the socioeconomic characteristics from each other in respect of age distribution, education, family size, farm size, annual family income, family expenditure, aromatic rice cultivation area, training in aromatic rice cultivation and organizational participation etc.

CHAPTER V
PROFITABILITY OF AROMATIC RICE PRODUCTION

5.1 Introduction

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

5.2 Profitability of aromatic rice production

5.2.1 Hired labor

Hired labor cost is one of the major cost components in the production process. It is one of the most important and largely used inputs for producing rice. It is generally required for different operations such as land preparation, transplanting, weeding, fertilizer and insecticides application, irrigation, harvesting and carrying, threshing, cleaning, drying, storing etc. The quantity of human labor used in aromatic rice production was found to be about 55 man-days per hectare and average price of hired labor was Tk. 400 per man-day. Therefore, the total cost of hired labour was Tk. 22000 representing 27.95 percent of total cost (Table 5.1).

5.2.2 Land preparation

Land preparation is the most important components in the production process. Land preparation included ploughing, laddering and other activities needed to make the soil suitable for aromatic cultivation. For land preparation in aromatic rice production, no. of tiller was required 2 with Tk. 2025 per ha. Thus, the average land preparation cost of aromatic rice production was Tk. 4250 per hectare, which was 5.39 percent of total cost (Table 5.1).

5.2.3 Seed

Cost of seed varied widely depending on its quality and availability. Per hectare total cost of seed for aromatic rice production was estimated Tk. 2550, which constituted 3.24 percent of the total cost (Table 5.1).

5.2.4 Urea

In the study area, farmers used different types of fertilizers. On average, farmers used urea 150 kg per hectare. Per hectare cost of urea was Tk. 2550, which represents 3.24 percent of the total cost (Table 5.1).

5.2.5 TSP

Among the different kinds of fertilizers used, the rate of application of TSP was 85 kg/ha. The average cost of TSP was Tk. 2020 which representing 2.57 percent of the total cost (Table 5.1).

5.2.6 MoP

The application of MoP per hectare (75 kg/ha) was found lower than other fertilizers. Per hectare cost of MoP was Tk. 1350, which represents 1.71 percent of the total cost (Table 5.1).

5.2.7 Gypsum

The application of gypsum per hectare (59 kg/ha) was found lower than other fertilizers. Per hectare cost of gypsum was Tk. 885, which represents 1.08 percent of the total cost (Table 5.1).

5.2.8 Zinc sulphate

The application of Zinc sulphate per hectare (10 kg/ha) was found lower than other fertilizers. Per hectare cost of Zinc sulphate was Tk. 1300, which represents 1.65 percent of the total cost (Table 5.1).

Table 5.1: Per hectare cost of aromatic rice production

Items of Cost	**Quantity (unit/ha)**	**Rate (Tk./Kg)**	**Cost (Tk./ha)**	**% of Total Cost**
Human labor	55	400	22000	27.95
Land preparation			4250	5.39
Seed	15	170	2550	3.24
Urea	150	17	2550	3.24
TSP	85	24	2020	2.57
MoP	75	18	1350	1.71
Gypsum	59	15	885	1.08
Zinc sulphate	10	130	1300	1.65
Irrigation		-	2150	2.74
Pesticide		-	5550	7.05
Manure	1200	3	3600	4.57
A. Total Variable Cost (TVC)			**48170**	**61.19**
Interest on operating capital @ of 9% for months			1654	2.10
Rental value of land			12500	15.88
Family labor	31	400	16400	20.83
B. Total Fixed Cost (TFC)			**30554**	38.81
C. Total cost (A+B)			**78724**	100

Source: Field survey, 2019

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

5.2.9 Irrigation

Cost of irrigation is one of the most important cost items for aromatic rice production. Production of aromatic rice largely depends on irrigation. The average cost of irrigation was Tk. 2150 per hectare, which represents 2.74 percent of the total cost (Table 5.1).

5.2.10 Pesticide

Farmers used different kinds of pesticides to keep their crop free from pests and diseases. The average cost of pesticides for aromatic rice production was Tk. 5550 which was 7.05 percent of the total cost (Table 5.1).

5.2.11 Manure

Farmers used manure to keep their land fertile. The average cost of manure for aromatic rice production was found to be Tk. 3600 which was 4.57 percent of the total cost (Table 5.1).

