# COMPARATIVE PROFITABILITY ANALYSIS OF ZERO TILLAGE GARLIC VERSUS BORO PADDY CULTIVATION IN SOME SELECTED AREAS OF NATORE DISTRICT

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# CERTIFICATE

This is to certify that the thesis entitled **"COMPARATIVE PROFITABILITY ANALYSIS OF ZERO TILLAGE GARLIC VERSUS BORO PADDY CULTIVATION IN SOME SELECTED AREAS OF NATORE DISTRICT"** submitted to the Department of Development and Poverty Studies, Faculty of Agribusiness Management, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE (MS)** in Development and Poverty Studies embodies the result of a piece of bonafide research work carried out by **MD. RUBEL RANA**, **REGISTRATION NO. 11-04483** 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 been duly acknowledged.

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Dedicated To
My Beloved Parents

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***The Author***

## ABSTRACT

This piece of research was undertaken in order to assess the comparative profitability of zero tillage garlic and boro paddy production at Gurudaspur Upazila in Natore district. A total number of 60 farmers were randomly selected. Necessary statistical analyses were performed to achieve the objectives of the study. The Cobb-Douglas production function was used to determine the effects of individual inputs on garlic and boro paddy cultivation. Per hectare total returns for garlic and boro paddy were Tk. 274464 and Tk.137828, gross margin were Tk. 94524 and Tk. 42751 and the net returns were Tk. 53877and Tk. 7383, respectively. The undiscounted Benefit Cost Ratio was 1.24 and 1.06 for garlic and boro paddy production, respectively. The results indicated that garlic cultivation was more profitable than the boro paddy cultivation. The net returns were influenced by most of the factors included in human labor, seed, fertilizer and manure, power tiller, and irrigation. Farmers producing garlic and boro paddy faced problems related to production and marketing of the crops. It may be concluded that the farmers should be encouraged to grow more garlic rather than boro paddy as a means of increasing farm income through diversification of crop production in the area under study.

## LIST OF CONTENTS

## LIST OF CONTENTS(Continued)

## LIST OF CONTENTS(Continued)

## LIST OF CONTENTS(Continued)

## LIST OF TABLES

LIST OF TABLES **(Continued)**

# LIST OF FIGURES

## ACRONYMS AND ABBREVIATIONS

µg: Microgram

BAU: Bangladesh Agricultural University

BBS: Bangladesh Bureau of Statistics

BER: Bangladesh Economic Review

Cal.: Calories

CDP: Crop Diversification Programme

DAP: Di-Ammonium Phosphate

et al.: and others (at elli)

FAO: Food and Agriculture Organization

FY: Fiscal Year

gm: gram

GoB: Government of Bangladesh

ha: Hectare

HIES: Household Income and Expenditure Survey

HYV: High Yielding Varieties

IOC: Interest on Operating Capital

Cal.: Kilo Calories

kg: Kilogram mg : Milligram

mm: Millimeter

MoP: Murate of Potash

MT: Metric Tons

Rs.: Rupee symbol

SDGs: Sustainable Development Goals

SFYP: Seventh Five-Year Plan

Sq. km: Square Kilometer

Tk.: Taka

TSP: Triple Super Phosphate

# CHAPTER 1
# INTRODUCTION

## 1.1 Background of the Study

Bangladesh is agriculture based lower middle income country. The agriculture sector is highly related to crop production. As a developing country, it has been striving for rapid development of its economy. The country has a population of 158.9 million encompassing an area of 147570 sq. km (BER, 2017). About 75.15 percent of total population of this country lives in rural areas (BBS, 2017). The agriculture sector had also performed relatively well in the last decade due to increased productivity, emerging diversification into value added products, such as fruits, vegetables, poultry, dairy and fish and self-sufficiency in rice production, the main cereal crop for the people of the country. This performance was achieved in spite of a large population, scarce cultivable land, a very high population density and the regular occurrence of natural calamity. However, still a large segment of population is under poverty line (24.3%), with most of the poor concentrating in the rural areas (BER, 2017).

At present, despite some diversification, most of the agricultural production is still concentrated on the limited number of crops, mainly the food grain and paddy continuing to be the most important crop. While cash crops, like sugarcane and jute have seen their production stagnating or declining over the past decades, there has been increased production of spices and tea. Production of fruits and vegetables has been also improved. In the non-crop sector, poultry, dairy and seafood have seen considerable upward trend of growth.

Agriculture provides employment to nearly about 42.7 percent of its total labor forces (BER, 2017). Agriculture lodges a key position in the overall economic range of the country in terms of its contribution to Gross Domestic Product (GDP). Figure 1.1 denotes the sectoral share of GDP at constant prices (Base Year: 2005-06).

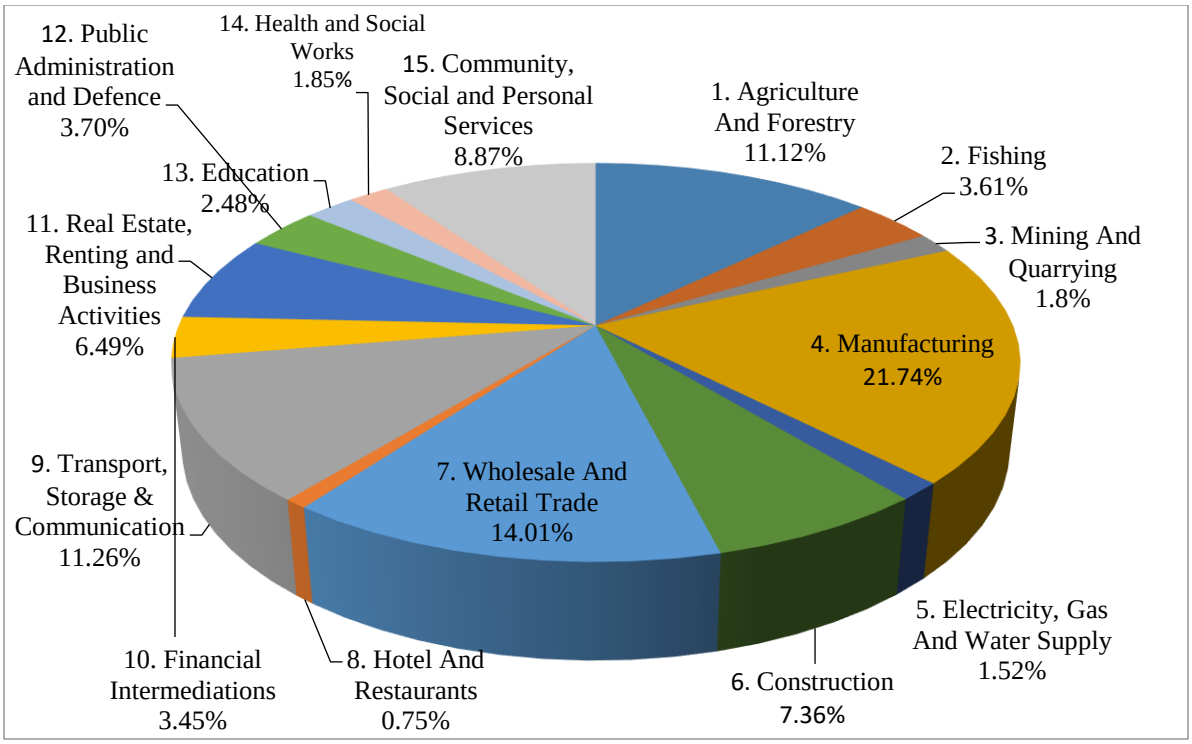


**Figure 1.1 Sectoral Shares of Gross Domestic Product at Constant Market Price**

Source: BER, 2017

Broad agriculture sector which comprises crops and Horticulture, Animal Farming, Forest and related services and Fishing contributes 14.51% to the gross domestic product (GDP) as a whole in the FY 2016-17 (BER, 2017). Despite increase in the shares of fisheries, Animal Farming, and forestry, crops and horticulture sector alone accounts for 53.36% share of agricultural GDP in FY 2016-2017 (BER, 2017) (Figure 1.2). In FY 2014-2015, within the broad agricultural sector, the provisional growth rate of agriculture and forestry sector stood at 1.79% according to the base year 2005-06, which was 1.96% in FY 2016-17. Of this growth performance, the growth of crops and horticulture sub-sector scaled up from 0.88 percent in FY 2015-16 to 0.96 percent in FY 2016-17.Over the last few years, there has been an increasing trend in food production. According to BBS, in FY2016-17, food grains production stood at around 388.14 lakh metric ton (MT). In the same fiscal year, the total internal procurement of food grains was 13.83 lakh MT, total import of food grains through public and private sectors was 58.23 lakh MT (rice 1.33 lakh MT and wheat 56.90 lakh MT).

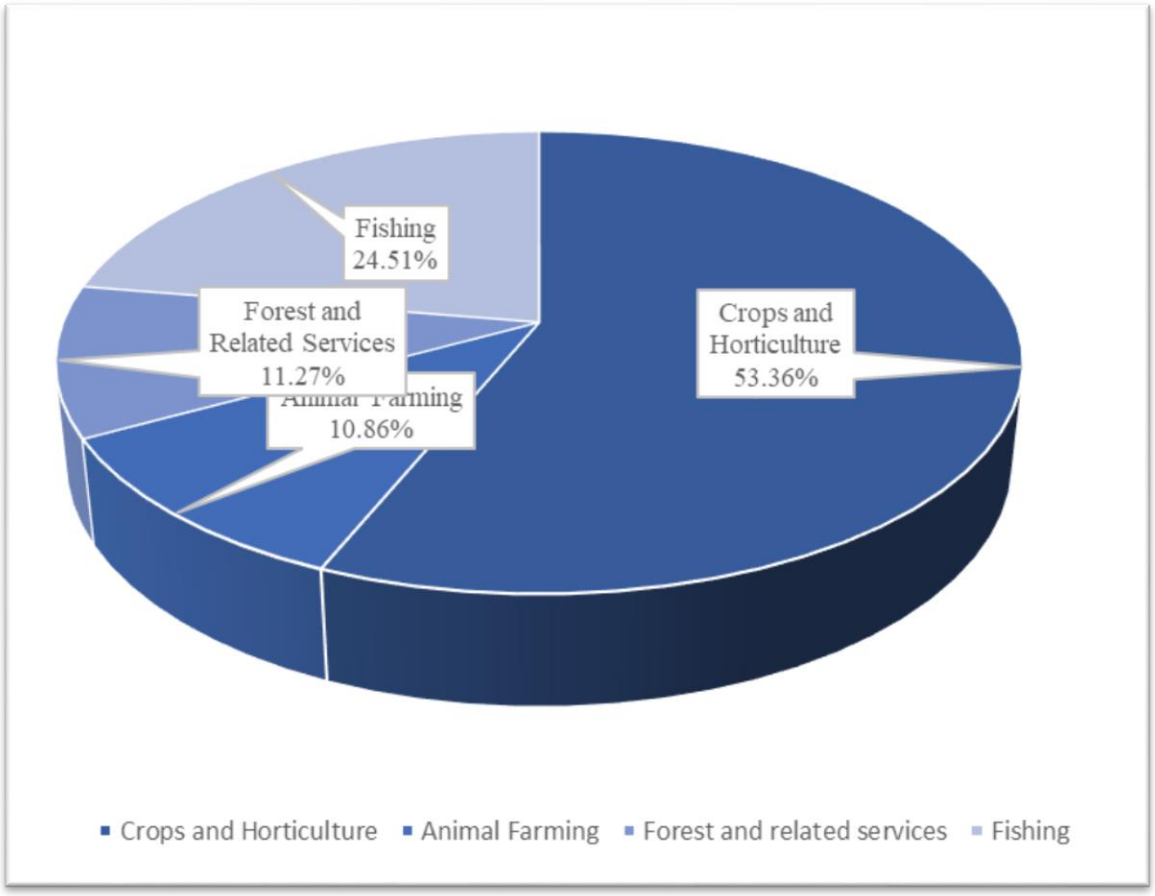


**Figure 1.2 Sub-Sectoral Share of Broader Agricultural GDP in 2016-17**

Source: BER, 2017

According to the BBS, the volume of food grains production in FY2015-16 stood at 388.17 lakh MT of which Aus accounted for 22.89 lakh MT, Aman 134.83 lakh MT, Boro189.38 lakh MT. In FY2016-17 food grains production stood at 388.14 lakh MT of which Aus accounted for 21.33 lakh MT, Aman136.56 lakh MT, Boro 180.24 lakh MT.

## 1.2 Importance of Garlic

Garlic (Allium sativum L.) has been used in world cuisines as well as in herbal medicine for thousands of years and at times, has been claimed to help prevent everything from high cholesterol to cancer (Rahman et. al., 2012). Garlic also helps eliminating waste materials and dangerous free radicals from the human body (Durak et al., 2004). Garlic has been used as food, a condiment, and for medicinal purposes for over 5,000 years. It is thought to have been originated in central Asia, and then later brought to the Mediterranean area. Garlic (*Allium sativumL*) belongs to the Amaryllidaceae family. The world production of garlic is about 9280000mt and it is ranked third of the spices grown in the world, China leads the world production of garlic (5964000mt) and also in the area (467000 ha). The highest national yield (21.00 mt/ha) is recorded from Egypt. The major garlic producing countries are China, India, South Korea, Egypt, Spain, Thailand, and Turkey (FAO, 1990). The crop is intensively cultivated during the winter season in Bangladesh.

Among the bulb spices, garlic ranks third in terms of area (44000 ha) and production (234000mt) covered 14 percent of the total area under spices. The average yield of garlic in our country is 5.32 mt per hectare which is very low compared to 11.07 mt per hectare produced by garlic producing countries of the world (BBS, 2017). Non-availability of HYV seed at proper time, lack of technical knowledge, infestation of insects and diseases and low market price were the major problems of garlic cultivation (Haque et al. 2013). Garlic is generally cultivated with traditional method. Table 1.1 denotes the present status of acreage and production of garlic and other spices condiments by year from 2006-07 to 2016-17. Production of garlic is increasing day by day in Bangladesh.

Figure 1.3 Picture of Garlic Bulbs

**Table 1.1 Acreage and Production of Condiments and Spices by Year from 2002-03 to 2016-2017**

| Year | Area ('000' ha) | | Production ('000' mt) | |
|---|---|---|---|---|
| | Condiments and Spices | Garlic | Condiments and Spices | Garlic |
| **2002-03** | 253 | 115 | 425 | 43 |
| **2003-04** | 270 | 121 | 609 | 73 |
| **2004-05** | 302 | 126 | 1000 | 90 |
| **2005-06** | 321 | 127 | 1182 | 102 |
| **2006-07** | 348 | 139 | 1405 | 177 |
| **2007-08** | 295 | 134 | 1368 | 145 |
| **2008-09** | 275 | 135 | 1212 | 155 |
| **2009-10** | 286 | 137 | 1350 | 164 |
| **2010-11** | 321 | 142 | 1649 | 209 |
| **20011-12** | 325 | 144 | 1756 | 234 |
| **2012-2013** | 317 | 134 | 1722 | 224 |
| **2013-2014** | 346 | 151 | 2043 | 312 |
| **2014-2015** | 374 | 169 | 2409 | 346 |
| **2015-2016** | 399 | 177 | 2488 | 382 |
| **2016-2017** | 412 | 185 | 2675 | 425 |

Source: Bangladesh Bureau of Statistics (BBS, 2013, 2017)

In some parts of Bangladesh, the growers plant garlic during the period from December to January after the harvest of transplanted Aman Rice (Rahman, 1992). The domestic production is not enough to meet the domestic demand. Hence, Bangladesh has to import large volume of garlic every year to maintain the supply demand at the cost of hard earned foreign currency (Table 1.2). It seems that there is a huge scope of increasing the production of garlic either (i) by increasing the area under cultivation, which is rather difficult because of limitation of land or (ii) by improving the existing production practices, which include among others, improved technologies, better management and selection of improved cultivars.

## 1.2 Importance of Paddy

Paddy is the amazing food grain that shapes the diets, culture, economy and the way of life in Bangladesh. It is the staple food for entire 158.9 million people (BBS, 2017). Keeping this in mind, since the independence all the successive governments have given high priority for attaining self-sufficiency in food production. Accordingly, the demand for paddy is constantly rising and 2.3 million people being added each year to its total population. The development of high yielding modern grain varieties of rice which are highly responsive to inorganic fertilizer and insecticides, effective soil management and water control (Hayami and Ruttan, 1985) helped the country to meet the increasing food grain. Among the high yielding varieties boro paddy varieties have maximum share to the total paddy production which is more or less stable over the last decades.

Figure 1.4 Picture of Boro Paddy

Paddy continuously provides 70 percent of total calorie intake for the people particularly for hard working people. The rice area is about 11.30 million hectares (BBS, 2017). The rice production is by far the most important provider of rural employment (HIES, 2005 and BBS, 2006). The area, production and yield rate of Paddy and boro paddy in different years were shown in Table 1.2.

**Table 1.2 Area, Production and Yield Rate of Paddy and Boro Paddy by Year from 2002-03 to 2016-17**

| Year | Area ('000' ha) | | Production ('000' mt) | |
|---|---|---|---|---|
| | **Paddy** | **Boro Paddy** | **Paddy** | **Boro Paddy** |
| **2002-03** | 10775.3 | 3846.15 | 25188 | 12222 |
| **2003-04** | 10828.74 | 3945.34 | 26190 | 12838 |
| **2004-05** | 10372.87 | 4065.59 | 25157 | 13837 |
| **2005-06** | 10533.6 | 4067.11 | 26530 | 13975 |
| **2006-07** | 10583.81 | 4259.92 | 27319 | 14965 |
| **2007-08** | 10578.95 | 4609.72 | 28931 | 17762 |
| **2008-09** | 11284.21 | 4718.22 | 31317 | 13084 |
| **2009-10** | 11358.70 | 4708.91 | 31975 | 18059 |
| **20010-11** | 11534 | 4772.47 | 33542 | 18617 |
| **2011-12** | 11533.12 | 4812.15 | 33889 | 18759 |
| **2012-2013** | 11423.00 | 4760.00 | 33833 | 18778 |
| **2013-2014** | 11371.00 | 4790.00 | 34356 | 19007 |
| **2014-2015** | 11421.00 | 4846.00 | 34710 | 19192 |
| **2015-2016** | 11300.50 | 4685.10 | 34710 | 18938 |
| **2016-2017** | 11072.30 | 4547.30 | 33813 | 18024*** |

Source: Bangladesh Bureau of Statistics (BBS, 2013, 2017), *** To be harmonized

### 1.4 Nutritive and Medicinal Value of these Crops

#### Garlic

As a small vegetable, garlic surely has a big and well-deserved reputation. This member of the Lily family, a cousin to onions, leeks and chives, can transform any meal into a bold, aromatic and healthy culinary experience. A member of the Lily or Allium family garlic is rich in a variety of powerful sulfur-containing compounds including thiosulfinates, sulfoxides, and dithiins. While these compounds are responsible for garlic's characteristically pungent odour, they are also the source of many of its health-promoting effects. In addition, garlic is an excellent source of manganese, a very good source of

vitamin B6, vitamin C and a good source of selenium. Numerous studies have demonstrated that regular consumption of garlic lowers blood pressure, decreases platelet aggregation, serum triglycerides and LDL-cholesterol (the potentially dangerous form) levels while increasing serum HDL-cholesterol (the protective form) and fibrinolysis (the process through which the body breaks up blood clots). The organosulfur compound found in garlic called *ajoene* may also be useful in the treatment of skin cancer. The most potent active constituent in garlic, *allicin*, has been shown to not only lower blood pressure but also to prevent weight gain (Elkayam et. al, 2003). Table 1.3 shows the amount of nutrient component as well as the biochemical substance of garlic that is included in 1 oz-wt serving of that food.

**Table 1.3 Biochemical Substances of Garlic Bulb in Each 1 oz-wt (28.35) of Edible Portion**

| Name of Substances | Quantity |
|---|---|
| Manganese | 0.47 mg |
| Vitamin B 6 (pyridoxine) | 0.35 mg |
| Vitamin C | 8.85 mg |
| Tryptophan | 0.02 g |
| Selenium | 4.03 mg |
| Calcium | 51.31 mg |
| Phosphorus | 43.38 mg |
| Copper | 0.08 mg |
| Vitamin B A1(Thiamin) | 0.06 mg |
| Protein | 1.80 g |
| Calories | 42.24 cal. |

Source: George Mateljan, 2006

**Boro Paddy**

Rice (paddy) is the staple food of over half the world's population. It is the predominant dietary energy source for 17 countries in Asia and the Pacific, 9 countries in North and South America and 8 countries in Africa. Paddy (rice) provides 20% of the world's dietary energy supply, while wheat supplies 19% and maize (corn) 5%. A detailed analysis of

nutrient content of rice suggests that the nutrition value of paddy varies based on a number of factors. It depends on the strain of paddy, that is between white, brown, red, and black (or purple) varieties of paddy, each prevalent in different parts of the world. It also depends on nutrient quality of the soil paddy is grown in, whether and how the paddy is polished or processed, the manner it is enriched, and how it is prepared before consumption.

About 40 percent of the world's population derives most of their calories from paddy. Almost 90 percent of the population of Bangladesh, Myanmar, Sri Lanka and Vietnam are paddy (rice) eaters. However, paddy is interwoven with Bengali culture. It is the symbol of wealth. The Food Department of the Government of Bangladesh recommends 410 gm of rice/head/day.