5.2.12 Total variable cost

The total variable cost of aromatic rice production was Tk. 48170 per hectare, which was 61.19 percent of the total cost (Table 5.1).

5.2.13 Fixed cost

5.2.13.1 Interest on operating capital

It may be noted that the interest on operating capital was calculated by taking in to account all the operating costs incurred during the production period of aromatic rice. Interest on operating capital for aromatic rice production was estimated at Tk. 1654 per hectare, which represents 2.10 percent of the total cost (Table 5.1).

5.2.13.2 Rental value of land

Rental value of land was calculated on the basis of opportunity cost of the use of land per hectare for the cropping period of six months. Cash rental value of land has been used as cost of land use. On the basis of the data collected from the aromatic farmers the land use cost was found to be Tk. 12500 per hectare, and it was 15.88 percent of the total cost (Table 5.1).

5.2.13.3 Family labor

In the study area, it was estimated that per hectare family labor cost for aromatic rice cultivation was Tk. 16400 for the aromatic rice farmers and their percentage of total cost of production was 20.83 percent (Table 5.1).

5.2.14 Total cost (TC) of aromatic rice production

Total cost was calculated by adding all the cost of variable and fixed inputs. In the present study per hectare total cost of producing aromatic rice was Tk. 78724 (Table 5.1).

5.2.15 Return of aromatic rice production

5.2.15.1 Gross return

Return per hectare of aromatic rice cultivation is shown in table 5.2. Per hectare gross return was calculated by multiplying the total amount of product with respective per unit price. It is evident from table that the average yield of aromatic rice per hectare was 3556 kg and the average price of rice was Tk. 38. Total by products values was added with gross return. Therefore, the gross return was Tk. 141628 per hectare (Table 5.2).

5.2.15.2 Gross margin

Gross margin is the gross return over variable cost. Gross margin was calculated by deducting the total variable cost from the gross return. On the basis of the data, gross margin was found to be Tk. 93458 per hectare (Table 5.2).

5.2.15.3 Net return

Net return or profit was calculated by deducting the total production cost from the gross return. On the basis of the data the net return was estimated as Tk. 62904 per hectare (Table 5.2).

Table 5.2: Per hectare cost and return of aromatic rice production

Sl. No.	Items	Amount (Tk. hectare)
Total Production (kg/ha)		3556
Price of aromatic rice (Tk./kg)		38
By products (Tk./ha)		6500
A.	Gross return (GR)	141628
B.	Total variable costs (TVC)	48170
C.	Total costs (TVC+TFC)	78724
D.	Net return (GR-TC)	62904
E.	Gross margin (GR-TVC)	93458
F.	Benefit-cost ratio (BCR) = GR/TC	1.80

5.2.15.4 Benefit cost ratio (BCR)

Benefit Cost Ratio (BCR) is a undiscounted relative measure, which is used to compare benefit per unit of cost. Benefit Cost Ratio (BCR) was found to be 1.80 which implies that one-taka investment in aromatic rice production generated Tk. 1.80 (Table 5.2). From the above calculation it was found that aromatic rice cultivation is profitable in Bangladesh.

5.3 Concluding remarks

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

CHAPTER VI
FACTOR AFFECTING PROFITABILITY OF AROMATIC RICE PRODUCTION

6.1 Introduction

The main focus of the present chapter is to make a quantitative analysis of different inputs used in the production process of aromatic rice production. Some crucial input, as stated before in section 3.8 have been included in the Cobb-Douglas production function model to explain the variation of productivity of aromatic rice production.

6.2 General form of aromatic rice production function

The general form of aromatic rice production function described by Panayotou (1985) as a function of efforts (X) which is a composite index of aromatic rice inputs:

$Y = f(X_1)$ ……(1)

The equation may be written as:

$Y = (X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9)$…….(2)

Where, Y is return from aromatic rice production and all the factors of production as explanatory variables ($X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9$) are for human labour, seed, land preparation, urea, TSP, MP, gypsum, zinc sulphate and manure respectively.

6.3 Specification of the model

In specifying production functional forms are to once again, decision function for aromatic rice the usual question applies as to which be used and what variables are

to be relevant to the production should be made about the algebraic form of production function whether it will he continuous or discontinuous, linear or non-linear function etc. Correct specification is vital for any model because, any incorrect specification would lead to biased parameter estimate.