**Table 1.4 Nutrients from Per 100 gm Rice**

| Composition | Rice |
|---|---|
| Calories (k. calorie) | 325 |
| Moisture content(percent) | 13.3 |
| Carbohydrate(percent) | 79 |
| Protein(gm) | 6.4 |
| Fat (gm) | 0.4 |
| B-carotine (µg) | 0 |
| Vitamin B(mg) | 0 |
| Thiamin | 0.21 |
| Riboflovine | 0.09 |
| Vitamin C(mg) | 0 |
| Calcium (Ca) (mg) | 9 |
| Iron (Fe) (mg) | 1 |

Source: Bose and Som, 1986; Wahed and Anjan, 2008

The opportunity cost of food imports may be high in terms of lower investment and consequently reduced rate of economic growth (Ghatak and Ingersent, 1984). The overall performance of the economy is, therefore, yet intricately linked to the performance of the agricultural sector (Matin, 2004). Hence, it is evident that Bangladesh should develop its agriculture sector to attain economic development. The total area of Bangladesh is about 14.845 million hectares of which 53.89 percent is cultivable, 3.16 percent is current fallow

land and rest 42.95 percent is covered by homesteads, rivers, tidal creeks, lakes, ponds, roads, etc. (BER, 2015). So there is a little scope left to increase agricultural output by bringing new land under cultivation. Increase in agricultural output could be attained, however, by using high yielding varieties (HYV) and adopting improved cultural and management practices. In the past, growth of agriculture in Bangladesh has centered on food grain production paddy alone comprises over 90 percent of that growth. Massive increase in rice production led to the decline in area of tubers, pulses, spices, oilseeds, roots, and other minor crops (Baset, 2003). Thus Bangladesh has to import spices at the cost of its hard earned foreign currency.

Realizing the importance of minor crops for the improvement of nutritional status of the people, the government of Bangladesh has taken a Crop Diversification Programme (CDP) in the seventh Five-Year Plan. Under the CDP strategy, emphasis was placed to increase production and consumption of those nutrient rich foods. The diversification has not yet taken place adequately within the crop sector, which is still dominated by the production of cereals.

In order to explore the potentials and possibilities of expansion in the acreage and production of the minor crops, it is, therefore, important to examine the past performance of the crops; to analyze the profitability of those crops in order that all these activities would reveal necessary information before farmers, researchers, planners and so on to take unique steps forward to increase both the acreage and production of minor Alliums; specially, garlic and onion as they are mostly cultivated and consumed Alliums in Bangladesh.

### 1.5 Justification of the Study

In the economy of Bangladesh, Agriculture sector continues to perform a very important role. This sector attained modest growth and experienced slow transition during the two decades since independence. The goal of the sector was to replace the traditional and vulnerable agriculture by a modern agriculture capable of sustained growth. Thus it is essential to ensure easy availability of agricultural inputs, execution of agriculture extension principles, modernization of research techniques to improve the quality of agricultural product and steps should be taken to apply and extend the use of technologies

obtained from agricultural research for sustainable agricultural development. To attain the sustainable development goals (SDGs) affirmed by the government of Bangladesh (GoB) different strategies should be taken. Among enormous different strategies taken by GoB agricultural commercialization is one of the most important strategies. To attain agricultural commercialization numerous studies on comparative profitability of different cropping pattern must be needed. The GoB has been pursuing a crop diversification strategy to reduce the dependency on paddy cultivation. In the seventh five year plan categorically emphasized the importance of crop diversification on valid agronomic, nutritional and economic reasons. According to the Planning Commission of Bangladesh cultivation of horticultural crops, pulses, oilseeds fodder and vegetables etc. are stressed in the plan documents. But unfortunately garlic has not been included in this programme. Due to lack of proper attention, the area and production of garlic remained more or less constant or even decreasing during the recent past years.

Agriculture of Bangladesh is still paddy based. In 2016-17 food grain production was 388.14 lakh mt. But still there is a deficiency in producing minor agricultural products. It is estimated that annual production of garlic is 234000 mt. against the national demand of 527000mt. With the increase of population, the demand for garlic and paddy is also increasing day by day. But the present production cannot meet up the prevailing demand. Therefore, every year for meeting deficit Bangladesh has to import a large volume (48728.55 mt) of garlic at the cost of foreign currency (BBS, 2017). However, garlic and boro paddy production is more labour intensive. So cultivation of these two crops can create more employment opportunities for the unemployed rural people of Bangladesh. A large number of farmers and traders live on by earnings from garlic and boro paddy cultivation and trading. By producing garlic and boro paddy, a substantial amount of foreign currency can be saved instead of importing garlic from other countries and exporting rice by our country.

The present study will help find the prevailing problems and develop our understanding on the interrelated aspects of garlic and boro paddy cultivation and choice making in production of garlic rather boro paddy. 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.

Finally, the study will be helpful for the individual farmers for effective operation and management of their farms through pointing the drawbacks and for the planners for proper planning and policy making. The study may be helpful to the extension workers to learn about various problems related to garlic and boro paddy production and to suggest the farmers for copying with those problems.

### 1.6 Objective of the Study

The specific objectives of the study are as follows:

a) To assess the socioeconomic profile of the respondent farmers;
b) To determine the profitability of zero tillage garlic and boro paddy cultivation;
c) To assess the factors affecting the garlic and boro paddy cultivation;
d) To identify the problems and constraints faced by the farmers producing garlic and boro paddy; and to suggest some policy guidelines/recommendations.

### 1.7 Organization of the Study

The study consists of nine chapters. Chapter 1 describes introduction of the study. Relevant review of literature, methodology, description of the study area, Socioeconomic characteristics of the sample farmers, cost and returns of garlic and boro paddy production, results, problems and constraints associated with farmers and summary, conclusion, policy recommendations and limitations of the study are presented in Chapter 2, Chapter 3, Chapter 4, Chapter 5, Chapter 6, Chapter 7, Chapter 8 and Chapter 9, respectively.

# CHAPTER 2
# REVIEW OF LITERATURE

This chapter represents the review of the past research works that are related to the present study. A few researches have been done on garlic and boro paddy production in Bangladesh partly. However, comparative economic analysis of garlic and boro paddy production is hardly ever found in the existing literature. Several important studies on garlic and boro paddy production, which have been conducted in the recent past, are discussed below:

**Chadha (1990)** conducted a study on onion and garlic in India. Area and production of onion and garlic in the world and India, export from other countries and factors limiting production and productivity in India are described. The research infrastructure, varietal improvement and production technology of onions and garlic in India, Kharif onion cultivation in North and East India, seed production and distribution, post-harvest technology, all year round production of onions, disease and pest control, and future research requirements are discussed.

**Sabur and Mollah (1993)** undertook a study on constraints to production and marketing of spices in Bangladesh. The study revealed that the real price of garlic, onion and turmeric increased significantly by 3.83 percent, 3.58 percent and 3.17 percent respectively during the study period. They examined that the storage facilities for spices, particularly cold storage, were limited and seasonal price variations largely dependent on the perishability of spices.

**Mahmood (1995)** examined the relative profitability of selected spices, compared with their competing crops. Among all competing crops onion was the most profitable crop with net profit of Tk. 26673, which was followed by potato (Tk. 25875.30), lentil (Tk. 20652.1) and garlic (Tk. 16755.49) in respect of net return per hectare.

**Hossain (1996)** carried out an experiment in Bangladesh agricultural University, Mymensingh. Plant highest, leaf number, pseudo stem and bulb diameter, dry matter content of foliage, bulb weight and bulb yield were found significantly higher for mulched plants.

**Trevisan *et al.* (1997)** reported that marketable yields and percentage of high quality bulbs were greatest with bulbs planted on 18 May that 27 April and 14 June.

**Shrivastava (1998)** studied on economics of agro-forestry in Indo-Gangetic *alliums* of Uttar Pradesh in India. The study was managed under an agro-silvicultural system with Eucalyptus and a mixture of agricultural crops e.g. mustard, gram, coriander, onion, garlic, and turmeric. Intercropping was to be carried out over the first 3 years. Detailed cost data were given, including initial expenditure, actual and projected working costs of Eucalyptus plantation for the first 6 years and costs of intercropping. Total profit from the first and second cycles was predicted as Rs.28363125 and Rs.75548I35, respectively with cost/benefit ratio of 4.0 and 7.2. The system generated 112960 man-days of employment in the first rotation.

**Bhuyan (1999)** conducted an experiment on the effect of planting time, mulch and irrigation on the growth and yield of garlic. In this experiment it was found that the highest yield was obtained from 25 October planting (3.92 mt/ha) followed by 9 November (3.58 mt/ha), 25 November (3.55 mt/ha), and 8 December (3.08 mt/ha). December 23 planting gave the lowest yield (2.31 mt/ha). It was observed that earlier planting gave the highest plant highest, number of leafs per plant, diameter of bulb, weight if individual bulb.

**Ali (2000)** attempted to measure and compares resource use and land productivity within tenure groups. Total gross cost for producing Aman, Boro and Aus were the highest in owner farms and the lowest in tenant farms. It observed that owner operators used higher level of inputs than owner-cum-tenant and tenant operators. Rice owner-cum-tenant operators obtained higher yield in Aman and Aus production then owner and tenant operators. In Boro paddy production tenant operators obtained maximum net return than owner operators and owner-cum- tenant operators in owner land. Finally, it was concluded that tenancy affects positively on resource use and production in a predictable fashion even in small scale peasant agriculture.

**Mustafi and Azad (2000)** conducted a study on adoption of modern rice varieties in Bangladesh. They examined the comparative profitability of BR-28 and BR-29 and found that the average yields 5,980 kg and 6,670 kg per hectare respectively. The gross margin was higher for BR-29 which was Tk. 27,717.02 per hectare. The farm level data also showed that the unit cost of BR-29 and BR-28 were Tk. 4.70 and Tk. 5.12 per kg. They also compared to BR-28 return from BR-29 is higher by Tk. 3,759 per hectare.

**Akter (2001)** conducted a study on relative profitability of alternate cropping patterns under irrigation condition in some selected area of Barguna district. The relative profitability of 5 dominant cropping patterns in two villages of Barguna district Bangladesh was assessed. The cropping patterns considered were (1) T. Aus Rice-T. Aman rice-HYV Boro rice; (2) T. Ausrice-T. Aman rice-wheat; (3) T. Aman rice-Jute HYV Boro rice; (4) T. Aman rice -chilli-fallow; and (5) T. Aman Rice-Jute-potato. Data were obtained through interviews with 60 farmers 10 farmers from each cropping pattern during June-August 2000. Cropping pattern 1 had the highest per hectare gross margin (Tk. 43312) and net return (Tk. 27643). While cropping pattern 4 had the lowest gross margin (Tk. 29575) and net return (Tk. 19000). The inclusion of HYV boro rice as a third crop in the cropping pattern increased boom income and employment.

**Harun-or-Rashid (2002)** studied the production potential and profitability in TPS-garlic intercropping system at different spacing and row arrangement. The spacing for TPS was 50x50 cm, while that of garlic were 10 x 10 cm, 15 x 10 cm, and 15 x 15 cm. The row arrangements were single, double, and alternative. The highest gross return (Tk. 169590/ha), net return (Tk. 74782/ha), LER (1.38) and BCR (1.80) were recorded from potato + garlic at 15 x 15 cm spacing as double row arrangement.

**Quazi and Paul (2002)** conducted a study on comparative advantages of crop production in Bangladesh. In their study, the economic profitability analysis demonstrates that Bangladesh has a comparative advantage in domestic production of rice for import substitution. However, at the export parity price, economic profitability of rice is generally less than economic profitability of many non-rice crops, implying that Bangladesh has more profitable options other than production for rice export. Several non-cereal crops, including vegetables, potatoes and onions have financial and economic returns that are as high as or higher than those of High Yielding Variety (HYV) rice.

**Zaman (2002)** conducted a study to accomplish a comparative analysis of resource productivity and adoption of modern technology under owner and tenant farms. It was found that gross cost for producing HYV boro rice were the highest in owner farms and the lowest in tenant farms. Owner operators used more hired labour where tenant operators used more family labour. The maximum return over total cost per hectare was obtained by owner operators and minimum by tenant operators. It was also observed that owner

operators were more efficient than tenant operators. It was also observed that owner operators were more efficient than tenant operators; it was also found that the degrees of adequacy level in the application of modern farm inputs were higher in owner farms than in tenant farms.

**Haque (2005)** conducted a comparative economic analysis of onion and garlic production in a selected area in Santhia Upazila of Pabna district. Both onion and garlic were profitable. Onion cultivation was more profitable than garlic cultivation. Per hectare average yield of onion and garlic was 8412 kg. and 4510 kg., respectively. Per hectare total cost of production, gross margin and net return of onion were Tk. 49437, Tk. 101230 and Tk. 93567, respectively. On the other hand, the corresponding figures for producing garlic were Tk. 49386, Tk. 43693 and Tk. 36304 respectively.

**Ahmed (2009)** conducted a comparative economic analysis of boro rice and potato production in some selected areas of Mymensingh district. Both boro rice and potato were profitable. Potato cultivation was more profitable than boro rice cultivation. Per hectare average yield of boro rice and potato were 6000 kg and 16302 kg, respectively. Per hectare total cost of production, gross margin and net margin of boro rice were Tk. 58202.74, Tk. 39402.2 and Tk. 24117.26, respectively. On the other hand, the corresponding figures for producing potato were Tk. 120221.71, Tk. 155436.23 and Tk. 142403.51, respectively.

The above mentioned opinions evidently show that only a few studies were conducted on garlic and boro paddy production. But no comparative economic study on garlic and boro paddy production was conducted in Bangladesh. The present study was, therefore, undertaken to determine the profitability of garlic and boro paddy production and thereby to facilitate farmers and policy maker’s decision making by providing information on economics of garlic and boro paddy production.

# CHAPTER 3
# METHODOLOGY

## 3.1 Introduction

An Appropriate methodology is the key for a successful research. The systematic design of a sound research has a well-organized and step wise method. The survey is an undivided part of methodology of social science. The scheme of any survey is predominantly determined by the nature, aims, and objectives of the study. It also depends on the availability of necessary resources, materials and time. There are several methods of collecting data for farm management research. A farm business study usually involves collection of information from individual farmers; collection of data for farm business analysis involves judgment of the analyst in the selection of data collection methods within the limits imposed by the resources available for the work (Dillon and Hardaker, 1993). In this study, "survey method" was employed mainly due to two reasons:

a) Survey enables quick investigations of large number of cases; and
b) Its results have wider applicability.

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

## 3.2 Selection of the Study Region

Selection of the study region is an important phase for the farm management research. "The area in which a farm business survey is to be carried out depends on the particular purpose of the survey and the possible cooperation from the farmers" (Yang, 1965). The researcher himself conducted a preliminary survey in Gurudashpur Upazila of Natore district to achieve the objectives of this study. On the basis of preliminary information, Jogendronagar, Durgapur and Khubjipur village were selected purposively because a large number of farmers grow garlic and boro paddy in these villages.

The other reasons for selecting the study region were as follows:

a) The area represents the same agro-ecological characteristics;
b) These were typical garlic and boro paddy growing villages with representative soil condition, topography and patterns;
c) Easy accessibility and good communication system existed in the selected villages;
d) Co-operation from the respondents were expected to be high since the researcher was inhabitant of the area and familiar with the local dialect, living experience, beliefs and other socioeconomic characteristics of the area; and
e) The study area is like a cluster region the villages are very adjacent.

### 3.3 Sampling Technique

In selecting samples for a study two factors need to be taken into consideration. The sample size should be as large as to allow for adequate degrees of freedom in the statistical analysis. On the other hand, administration of field research, processing and analysis of data should be manageable within the limitation imposed by physical, human and financial resources (Mannan, 2001). However, because of diversity in the technical and human environment, it is necessary to sample several numbers of the population before any conclusion can be drawn. Therefore, the purpose of sampling is to select a sub-set of the population that is representative of the population (Rahman, 1998).

It was not possible to visits all the farmers in the study area due to limitation of time, money and personnel as there were a huge number of farmers. A simple stratified random sampling technique was followed in the present study for minimizing cost, time and to achieve the ultimate objectives of the study.

Three villages of Gurudashpur Upazila in Natore district were selected. Two lists of farmers, who cultivated garlic and boro paddy, were collected with the help of agricultural extension personnel and elderly farmers of the study area. A total number of 60 farmers, 30 farmers for garlic and 30 farmers for boro paddy were randomly selected from the lists. Thus the selected farmers were interviewed to achieve the ultimate objectives of the study.

### 3.4 Period of Study

Since farming is seasonal one, a farm business survey should cover a whole crop year in order to have a complete sequence of crops. The researcher must determine to what extent

the information for a particular year represents normal or average conditions, particularly for crop yields, annual production and price level. Farmers generally plant garlic from mid-December to mid-January and harvest after three to three and half months and cultivate boro paddy January-February and ends in mid-April-May. The data collection period was therefore, pertained this period of 2018. Besides these, secondary data were collected from different published and un-published sources to fulfill of the objectives of the study.

### 3.5 Preparation of Survey Schedule

Two sets of comprehensive survey schedules were set to collect necessary data and information from the farmers in such a way that all the factors in the production of garlic and boro paddy could be included in conformity with the objectives of the study. As the survey mainly depends on the preparation of the survey schedule, pretested to verify the relevancy of the question and nature of response of the respondents. The necessary adjustments were made and a final survey schedule was developed accordingly.

The questionnaires were designed with the following specific heads:

a) General information about the farmers;
b) Family composition of the farmers;
c) Information about land;
d) Price of inputs in garlic and boro paddy cultivation;
e) Source of capital for cultivation of garlic and boro paddy;
f) Amount of yield obtained from garlic and boro paddy and their disposal; and
g) Problems faced by the farmers in producing garlic and boro paddy.

### 3.6 Collection of Data

Obviously, both technical and socioeconomic data are needed in this research. The researcher himself collected the data by interviewing the selected respondents. It was very difficult to collect accurate data since farmers did not keep any written records of their farm

activities. To overcome this problem, all possible efforts were made by the researcher to dig out the accurate information from the field level farmers memory. At first, the objectives of the present study were explained to the farmers and were requested to provide correct information so far as they could remember.

### 3.7 Accuracy of the Data

Adequate measures were taken during the period of data collection to minimize the possible errors. The measures taken were:

a) Built-in-check in the interview schedule;

b) Field checking; and

c) Independent re-interviewing of the respondents.

In case of any inconsistency and lapses, the neighboring farmers were asked for necessary verification and data were checked and corrected through repeated visits. In order to ensure consistency and reliability of the parameters being generated out of the data, follow up visits were also made to the field to obtain supplementary information. Data were collected both at farmer's house and in the field.

### 3.8 Processing of Data

The collected data were manually edited and coded. Then all the collected data were summarized and scrutinized carefully. Data were processed transferring to master sheets to facilitate tabulation in order to meet the objectives of the study. Moreover, data entry was made in computer and analyses were done using the concerned software Microsoft Excel. It may be noted that information was collected initially in local units. After necessary checking it was converted into standard international units such as hectare, metric ton, etc. The survey results are summarized and presented in Chapters 5 and 6.

### 3.9 Analytical Technique

To meet particular research objectives, several analytical methods were employed in the present study. Tabular method was used for a substantial part of data analysis. This technique is intensively used for its inherent quality of purporting the true picture of the

farm economy in the simplest form. Relatively simple statistical techniques such as percentage and arithmetic mean or average were employed to analyze data and to describe socioeconomic characteristics of garlic and boro paddy growers, input use, costs and returns of garlic and boro paddy production and to calculate undiscounted benefit cost ratio (BCR). Per hectare gross margin and net return of garlic and boro paddy were calculated by using the following algebraic equations presented in Sub-sections 3.9.1 and 3.9.2.

### 3.9.1 Gross Margin

Gross margin has given an estimate of the difference between total revenue and variable cost.

That is,

$$GM = TR - VC$$

Where,

GM = Gross Margin

TR = Total Return

VC = Variable Cost

Gross margin is widely used in short run analysis and farm planning. This analysis is easily understandable for its simplicity. Per hectare total return was calculated by multiplying per hectare total amount of product by annual average farm gate price.

### 3.9.2 Net Return

Net return analysis considered fixed cost; cost of land rent, interest on operating capital, etc. So per hectare net return was determined by subtracting per hectare total cost (variable cost and fixed cost) of production from per hectare total return. To determine the net returns of garlic and boro paddy production the following equation was used in the present study:

$$\Pi = P_y Y - (\Sigma P_{xi} X_i + \text{Total Fixed Cost})$$

Where,

$\Pi$ = Net return (Tk./ha)

$P_y$ = Per unit price of the product (Tk./kg)

Y = Quantity of the product (kg/ha)

$P_{xi}$ = Per unit price of $i^{th}$ inputs (Tk./kg)

$X_i$ = Quantity of the $i^{th}$ (Variable) inputs (kg/ha)

i = 1, 2, 3……, n (number of inputs)

### 3.9.3 Functional Analysis

Apart from the tabular analysis, the functional technique was also followed in this study. Cobb-Douglas production function model 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.

The model specification was as follows:

$$Y_i = \alpha X_{1i}^{\beta 1} X_{2i}^{\beta 2} X_{3i}^{\beta 3} X_{4i}^{\beta 4} X_{5i}^{\beta 5} X_{6i}^{\beta 6} e^{ui}$$

By taking log in both sides the Cobb-Douglas production function was transformed into the following logarithmic form because it could be solved by the ordinary least square (OLS) method:

$$\text{In } Y_i = \text{In } \alpha + \beta_1 \text{In } X_{1i} + \beta_2 \text{In } X_{2i} + \beta_3 \text{In } X_{3i} + \beta_4 \text{In } X_{4i} + \beta_5 \text{In } X_{5i} + \beta_6 \text{In } X_{6i} + u_i$$

Where,

Y = Gross return (Tk./ha)

In α = Constant or intercept of the function

$X_1$ = Seed cost (Tk./ha)

$X_2$ = Human labor cost (Tk./ha)

$X_3$ = Fertilizer and manure cost (Tk./ha)

$X_4$ = Irrigation cost (Tk./ha)

$X_5$ = Insecticides and pesticides cost (Tk./ha)

$X_6$ = Tillage cost (Tk./ha)

ln = Natural logarithm

i = 1,2, 3……, n(n=30)

*e* = Base of natural logarithm

$u_i$ = Error term.