However, in real situations, there is always a compromise between theoretical elegance of the model and data availability for econometric estimation with empirical data, two forms of production function model were initially chosen to assess the effect of explanatory variables (inputs) This function was Cobb-Douglas forms Finally. However, a Cobb-Douglas production function with nine independent variables was used. This function was chosen as the specific functional form of the underlying relationship between the value of catch and its explanatory variables on the basis of best-fit and significant result on output.

Covering to the notation used in the text, the Cobb-Douglas production function form can be stated as

$$Y=a\ X_1^{\beta 1}X_2^{\beta 2}X_3^{\beta 3}X_4^{\beta 4}X_5^{\beta 5}X_6^{\beta 6}X_7^{\beta 7}X_8^{\beta 8}\ X_9^{\beta 9}e^{ui}$$

The alternative form of Cobb-Douglas production function in equation can be estimated using OLS (ordinary least squares) method, in a log linear form.

The estimated equation is.

$$Ln\ Y= lna+\beta_1 lnX_1+\beta_2 lnX_2+\beta_3 lnX_3+\beta_4 lnX_4+\beta_5 lnX_5+\beta_6 lnX_6+\beta_7 lnX_7+\beta_8 lnX_8+\beta_9 lnX_9+Ui$$

Where,

Y=Gross return from aromatic rice production (Tk./ha);

X_1= Human labor (Tk./ha);

X_2= Seed (Tk./ha);

X_3= Land preparation (Tk./ha);

X_4= Urea (Tk./ha),

X_5= TSP (Tk./ha),

X_6= MP (Tk./ha),

X_7= Gypsum (Tk./ha),

X_8= Zinc sulphate (Tk./ha),

X_9= Manure (Tk./ha),

In = Natural logarithm,

a= Intercept,

β=Coefficient of the concerned variables;

i = 1, 2, 3, …..n; and

U=Error term

6.4 Interpretation of result of the model

The value of the estimated coefficients of the production function for aromatic rice production is presented in Table 6.1.

Characteristics of the model are noted below:

- ✓ F-value was used to measure the goodness of fit for different types of inputs.
- ✓ The coefficient of multiple determinations indicated the total variation of output explained by the independent variables included in the model.
- ✓ Coefficient having sufficient degrees of freedom was tested for significance level at 1 percent and 5 percent probability levels.
- ✓ Stages of production were estimated by return to scale, which was the summation of all the production elasticity of variable inputs.

Table 6.1 Estimated value of coefficient and relative statistics of profitability

Explanatory variables	Coefficient	Standard error	p- value
Intercept	2.733	0.160	0.000
Human labor	0.111	0.005	0. .003*
Seed	0.249	0.006	0. .033*
Land preparation	-0.108	0.008	0.440 NS
Urea	0.262	0.010	0.001**
TSP	0.013	0.006	0.902NS
MP	0.121	0.009	0.527NS
Gypsum	0.242	0.021	0. .006**
Zinc sulphate	-0.474	0.041	0.014*
Manure	0.534	0.032	0.001**
R^2	0.82		
Adjusted R^2	0.79		
Return to scale	0.95		
F-value	17.17**		

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

Estimated value of the coefficient and related statistics of Cobb-Douglas production function for the sample farmers producing aromatic rice are presented in Table 6.1.

The results indicate that Cobb-Douglas production function fitted well as considering the value of R and F-value. The following features were noted.

Human labor

The regression coefficient of human labor was positive in aromatic rice production and significant at the 1 percent level. It reveals that one Taka increase in the labour, keeping other factors constant, would increase gross return of aromatic rice production by 0.111 Taka (Table 6.1).

Seed

The estimated co-efficient of seed was 0.249 which was significant at 5 percent level of significant for aromatic rice production. This indicates that an increase of 1 percent in seed of this input keeping other factors constant would result in an increase of gross return by 0.249 percent.

Land preparation

The regression coefficient of land preparation was negative in aromatic rice production and insignificant indicating that one Taka increase in the cost of land preparation, keeping other factors constant, would decrease gross return of aromatic rice production by 0.108 Taka (Table 6.1)

Urea

The regression coefficient of urea was positive in aromatic rice production and significant at 1 percent level indicating that one Taka increase in the cost of urea, keeping other factors constant, would increase gross return of aromatic rice production by 0.262 Taka (Table 6.1).

TSP

The regression coefficient of TSP was positive in aromatic rice production and insignificant indicating that one Taka increase in the TSP, keeping other factors constant, would increase gross return of aromatic rice production by 0.013 Taka (Table 6.1).

MP

In aromatic rice culture, the estimated coefficient of the variable MP was positive in aromatic rice cultivation and insignificant. It shows that one Taka increase the MP, keeping other factors constant, would increase gross return of aromatic rice production by 0.121 Taka (Table 6.1).

Gypsum

The regression coefficient of gypsum was positive in aromatic rice production and significant at 1 percent level. It shows that one Taka increase in the gypsum, keeping other factors constant, would increase gross return of aromatic rice production by 0.242 Taka (Table 6.1).

Zinc sulphate

The regression coefficient of zinc sulphate was negative in aromatic rice production and significant at 5 percent level. It shows that one Taka increase in the zinc sulphate, keeping other factors constant, would decrease gross return of aromatic rice production by 0.474 Taka (Table 6.1).

Manure

The regression coefficient of manure) was positive in aromatic rice production and significant at 1 percent level. It shows that one Taka increase in the manure, keeping other factors constant, would increase gross return of aromatic rice production by 0.534 Taka (Table 6.1).

Value of adjust R^2

As it is evident from Table 6.1 that the value of the coefficient of determination adjust $R^2$of aromatic rice production was 0.79 which implies that about 79 percent variation in the gross return was explained by the included explanatory variables of the model (Table 6.1).

F-value

The F-value of the equation is 17.17 which were highly significant implying that all the included explanatory variables were important for explaining the variation in aromatic rice production (Table 6.1). Therefore F-values of the individual coefficient or the relevant inputs should be expected to become significant.

Return to scale

If returns to scale are equal to one then there are constant returns to scale. If returns to scale are more than one then there are increasing returns to scale. If returns to scale are less than one then there are decreasing returns to scale. The summations of the production coefficient of selected variables i.e. the returns to scale are 0.95 in aromatic rice production. This means that the production function exhibits decreasing returns to scale (Table 6.1)

6.5 Concluding remarks

The results presented in Table 6.1 as well as the above-mentioned interpretations of individual coefficient clearly support the rejection of null hypothesis. This means that the included variables of the model had some significant positive impacts and higher returns might be obtained by applying more doses of the selected inputs in the study area.

CHAPTER VII
PROBLEM OF AROMATIC RICE PRODUCTION

7.1 Introduction

It is well known that farmers in Bangladesh face various problems associated with aromatic rice production. This chapter attempts to identify and analyze the problems concerned with aromatic rice production and ranked the problems according to their responses. Constraints to aromatic rice production experience says that farmers in Bangladesh cannot get the required quantity of inputs and technical supports and finally the optimum price of their products. They do not have enough funds for aromatic rice cultivation due to their subsistence farming. The major problems of the selected farmers in Chirirbandar upazila under Dinajpur district were identified and their responses are represented in.

7.2 Problems of aromatic rice cultivation

Farmers face some problems in aromatic rice production. Table 7.1 shows different problems mentioned by the farmers. These are described below:

Low price of aromatic rice

Low price of rice particularly just after harvesting of the product caused disincentive for the farmers to produce the crop. About 60.95% of the farmers in the study areas responded this problem. In the rank order, low price of aromatic rice was the 1st rank in the study areas.

High price of fertilizer

Fertilizer is the vital input for the production of aromatic rice. About 43.81% of the farmers in the study areas mention that fertilizers price was increasing. So,

production cost also increases in the study area. In the rank order, problem of high price of fertilizer was 2nd in the study areas.

Lack of quality seed

High quality of seed is the main input for aromatic rice cultivation. Farmers in the study area could not get high quality of seed. Sometimes seed were mixed with some other particle and could not proper germination. About 39.05% of the farmer in in the study area thought that lack of quality seed is the big problem for aromatic rice cultivation. The study areas, lack of quality seed was 3rd in the rank order.