$\beta_1, \beta_2 \ldots\ldots\ldots \beta_6$ = coefficient of respective variables

Detailed information on the selected model and its interpretations are given in Chapter 7.

### 3.10 Major Cost Items

In this section an attempt has been made to estimate the costs and returns of garlic and boro paddy production. To estimate the net returns of garlic and boro paddy production, it is essential to estimate the actual costs and returns in appropriate procedures. Inputs used in the study area were both purchased and family supplied. Thus, the total production costs consisted of cash and non-cash expenses farmers had to pay cash for the purchased inputs like hired labour, seeds, fertilizers, insecticides, fertilizers, irrigation charge, etc. It was easy to calculate the costs of these items. On the other hand, no cash was actually paid for home supplied inputs like family labour, tools and equipment, manures etc. In these cases, family supplied labour costs were estimated by applying the opportunity cost principle. Opportunity cost of an item is defined as an income, which an input is capable of earning in an alternative employment in or outside the farm (Bishop and Toussaint, 1958). The input items were valued at the existing market price in the area during survey period or the prices at which the farmers really bought the inputs. A list of cost items and their estimation procedure has been discussed under the following heads:

(a) Seed cost;
(b) Human labour cost;
(c) Fertilizer cost;
(d) Manures cost;
(e) Irrigation water cost;
(f) Insecticides and pesticides cost;
(g) Tillage cost;
(h) Tools and equipment cost;
(i) Interest on operating capital; and
(j) Land use cost.

#### 3.10.1 Cost of Seed

In the selected study region, the farmers used both family supplied and purchased seeds and seedlings of garlic and boro paddy. Family supplied seed were priced at the prevailing market price and the costs of purchased seed were priced on the basis of actual price paid by the farmers in the study region.

### 3.10.2 Cost of Human Labour

The most essential input in all kinds of production is human labour. It was mentioned earlier that garlic and boro paddy production was labour intensive. Human labour was required for different operations like seed bed preparation, seedling raise, land preparation, manuring, weeding, irrigating, harvesting and so on. It was classified into two categories, family labour and hired labour. Family labour consists of the farm operator himself and other family members. In determining family labour cost, actual man-days devoted by the workers were taken into account. Eight hours of work were equivalent to one man-day. Family labour cost was calculated by applying the principle of opportunity cost. The average wage of the hired labour was taken as the opportunity cost of the family labour. In pricing the labour no discrimination was made between the family and the hired labour. Family labour was priced at the prevailing wage paid in cash to hired labour. There was no fixed wage rate all over the season and different wage rates were found for different activities in different seasons.

### 3.10.3 Cost of Fertilizer

In the selected study region farmers used different kind of fertilizers for higher yield of garlic and boro paddy. They normally used Urea, Triple Super Phosphate (TSP), Murate of Potash (MOP), Di-Ammonium Phosphate (DAP) and Gypsum. Fertilizer costs represented the actual prices paid by the farmers including all incidental charges.

### 3.10.4 Cost of Manure

In the study region, farmers used cow-dung as manure in their garlic and boro paddy production. A large quantity of manure was supplied from the farmers' home. While some farmers bought cow-dung from the milk producers. The cost of cow-dung was priced at the prevailing market price.

### 3.10.5 Cost of Irrigation Water

In the study region most of the farmers used irrigation water for their garlic and boro paddy production. Shallow tube-well irrigation was widely applied in the study area. Some farmers had their own shallow tube-well to irrigate their crop field, while others bought

irrigation water from the shallow tube-well owners. In the study area, only one payment system was practiced; under this system farmer's had to pay cash taka for irrigation water charge per unit of land. The cost of irrigation water was estimated as the actual amount of money had to pay by the farmers in cash.

### 3.10.6 Cost of Insecticides and Pesticides

In the study region, most of the farmers used insecticides and pesticides for cultivation of garlic and boro paddy. Commonly used insecticides and pesticides were Thiovit, Furadan, Heptachlor, Dimecrone, Nogos, etc. The cost of insecticides and pesticides represented the amount of money, which the farmers actually paid to buy the items.

### 3.10.7 Tillage Cost

In the study region, all the sample farmers used power tiller for land preparation. They mainly used hired power tillers. A power tiller owner supplied fuel as well as driver for land preparation and laddering. Farmers used to pay a fixed rate as service charge for using power tiller. Generally, farmers used no passes for preparing garlic land and five to six passes for preparing boro paddy land. The wage rate of power tiller was considered as the actual amount of money paid by the farmers in cash.

### 3.10.8 Cost of Tools and Equipment

Tools and equipment were used in different operations. In the study area farmers used some simple farm implements such as country plough, ladder, spade, khurpi, Kanchi, basket etc. Separate cost of tools and equipment was not calculated. It should be noted that hired labour used their tools and equipment and did not charge for that. Since the family labour cost was estimated at the rate of hired labour, the cost of tools and equipment for a particular operation, therefore, was equal to wage rate. Similarly, the cost of tools and equipment concerning mechanical power was also included in the heading of cost of mechanical power. Rest of the cost of tools and equipment in producing garlic and boro paddy were very negligible and therefore, were ignored in the study.

### 3.10.9 Interest on Operating Capital (IOC)

Interest on operating capital was determined by taking all costs incurred on various operations in the process of cultivation of garlic or boro paddy excluding those for which interest was already calculated. Interest on operating capital was charged at the rate of 10 percent per annum and was estimated for the duration of six months for garlic and boro paddy. It was assumed that if the farmers borrowed the money from a bank, they had to pay interest at the same rate. It was estimated by using the following formula:

Interest on operating capital = AI*i*T

Where,

AI= (Total investment)/ 2

i = Rate of interest

T = Length of crop period in months

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

### 3.10.10 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) Valuation of land at its cash rental price per year; and
c) Forgoing income from the alternative use.

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

# CHAPTER 4
# DESCRIPTION OF THE STUDY AREA

## 4.1 Introduction

This chapter presents a brief description of the study area. Knowledge of the study area is very essential to understand the location, physical features and topography, soil type, temperature, rainfall, agricultural and economic condition, population, education and other socioeconomic infrastructure available in the area. This chapter aims at present the above-mentioned characteristics of the study area.

## 4.2 Location

The study was conducted on three villages namely Jogendronagar, Durgapur and Khubjipur under Gurudashpur Upazila of Natore district. The selected villages are situated around 9 km to the northwest of the Upazila headquarter. The selected villages are under the union council of Biaghat and Khubjipur. They are 1.5 km to the north from the Biaghat union council and in Khubjipur union council.

Natore district is bounded by Naogaon and Bogra districts on the north, Pabna and Kushtia districts on the south, Pabna and Sirajganj districts on the east, Rajshahi district on the west. Gurudashpur Upazila is situated 25 km east to the district head quarter. It is bounded by Singra and Tarash Upazilas on the north, Baraigran and Chatmohar Upazila on the south, Tarash and Chatmohar Upazila on the east, Natore Sadar and Baraigram Upazila on the west. The location of the study area is shown in Maps 4.1 and 4.2.

## 4.3 Physical Features, Topography and Soil Type

The study area belongs to the Agro-Ecological Zones of Lower Atrai Basin (AEZ-5) and Low Ganges River Flood Plain (AEZ-12). Most part of Natore district is plain land. Chalan Beel, the largest beel in Bangladesh is located in the study area. No mountains, hills or hillocks are found in the area. Gur and Atrai are flowing through the study area. Soils in AEZ-5 of Natore had pH 6.73±0.27, organic matter 1.89±0.20%, available P 31±26 ppm, exchangeable K 0.42±0.02 and available Zn 2.8±0.2 ppm.