Lack of credit facility

One of the major constraints in agricultural production systems in Bangladesh is low input supply due to lack of money. As the farmers did not possess adequate amount of money for purchasing inputs they had to borrow from others. Sometimes it requires high interest rate. The mustard growers of the study areas reported that lack of fund was a big problem of aromatic rice cultivation. About 29.52% of the farmers was in the study areas faced this problem. The credit need of the poor farmers is mostly meeting from non-institutional sources at prohibitive rates of interest. The result also showed that the credit was necessary mostly for purchasing seed and paying water charge. In the rank order, lack of credit facility was the 4th in rank.

Disease attack

Problem of attack by pest and disease in the study areas are the main problem for aromatic rice cultivation. When disease attract in the field, it damaged large portion of grain. It is a big loss for the aromatic rice farmers. About 24.76% of the farmers in the study areas claim that yield become lower because of disease attack. In the rank order, disease attack was the 5th problem in the study areas.

Lack of labor

Labors are not available in the study area because most of the labors are involved in other business. Labors are tendency to waste time and cannot work properly. So, Production cost became high as well as production level also lower. In the study areas, 20% of the farmers agreed that labor was not available for aromatic rice cultivation. In the rank order, lack of labor was the 6th in the study areas.

High price of pesticides

On an average 18.09% of the farmers in the study areas farmers object that pesticides price are too high. They need to invest huge money to buy pesticides for controlling pest. In the rank order, high price of pesticides was ranked 7th in the study areas.

Unavailability of fertilizer

Some areas in the study area farmers claim that some fertilizers are not available to them. So they bought fertilizer in the market which was far from village. Fertilizer unavailability was the problem for the farmers in the study areas and about 17.14% of the farmers reported. In the rank order, unavailability of fertilizer was the 8th in the study areas.

Lack of irrigation facility

Irrigation water is one of the most important inputs for aromatic rice production. Yield of aromatic rice varied in the application of irrigation water. They took irrigation facility from other farmer by some rate of amount but it is a problem for timely supply of water. About 8.56% of the farmers in the study areas reported that they did not receive water timely and water charge was much higher for them.

Lack of adequate transportation facilities

In the study areas, rickshaw and van were the only means of transportation on the roads. For lack of adequate transportation in the study areas, the farmers had to sell their product in the local market at low price. About 7.62% of the farmers in the study areas mention that lack of adequate transportation facilities as a problem. In the rank order, problem of lack of adequate transportation facilities was the 10th in the study areas.

Table 7.1 Problems of aromatic rice cultivation

List of problems	Extent of problem		
	Farmers	**% of farmers**	**Rank order**
Low price of aromatic rice	64	60.95	1st
High price of fertilizer	46	43.81	2nd
Lack of quality seed	41	39.05	3rd
Lack of credit facility	31	29.52	4th
Disease attack	26	24.76	5th
Lack of labor	21	20.00	6th
High price of pesticides	19	18.09	7th
Unavailability of fertilizer	18	17.14	8th
Lack of irrigation facilities	9	8.56	9th
Lack of adequate transportation facilities	8	7.62	10th

7.3 Concluding remarks

The above-mentioned problems, of course, are interrelated with one another and hence, need to be removed comprehensively through an integrated programme for the overall development of aromatic rice production. Problems faced by the farmers were ranked on the basis of corresponding percentages. Most of the farmers reported that low price of aromatic rice was the main constraint for their aromatic rice production.

CHAPTER VIII

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Rice is the staple food of about half of the world's population. Of the three most important cereals produced in the world rice is used for human consumption. Bangladesh, producing about 36 million tons of milled rice annually, is the 3rd largest rice producer in the world. About 10 million hectares, consisting of very small farms, are used annually to produce this rice. The rice sector contributes about 13.35% to the national GDP and offers more than 40% of employment. For income generation, the rural poor spend up to 60% of their time on rice production and processing activities. Bangladesh produces many aromatic and non-aromatic rice varieties with excellent eating quality for regular consumption as steamed rice as well as for polao and biryani preparations. For regular consumption, local varieties such as Kataribhog, Kataktara ,Banshful ,Bau-pagal, and Nizershail are among the fine varieties that are currently grown .BRRI-developed BR-6, BR-16 (shahibalam), BR-36 ,BR-38, and BR-39 are the fine, slender grains that have attractive qualities in the export market. Some of them have slightly pleasing aroma. For polao and biryani type preparations, Kalijira, Chinigura, Dolhabhog (BR-5), BR 34 and BR-38 are among varieties that are considered excellent, with small-to-medium sized grains and fine aroma .BR-26 rice is slender and long and has soft and slightly sticky consistency qualities that should have demand in the East Asian markets (Japan and Korea). However, little work have been done on determination of economic profitability of these varieties of rice.

The average are a devoted to aromatic rice production in the T.Aman season was 12.5%, with an average yield of 2.0 tons /ha and there sultant total production of 1.42 million metric tons. In respect of production of aromatic rice, Dinajpur, Naogaon, Chittagong and Sherpur had 1st, 2nd, 3 rd and 4 th position respectively in 2016-18. The demand for coarse and medium rice is much higher in the country. During the seventies and eighties, most of the rice varieties developed in

the country fell in the coarse/medium categories. During the nineties, Bangladesh Rice Research Institute (BRRI) developed quite ago od number of fine and aromatic varieties which have high demand in both domestic and foreign markets. In near future, Bangladesh is likely to become a rice exporter if the country can maintain growth in rice production as it has been doing in the past several years. Bangladeshi fine quality and aromatic rice could find significant markets both at home and abroad. In Bangladesh, the very thought of rice exports evokes mixed feelings and sentiments. While so many prospects are insight, achievement of the goal is associated with a number of productions, marketing and trade related problems. Thus, it would be pertinent to examine the relevant issues for assessing the prospect of production of aromatic rice in Bangladesh.

Objectives:

1. To describe some selected socio-economic characteristics of the aromatic rice cultivars;
2. To estimate the cost and returns of aromatic rice production;
3. To determine the profitability of aromatic rice production in the study areas;
4. To identify the factors affecting profitability of aromatic rice production; and
5. To identify the problem faced by farmers in aromatic rice cultivation.

8.1 Summary of the study

The majority (56.19 percent) of the respondents was middle-aged category while 30.48 percent and 13.33 percent of the respondents were young and old aged categories respectively. The majority 42.86 percent of the farmer's had primary level of education. About 31.43 percent of the farmers had secondary level of education, 12.38 percent was illiterate and 26.67 percent could sign only. The majority (57.14%) of the farmers had medium family while 17.14 percent of them had large family and 25.71 percent of them had small family.

The highest 61.90 percent of the farmers had small sizeof land while 23.81 percent of them had medium and only 14.29 percent of them had large farm size. The largest proportion (51.3 percent) of farmers had small aromatic rice cultivation land compared to 33.33 percent having medium, 10.43 percent had marginal aromatic rice cultivation land and only 4.76 percent of the farmers had large farm size. The majority (55.24 percent) of the respondents had medium experience in aromatic rice cultivation while 32.38 percent and 12.38 percent of the respondents had low and high experience in rice cultivation respectively. The highest portion (67.62 percent) of the farmers had medium annual family income compared to 15.24 percent having low and 17.14 percent of the farmers had high annual family income. The highest portion (60.00 percent) of the farmers had high family expenditure compared to 21.90 percent had medium and 18.09 percent of the farmers had low family expenditure. The highest proportion (69.52 percent) of the farmers had training in aromatic rice cultivation and 30.48 percent of the farmers had no training in aromatic rice cultivation. The majority 77.14 percent of the farmers had no participation and 22.86 percent of the farmers had organizational participation.

The total cost of hired labour was Tk. 22000 representing 27.95 percent of total cost. For land preparation in aromatic rice production, no. of tiller was required 2 with Tk. 2025 per ha. Thus, the average land preparation cost of aromatic rice production was Tk. 4250 per hectare, which was 5.39 percent of total cost. Per hectare total cost of seed for aromatic rice production was estimated Tk. 2550, which constituted 3.24 percent of the total cost. Per hectare cost of urea was Tk. 2550, which represents 3.24 percent of the total cost. The average cost of TSP was Tk. 2020 which represented 2.57 percent of the total cost. Per hectare cost of MoP was Tk. 1350, which represents 1.71 percent of the total cost. Per hectare cost of

gypsum was Tk. 885, which represents 1.08 percent of the total cost. Per hectare cost of Zinc sulphate was Tk. 1300, which represents 1.65 percent of the total cost. The average cost of irrigation was Tk. 2150 per hectare, which represents 2.74 percent of the total cost. The average cost of pesticides for aromatic rice production was Tk. 5550 which was 7.05 percent of the total cost. The average cost of manure for aromatic rice production was found to be Tk. 3600 which was 4.57 percent of the total cost.