n

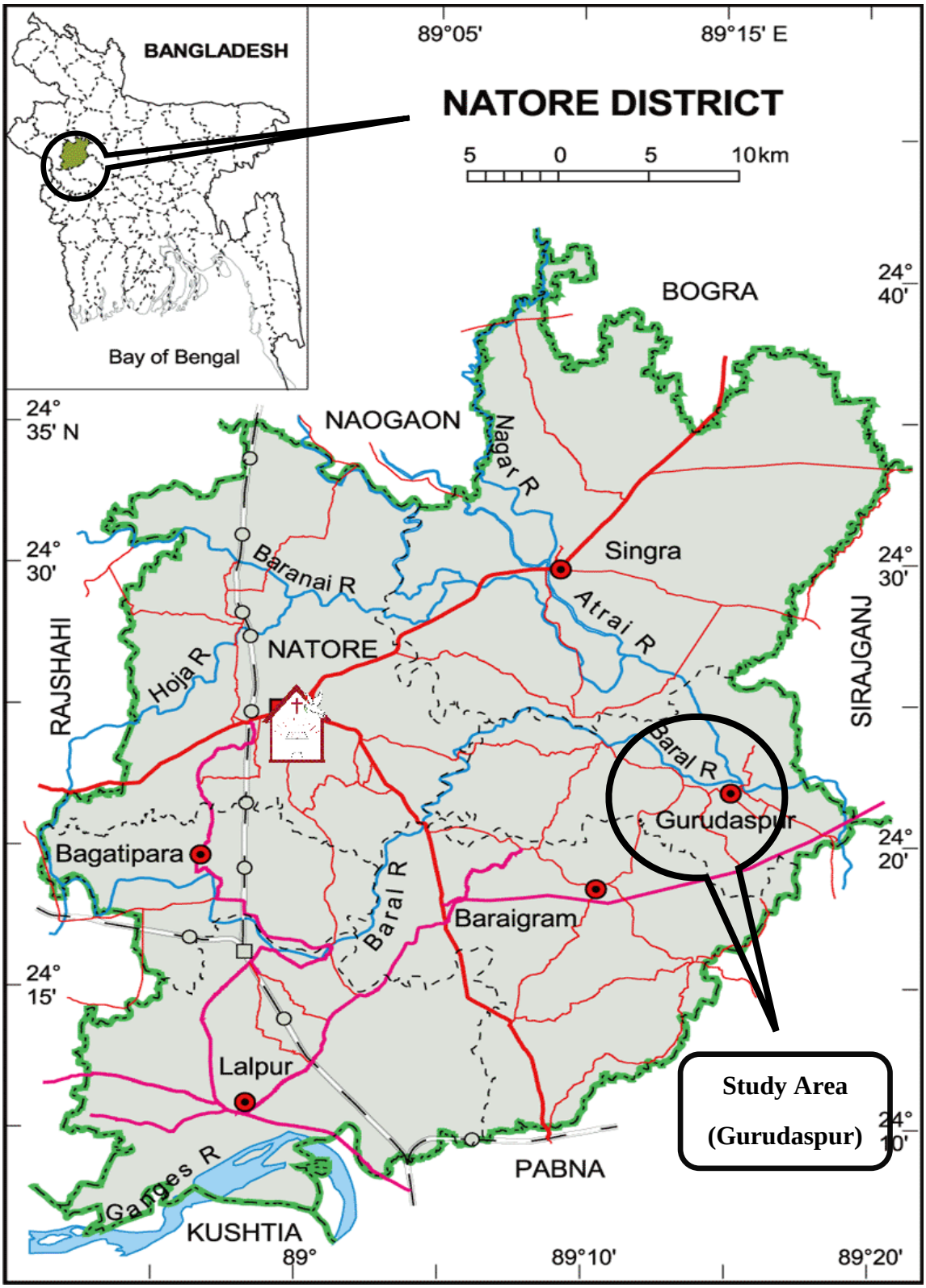


**Figure 4.1 Map of Natore District**

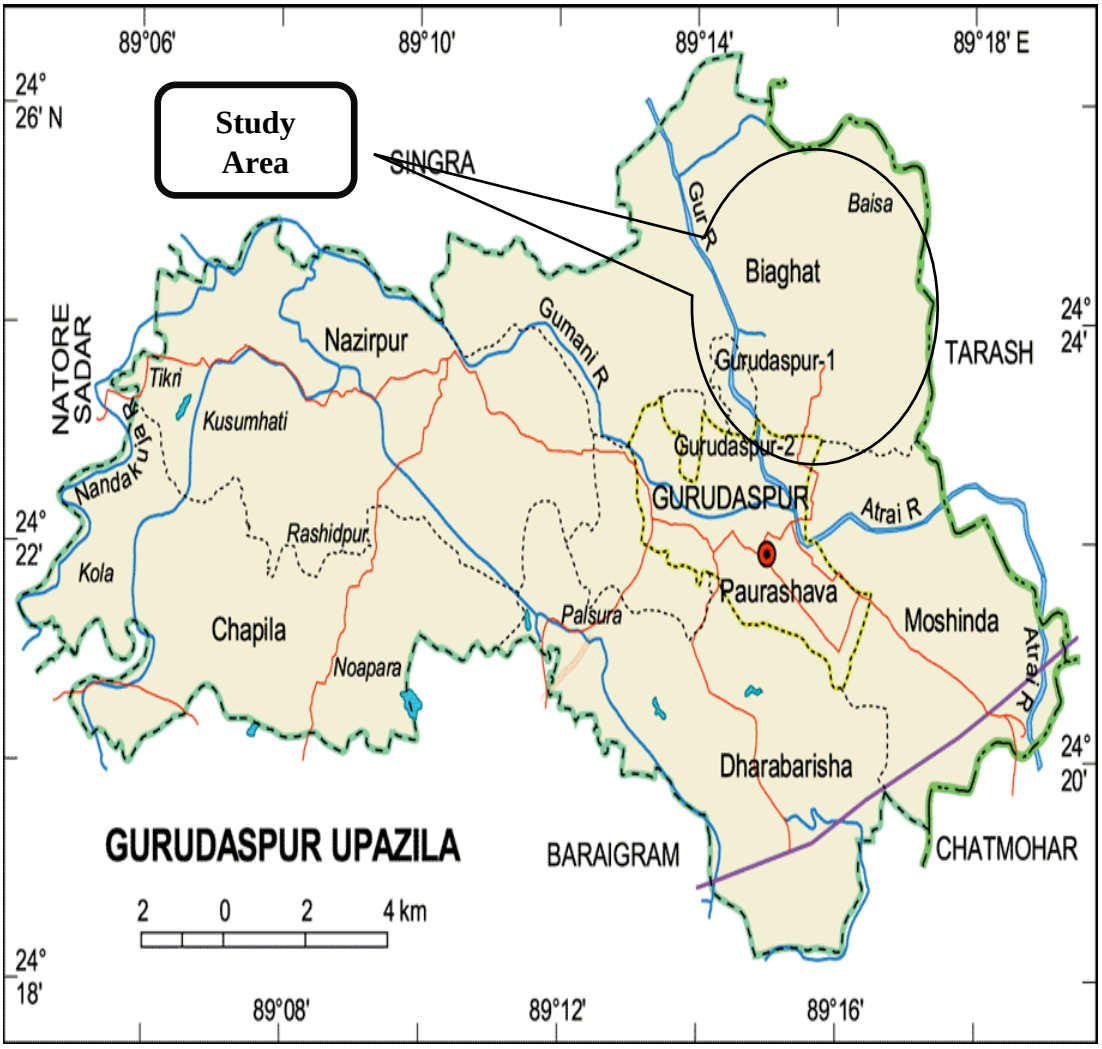


**Figure 4.2 Map of Gurudaspur Upazila**

**Table 4.1 Distributions of Agricultural Land Types (in hectare) of Natore District**

| Upazila | High land | Medium land | Low land | Total land |
|---|---|---|---|---|
| **Bagatipara** | 6543.36 | 3785.42 | 862.78 | 11191.58 |
| **Baraigram** | 8950.83 | 11368.83 | 4010.43 | 24330.11 |
| **Gurudaspur** | 2442.68 | 5640.50 | 4202.26 | 12285.44 |
| **Lalpur** | 4373.842 | 16000.05 | 999.57 | 21373.47 |
| **Nature Sadar** | 8869.89 | 19152.55 | 1104.79 | 29127.24 |
| **Singra** | 2241.15 | 17764.89 | 20561.67 | 40567.71 |
| **Total** | 33421.77 | 73712.27 | 31741.51 | 138875.56 |

Source: BBS, 2017

### 4.4 Area, Population and Household

Natore district is bounded on the north by Bogra and Noagaon districts, the east by Sirajganj and Pabna districts, the south by Pabna and Kushtia districts and the west by Rajshahi district. It lies between 24°25' & 24°58' north latitudes and between 88°01' & 88°30' east longitudes. The total area of the district is 1900.19 Sq.km. (733.66 Sq. miles) of which 6.56 Sq.km. covers forest area. The road distance from Natore to Dhaka is 220 kilometers. Lalpur is the lowest Average annual rainfall area of Bangladesh. Total area of Natore district is 1900.19 Sq. km of which 32.82 Sq.km. is riverine and 6.56 Sq.km. is reserve forest. In respect of area the district ranks 6th among the 8 districts of Rajshahi division. Total area, Effective land area and riverine area of Gurudaspur Upazila are 203.2 Sq.km. 195.93 Sq.km. and 7.0 Sq.km. respectfully. The Upazila covers 10.69 percent of the total area of Natore district (BBS, 2017).

**Table 4.2 Area, Population and Household in the Study Area**

| Study Area | Area (sq. km) | Population | Household |
|---|---|---|---|
| **Jogendronagar** | 4.10 | 4796 | 1598 |
| **Durgapur** | 1.93 | 7686 | 1970 |
| **Khubjipur** | 22.29 | 20832 | 5345 |
| **Gurudaspur** | 203 | 215000 | 55000 |
| **Natore** | 1900 | 1706000 | 434000 |

Source: Field Survey, 2018

According to the Population Census 2011, number of households in Natore district is 423875 which is 1.68 percent of total households of the country. The density of population is 898 per sq. km. The percentage of male and female is 50.06 and 49.94, respectively.

### 4.5 Climate

Yield of garlic and boro paddy largely depends upon the temperature, humidity, rainfall and day length. So it is very important to know the climatic condition of the study area. But there is no local arrangement for recording temperature, rainfall, and humidity in the study area. However, Ishwardi Meteorological Station provides data on climatic condition

of Natore district. The district is remarkable for its high temperature, humidity and coldness. Maximum and minimum mean temperature during winter varies from 24.4°C to 10.6°C. During the summer maximum and minimum mean temperature varies from 36.7°C to 25.3°C. The dry winter season starts from October and continues up to March. Summer comes from April and continues up to June.

The district annual rainfall data shows that it was 1584 mm in 2015 (Table 4.3). Monthly rainfall shows that it ranges from 0 mm to 394 mm (Table 4.4). Heavy rainfall occurs during monsoon while the rainfall is the lowest in January and December. Table 4.4 shows that highest rainfall usually occurred in July. Humidity range is around 65 percent (March) to 85 percent (July) in the study area (Table 4.6). The average rainfall of study area is less than the district average since the study area is located near Lalpur which is one of the areas experiencing the lowest rainfall in the country.

**Table 4.3 Annual Rainfall at Ishwardi Station 2007-15 (in Millimeter)**

| Name of Stations | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|
| **Ishwardi** | 1573 | 1304 | 1292 | 893 | 1736 | 1062 | 1129 | 1440 | 1584 |

Source: BBS, 2017

**Table 4.4 Monthly Rainfall at lshwardi Station (In Millimeter), 2015**

| Name of Stations | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ishwardi** | 0 | 8 | 38 | 111 | 147 | 332 | 394 | 254 | 213 | 82 | 3 | 2 |

Source: BBS, 2017

**Table 4.5 Average Maximum and Minimum Temperature (°C) in Selected Station**

| Name of Stations | 2011 | | 2012 | | 2013 | | 2014 | | 2015 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. | Max. | Min. |
| **Ishwardi** | 30.8 | 20.2 | 31.3 | 21.1 | 31.01 | 20.03 | 33.4 | 20.02 | 33.6 | 20.3 |

Source: BBS, 2017

**Table 4.6 Monthly Average Relative Humidity of 2016 by Ishwardi Station (in Percentage)**

| Name of Stations | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ishwardi** | 82 | 77 | 65 | 75 | 77 | 85 | 85 | 82 | 81 | 80 | 80 | 79 |

Source: BBS, 2017

### 4.6 Agriculture and Economic Condition

Agriculture of the selected villages was mainly based on crop production. The main crops of the study area were Paddy, wheat, mustard, onion, garlic, khesari (Cow pea), lentil etc. Moreover, different kinds of fruits and vegetables are grown in the study area. Livestock farming is another important source of income of the people of the study area. Fruits grown in the Upazila are Mango, jackfruit, guava, watermelon, papaya, litchi, wood apple, date etc. Varieties of fish are caught from rivers, Chalan Beel and paddy fields during the rainy season. Extinct or nearly extinct crops of the area are sesame, linseed, kaun, china and arahar.

### 4.7 Main Occupation

Agriculture is the main source of income of the people of the study area. A small number of people were engaged in service, business and rural transportation. The main occupation of the landless farmers was wage labour, van, petty business, fishing etc. In Gurudaspur Upaziala 41.98 percent people was engaged in agriculture, while this was 34 percent for Natore District.

### 4.8 NGO Activities

Micro credit has been playing a vital role in the development of the rural economy. In the study area some NGOs, have been operating their programme for several years. Operationally important NGOs of the study area were ASA, Shakti Foundation and Grameen Bank etc. They provide credit for poultry, livestock and fishery enterprise. Small and marginal farmers often get loan from those NGOs.

### 4.9 Transport, Communication and Marketing Facilities

Transport, communication and marketing facilities are the important infrastructures, which play a vital role in the agricultural as well as economic development of a country. Without these facilities, it becomes difficult to develop rural area because the introduction of modern technology becomes an impossible task. Among the study villages Jogendronagar and Durgapur are well communicated through pukka roads, Khubjipur is communicated through muddy road with the highways and surrounding markets. It has pucca road 78 km, semi-pucca road 5 km, muddy road 236 km and waterway 20 nautical miles. Anybody can reach the study area by van, engine-boat, bi-cycle, motorcycle and also by car. Farmers carry their product mainly by van. There are some local bazaars and big hats in the study area and around the study area. The hats are operated twice a week on different days. Farmers sell their product directly to those markets. The number of hats and bazars of Gurudaspur Upazila is 22. Chachkoir bazaar hat is the biggest and the most popular bazaar from all the other markets in Natore district.

# CHAPTER 5
# SOCIO-ECONOMIC CHARACTERISTICS OF SAMPLE FARMERS

## 5.1 Introduction

The aim of this chapter is to present a brief description of the socio-economic characteristics of the sample farmers. Socioeconomic aspects of the farmers can be looked upon from different points of view depending on a number of variables related to their standard of living, the socio-economic environment in which they live and the nature and the extent of the farmers' participation in national development activities. It was not possible to collect all the information regarding the socio-economic characteristics of the sample farmers due to limitation of time and resources. Socio-economic characteristics of the farmers affect their production pattern. The decision-making behaviour is also determined to a large extent by it. It affects the adoption of innovations. The socio-economic background of the sample farmers particularly the family size and composition, literacy level, occupation, land ownership pattern and its distribution etc. are discussed in this section.

## 5.2 Composition of the Family Size

Family size is important in every aspect of society and the relation to production of enough food grain for farm family. In this study, family has been defined as the total number of persons living together and taking meals from the same kitchen under the control of one head of the family. The family members considered as wife, sons, unmarried daughters, father, mother, brothers and other relatives who live permanently in the family.

**Table 5.1 Average Family Size and Distribution of Members According to Sex of the Sample Farmers**

| Particulars | Garlic Growers | | Boro paddy Growers | | All Farmers | |
|---|---|---|---|---|---|---|
| | Number | Percent | Number | Percent | Number | Percent |
| **Male** | 2.4 | 62.02 | 2.33 | 59.29 | 2.36 | 60.51 |
| **Female** | 1.47 | 37.98 | 1.6 | 40.71 | 1.54 | 39.49 |
| **Total** | 3.87 | 100 | 3.93 | 100 | 3.9 | 100 |

Source: Field Survey, 2018

The average family sizes for garlic and boro paddy growers were 3.87 persons and 3.93 persons respectively. For garlic growers 62.02 percent members were male and 37.98 percent members were female. On other hand in the case of and boro rice growers 59.29 percent were male and 40.71 percent were female. The average family size was 3.9 people in all groups, which is lower than the national family size 4.5.

### 5.3 Age Distribution of the Farm Families

Age of garlic and boro paddy farm family members was calculated from their birth to the time of the interview. Farm family members were grouped into three categories according to their ages (Table 5.2). In case of garlic, it can be seen from the table that 23.27 percent family members belonged to the age group below 15 years, 74.14 percent family members were in the age group between 15 -59 years and only 2.59 percent of the family members were above 59 years of age. In case of boro paddy, it can be seen from the table that 15.25 percent family members belonged to the age group below 15 years, 79.66 percent family members were in the age group between 15-59 years and only 5.09 percent of the family members were above 59 years of age. In both garlic and boro paddy farm families the highest number of family members were in the age group between 15 to 59 years and the lowest number of family members belonged to the age group of above 59 years (Table 5.2). It is revealed that most of the family members are in active group.

**Table 5.2 Distribution of Family Members by Age Groups**

| Age Groups (Years) | Garlic Growers | | Boro paddy Growers | | All Farmers | |
|---|---|---|---|---|---|---|
| | Number | Percent | Number | Percent | Number | Percent |
| **Below 15** | 27 | 23.27 | 18 | 15.25 | 45 | 19.23 |
| **15-59** | 86 | 74.14 | 94 | 79.66 | 180 | 76.92 |
| **Above 59** | 3 | 2.59 | 6 | 5.09 | 9 | 3.85 |
| **Total** | 116 | 100 | 118 | 100 | 234 | 100 |

Source: Field Survey, 2018

### 5.4 Educational Status of Farm Families

Education has a great impact on and it contributes to economic and social development, as commonly known that education is the backbone of a nation. It plays a vital role in the acquisition of information about the innovation in various production processes of agriculture sector. Education helps every person to make right decision regarding his farm production and farm business. It makes a man more capable of managing scarce resources and hence to earn maximum profit (Miah, 1990). The educational status of garlic and boro paddy farm family members is given in Figure 5.3.

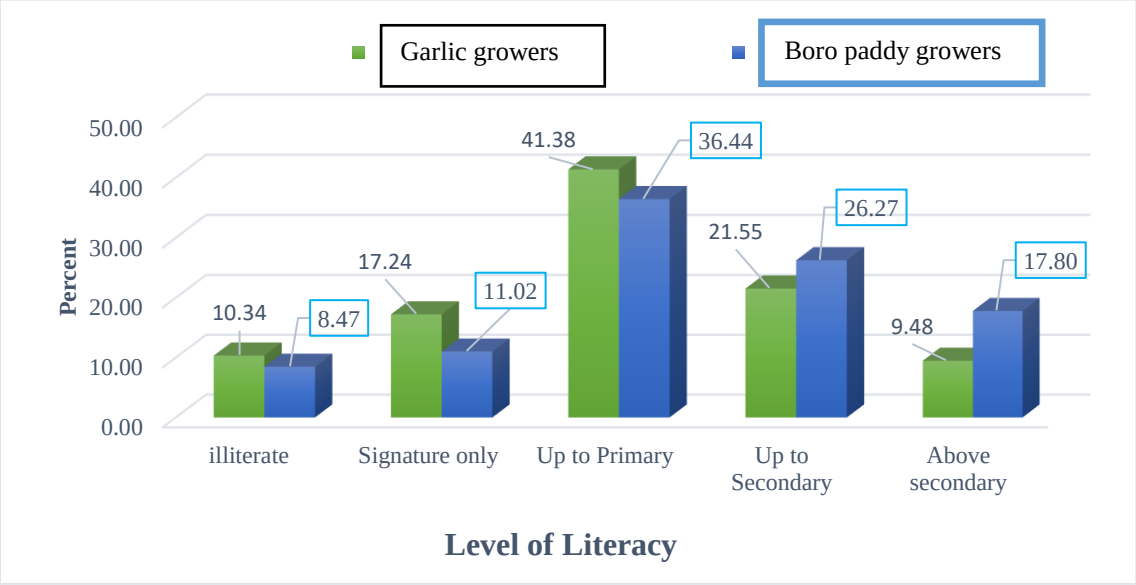


**Figure 5.1 Educational Statuses of the Farm Families**

Source: Field Survey, 2018

In case of garlic farm families, it can be seen from the figure 5.1, that 10.34 percent family members were illiterate, 17.24 percent were capable to sign, 41.38 percent had primary education, 21.55 percent had secondary education and 9.48 percent had higher secondary education and above.

In case of boro paddy farm families, it can be seen from the above figure that 8.47 percent family members were illiterate, 11.02 percent were capable to sign, 36.44 percent had primary education, 26.27 percent had secondary education and 17.80 percent had higher secondary education and above. Moreover, it was found that literacy rate of garlic and boro paddy farm families were 89.65 percent and 91.53 percent, respectively. It indicates that literate farmers are involved in production process.

### 5.5 Annual Household Income of the Respondents

Annual household income of the respondents included all the incomes of the all family members from different income source like field crops, livestock rearing, business, services, foreign remittance and others. On the basis of annual income, farmers were classified into three categories arbitrarily as 'low', 'medium' and 'high' annual income category. A family's income below Tk. 150000 per year is considered as a low income Tk.150000-250000 as medium income and above Tk. 250000 as high income family, respectively. The distribution of farmers according to their income is presented in Table 5.5.

**Table 5.3 Distribution of Annual Household Income**

| Category | Basis of categorization ('000' Tk.) | Garlic Growers | | Boro paddy Growers | |
|---|---|---|---|---|---|
| | | Number | Percent | Number | Percent |
| Low income | ≤ 150 | 6 | 20 | 8 | 26.67 |
| Medium income | 150-250 | 13 | 43.33 | 15 | 50 |
| High income | > 250 | 11 | 36.67 | 7 | 23.33 |
| Total | | 30 | 100 | 30 | 100 |

According to the table 5.5 among the garlic growers 20 percent are low income, 43.33 percent are medium income and 36.67 percent are high income category. And for boro growers 26.67 percent are low income, 50 percent are medium income and 23.33 percent are high income group. Here garlic farmers are comparatively higher income generating then boro paddy farmers.

### 5.6 Occupational Status of the Sample Farmers Family

The selected farmers of the study area were engaged in various types of occupations, although agriculture was the main source of employment for the people of the study area. The work in which a person engaged throughout the year is known as the main occupation of that person. Besides agriculture, some farmers were engaged in small enterprise; some were engaged in services like government, semi-government, non-government organization schools, madras has; some of them were engaged in rural non-farm activities like, weaving, rural transportation, shop keeping and other wage earning activities. The occupational status of the farmers has been categorized into ten groups as is shown in Figure 5.2 and Figure 5.3.

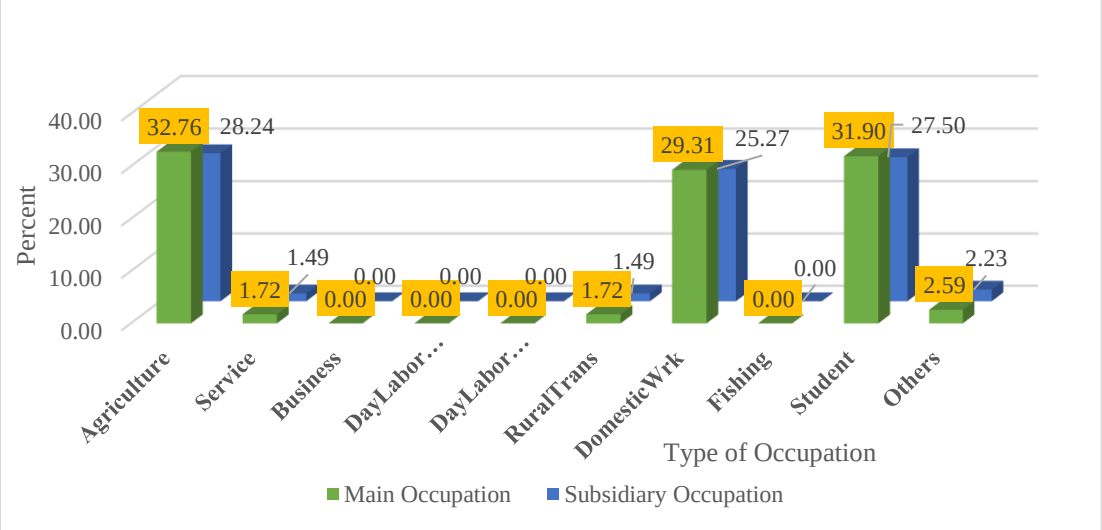


**Figure 5.2 Occupation Types of Garlic Grower's Family Members**

Source: Field Survey, 2018

It is shown from the figure 5.2 that in case of garlic growers, 32.76 percent of the farmer's family members were engaged in agriculture as their main occupation and 28.24 percent as their subsidiary occupation.