The total variable cost of aromatic rice production was Tk. 48170 per hectare, which was 61.19 percent of the total cost. Interest on operating capital for aromatic rice production was estimated at Tk. 1654 per hectare, which represents 2.10 percent of the total cost. On the basis of the data collected from the aromatic farmers the land use cost was found to be Tk. 12500 per hectare, and it was 15.88 percent of the total cost. Per hectare family labor cost for aromatic rice cultivation was Tk. 16400 for the aromatic rice farmers and their percentages of total cost of production was 20.83 percent.

Per hectare total cost of producing aromatic rice was Tk. 78724. The gross return was Tk. 141628 per hectare. The gross margin was found to be Tk. 93458 per hectare. The net return was estimated as Tk. 62904 per hectare. Benefit Cost Ratio (BCR) was found to be 1.80 which implies that one-taka investment in aromatic rice production generated Tk. 1.80. From the above calculation it was found that aromatic rice cultivation is profitable in Bangladesh.

Cobb-Douglas production function analysis was carried out for examining the effect of input use. In most of the cases, the explanatory variables like human labor, seeds, urea, gypsum, zinc sulphate and manure were found to have significant effect on production in aromatic farms, but land preparation, TSP, MoP were found to have insignificant effect on production of aromatic rice. The

summation of co-efficient of different inputs were less than one implying that the production functions exhibited decreasing returns to scale.

This study also identified some of the problems associated with aromatic rice production. The findings revealed that low price of aromatic rice was the 1st problem followed by high price of fertilizer, lack of quality seed and lack of adequate transportation facilities was the last problem in aromatic rice production.

8.2 Conclusion

From the above discussions it can be said that aromatic rice producer farmer was more profitable than other farmers if we consider their total production. But they didn't receive their full production. They receive only half of the produce after investing in all the costs of production along with the share of their labor and management inputs. Bangladesh is predominantly an agriculture country. Agricultural development is still synonyms with the economic development. At present agricultural sector are largely dominated by the rice production. Rice is the staple food of Bangladesh and basically rice cultivation is the major source of livelihood of the people of Bangladesh. About 90 percent of the population in Bangladesh depends on rice as a major staple food. Aromatic rice is mainly cultivated in the northern district of Bangladesh. Most of the people in Bangladesh eat aromatic rice in different festivals and makes various kinds of food stuff using aromatic rice by its proper processing. So, aromatic rice production is equally important side by side with rice production. This study tried to find out the research gap with the previous study and provide a better solution for the farmers in the study area. An attempt was made in the present study to examine the profitability and resource use efficiency of aromatic rice producing farms. The overall objectives of the study was to measure the profitability of aromatic rice producing farms and identify the socio-economic characteristics of the farmers in

the study area. The study showed that aromatic rice production is profitable for farmers and that even more returns might be obtained by applying more doses of selected inputs.This study tried to identify some of the problems faced by the aromatic rice producing farmers and provide some policy guidelines.

8.3 Policy Recommendations

The study has revealed some valuable information regarding aromatic rice production. Following policy recommendations have been made for increasing the production and financial returns of aromatic rice farmers.

i. Though the government is already given subsidy on fertilizer like urea and other inputs required for aromatic rice production but fair prices of inputs should be ensured so that the farmers can get the inputs at a reasonable price.
ii. Bank loan and institutional credit should be made available on easy terms and conditions to the aromatic rice producer farmers.
iii. Scientific method of cultivation should be followed by the farmers increase production. The farmers should be provided with training, adequate services, information and necessary facilities to cope with new and changed situation.
iv. Efforts should be taken to develop suitable market infrastructures with respect to quick transportation, facilities for promotion of aromatic rice production in the study area.
v. Provision should be made to supply sufficient fertilizer and others essential inputs in the market to reduce the cost of aromatic rice production.

REFERENCES

Akter, T., Parvin, M. T., Milla, F. A. and Nahar, A. (2019). Factors determining the profitability of rice farming in Bangladesh. *J Bangladesh Agril Univ* 17(1): 86–91.

Anik, A. R. & Talukder, R. K. (2002). Economic and financial profitability of aromatic and fine rice production in Bangladesh. Bangladesh Journal of Agricultural Economics, Bangladesh Agricultural University, vol. 25(2), pages 1-11, DOI: 10.22004/ag.econ.201455

BEF. (2019). The potential of Exporting Fine Quality Rice from Bangladesh. A Proposal for a Study Submitted to BRAC, Dhaka.

Bunthan, S., Takahashi, Y. and Izumida, Y. (2018). A Study on Cambodian Rice Farming: Comparative Analysis on Aromatic and Non-Aromatic Rice Farming in Voatkor Commune, Battambang Province. International Journal of Environmental and Rural Development, p- 9-1.

DAE. (1999). Agricultural Extension Manual. Department of Agricultural Extension, Ministry of Agriculture, Government of the People's Republic of Bangladesh.

Dillion, J. L. and Hardaker, J. B. (1993). Farm Management Research for Small Farmer Development, FAO Publication, Rome, Italy.

Islam, M. Z., Begum, R., Sharmin, S. and Khan, A. 2017. Profitability and productivity of rice production in selected coastal area of Satkhira district in Bangladesh. International Journal of Business, Management and Social Research, 03(01), 148-153. Crossref: https://doi.org/10.18801/ijbmsr.030117.17.

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.

Khan, M. (2002). Input-Output Relationship and Resource Use Efficiency of Modem Aromatic and Aman Rice Production in Bangladesh. Bangladesh J. Agril. Res. 27(3): 503-515.

MoYS. (2012). The Population Category in Bangladesh. Ministry of Youth and Sports, Government of the People's Republic of Bangladesh.

Mustafi, B. A. A., M. A. Islam and Banik, M. (2000). A study on Production and Export potential of fine rice in the Barind Tract Area, Agricultural Economics Division. Bangladesh Rice Research Institute, Gazipur-1701.

Nasreen, M., Hossain, K. M., and Azad, M. A. K. (2013). Climate Change and Livelihood in Bangladesh: Experiences of people living in coastal regions Proce of Int. Con. of Building Resilience, 1-25.

Nasrin, J. (2013). Financial Profitability of Aromatic Rice Production and its Impacts on Farmers' Livelihood in Selected Areas of Tangail District.

Omar, M. I., Rahman, M. C., Chowdhury, A. and Siddique, M. A. B. (2019). Supply Chain Analysis of Kataribhog (Aman Season) Rice at Dinajpur District in Bangladesh. European Journal of Business and Management., 11(1). DOI: 10.7176/EJBM.

Panayotou, T. (1985). Small Scale Fisheries in Asia Socioeconomic Analysis and Policy, No 2296. International Development and Research Centre, Canada.

Poddar, K. K. (2015). Effects of Climate Change on Rural Farmers Livelihood. M.S. (Ag. Ext. & Info. Syst) Thesis, Department of Agricultural Extension and Information System, Sher-e-Bangla Agricultural University, Dhaka.

Sammy, H. M. ; Latif, M. A. ; Rahman, M. R. ; Bisakha Dewan ; Rasha, R. K. (2015). Profitability and household level efficiency of aromatic rice production in Dinajpur district of Bangladesh. International Journal of Sustainable Agricultural Technology., Vol.11 No.4 pp.1-5.

Sujan, M. H. K., Islam, F., Azad, M. J. and Rayhan, S. J. (2017). Financial profitability and resource use efficiency of boro rice cultivation in some selected area of Bangladesh. African Journal of Agricultural Research. Vol. 12(29), pp. 2404-2411, DOI: 10.5897/AJAR2017.12443.

Talukdar, R. K. (204). "Economic and Financial Profitability of Aromatic and Fine Rice Production in Bangladesh", MS Thesis, Department of Agricultural Economics, Bangladesh Agricultural University, Mymensing, Bangladesh.

Toma, R. A. Z., Begum, I. A., 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.* Vol. 12 No. 1, pp. 235-242. http://www.ijias.issr-journals.org/.