While 1.72 percent, 1.72 percent, 29.31percent, 31.90 percent and 2.59 percent farmer's family members were involved in service, rural transportation, domestic services, students, others respectively as their main occupation.

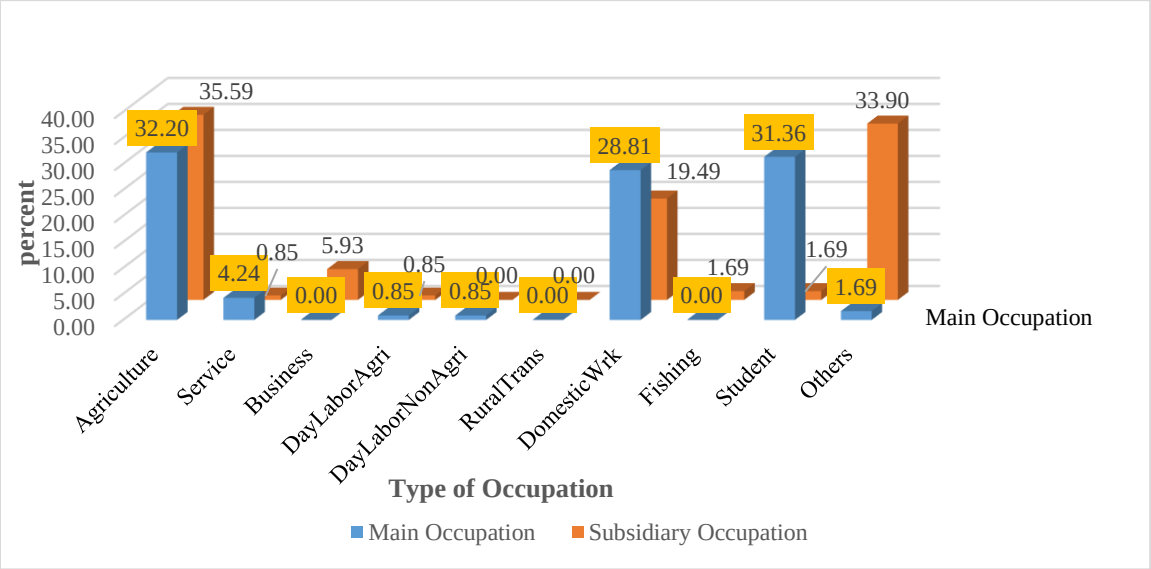


**Figure 5.3 Occupation Types of Boro Paddy Grower's Family Members**

Source: Field Survey, 2018

From the figure 5.3 it is shown that, for boro paddy growers, 32.20 percent of the farmer's family members were engaged in agriculture as their main occupation and 35.59 percent as their subsidiary occupation. While 4.24 percent, 0.85 percent, 0.85 percent, 28.81 percent, 31.36 percent and 1.69 percent farmer's family members were involved in service, day labour agriculture, day labour non-agriculture, domestic works, students, others respectfully as their main occupation.

### 5.7 Land Distribution Pattern

Land tenure refers to the possession of and right to the use of land. People hold varying kind of rights in the use of land and are said to belong to the different tenure classes (Bishop and Toussaint, 1958). According to Yang (1965), farm size is being computed by the entire land operated by the fanners. It is computed by adding the area rented and mortgaged in

from others and deducting the area rented and mortgaged out to and leased out to others. Therefore, farm size can be measured by using the following formula:

Farm Size = Own Land (Crop Land+ Homestead + Orchard + Pond) + Rented in + Mortgaged in - (Rented out + Mortgaged out).

**Table 5.4 Average Land Distribution of the Sample Farmers**

| Category of Land | Garlic Growers | | Boro Rice Growers | |
|---|---|---|---|---|
| | Area per ha | Percent | Area per ha | Percent |
| **Crop Land** | 0.88 | 92.63 | 1.52 | 93.25 |
| **Orchard** | 0 | 0 | 0.02 | 1.23 |
| **Homestead** | 0.06 | 6.32 | 0.07 | 4.29 |
| **Ponds** | 0.01 | 1.05 | 0.02 | 1.23 |
| **Total** | 0.95 | 100 | 1.63 | 100 |

Source: Field Survey, 2018

It appears from Table 5.3 that the average farm size of garlic and boro paddy growers was 0.95 ha and 1.63 ha, respectively. Crop land area of garlic and boro paddy growers were 92.63 percent and 93.25 percent, respectively to the total land area, orchard area were 0 percent and 1.23 percent, homestead area were 6.32 percent and 4.29 percent and ponds area were 1.05 percent and 1.23 percent respectively to the total land area.

### 5.8 Concluding Remarks

From the above discussions it is clear that there are some variations in socioeconomic characteristics between the garlic and boro paddy growers. But the magnitude of the variations was not large. As the same locality all the socio-economic profile looks very similar between garlic and boro cultivar. There are substantial indications suggesting that both garlic and boro paddy growers were progressive.

# CHAPTER 6
# COMPARATIVE PROFITABILITY ANALYSIS OF GARLIC AND BORO PADDY

## 6.1 Introduction

The costs, returns and profitability of garlic and boro paddy production are projected in this section. For calculating the costs and returns of garlic and boro paddy production, the costs items were classified into two groups; (i) variable cost; and (ii) fixed cost. Variable cost included the cost of all variable factors like seed, human labour, tillage, fertilizer and manure, irrigation and insecticides and pesticides. On the other hand, fixed cost was calculated for land use cost and interest on operating capital. On the return side, gross return, gross margin, net return, and undiscounted benefit cost ratio (BCR) were determined in this section.

## 6.2 Variable Cost

### 6.2.1 Cost of Seed

Cost of seed of garlic and boro paddy varies depending upon the quality and availability of seeds. It can be seen from Table 6.3 that per hectare use of garlic seed was 804.4 kg and average cost of garlic seed per hectare was estimated Tk. 35307 per hectare use of boro paddy seed was 41.06 kg and average cost of rice seed per hectare was estimated Tk. 1471 (Table 6.4). Seed cost constituted 12.69 and 1.13 percent of total cost of producing garlic and boro paddy, respectively. It was clear that cost of seed was relatively higher for garlic than that of boro paddy.

### 6.2.2 Cost of Human Labour

Human labour was the most important and largely used input in producing both garlic and boro paddy production. It shared a large portion of total cost of garlic and boro paddy production. For human labour calculating both hired and home supplied labour are counted. It can be seen from Table 6.1 that the amount of human labour used for garlic cultivation was 357.05 man-days per hectare. While it was 130.33 man-days per hectare for boro production (Table 6.2) Total cost of human labour was estimated Tk.111353 and

Tk. 50841 covering 40.04 and 38.97 percent of total cost of garlic and boro paddy production, respectively (Tables 6.3 and 6.4).

**Table 6.1 Operation Wise per Hectare Human Labour Cost of Garlic Cultivation**

| Operations | Total Labour (Man-days) | Total Cost (Tk.) | Percentage of Total Cost |
|---|---|---|---|
| Land Preparation | 26.93 | 8080 | 7.26 |
| Seedling Plantation | 123.47 | 37040 | 33.26 |
| Fertilizer, Manure and Pesticide Application | 7.07 | 1413.33 | 1.27 |
| Weeding and Mulching | 75.73 | 18933.33 | 17 |
| Harvesting and Transporting | 96.93 | 33926.67 | 30.47 |
| Drying, Sorting and Storage | 39.86 | 11960 | 10.74 |
| Total | 357.05 | 111353.3 | 100 |

Source: Field Survey, 2018

Regarding the operation wise distribution of human labour, it was found that the highest percentage of human labour was employed for seed plantation, while fertilizer, manure and pesticide application constituted the lowest percentage of human labour use for garlic production (Table 6.1). Regarding the operation wise distribution of human labour, it was found that the highest percentage of human labour was employed for harvesting, while fertilizer, manure and pesticide application constituted the lowest percentage of human labour use for boro paddy production (Table 6.2).

### 6.2.3 Cost of Fertilizer

It was found that farmers used different kind of fertilizers in producing their enterprises. Commonly used fertilizers were Urea, TSP, MOP, Gypsum. They also used newly introduced fertilizer like DAP. DAP was used garlic cultivation rather than TSP and in boro paddy cultivation farmers used TSP. There were some variations in the application of fertilizers between enterprises. It can be seen from Table 6.3 that per hectare use of Urea, DAP, MOP, Gypsum and ZnSO4 for garlic production were 355.33 kg, 257.6 kg, 176 kg,

54.8 kg and 6kg whose costs were estimated at Tk. 5685, Tk. 7780, Tk. 2640, Tk. 548 and Tk. 1200, respectively. Per hectare use of Urea, TSP, MOP, Gypsum and ZnSO4 for boro production were 224.32 kg, 157.24 kg, 124.49 kg, 60.95 kg and 4.71 kg whose costs were Tk. 3589, Tk. 3774, Tk. 1799, Tk. 609, and Tk. 943, respectively (Table 6.4). It was found that farmers paid the highest percentage (39.47 percent) of fertilizer cost for DAP and lowest percentage (2.78 percent) of fertilizer and manure cost for Gypsum for garlic production (Figure 6.1) and they paid the highest percentage (38.19 percent) of fertilizer cost for TSP and lowest percentage (3.6 percent) of fertilizer and manure cost for Gypsum for boro paddy production (Figure 6.2).

**Table 6.2 Operation Wise per Hectare Human Labour Cost of Boro Paddy Cultivation**

| Operations | Total Labour (Man-days) | Total Cost (Tk.) | Percentage of Total Cost |
|---|---|---|---|
| Seed Bed Preparation | 11.79 | 4126.38 | 8.12 |
| Seedling Preparation | 8.19 | 2866.16 | 5.64 |
| Land Preparation | 8.51 | 2977.69 | 5.86 |
| Transplanting | 18.74 | 7494.4 | 14.74 |
| Fertilizer, Manure and Pesticide Application | 4.49 | 1347.85 | 2.65 |
| Weeding | 24.66 | 8631.95 | 16.98 |
| Harvesting | 36.36 | 16360.55 | 32.18 |
| Threshing and Storing | 17.59 | 7035.56 | 13.84 |
| Total | 130.33 | 50841 | 100 |

Source: Field Survey, 2018

### 6.2.4 Cost of Manure

It was observed in the present study area that farmers used cow dung for producing their enterprises. They bought a large portion of cow dung from the milk producers. It was found that cow dung application was 10 gari and 4.07 gari per hectare for garlic and boro paddy production, respectively. According to the respondent farmer, 1 gari cow dung equivalent

to almost 200 kg. And the cost of cow dung for garlic and boro paddy production was Tk. 3000 and Tk. 1224 (Table 6.4).

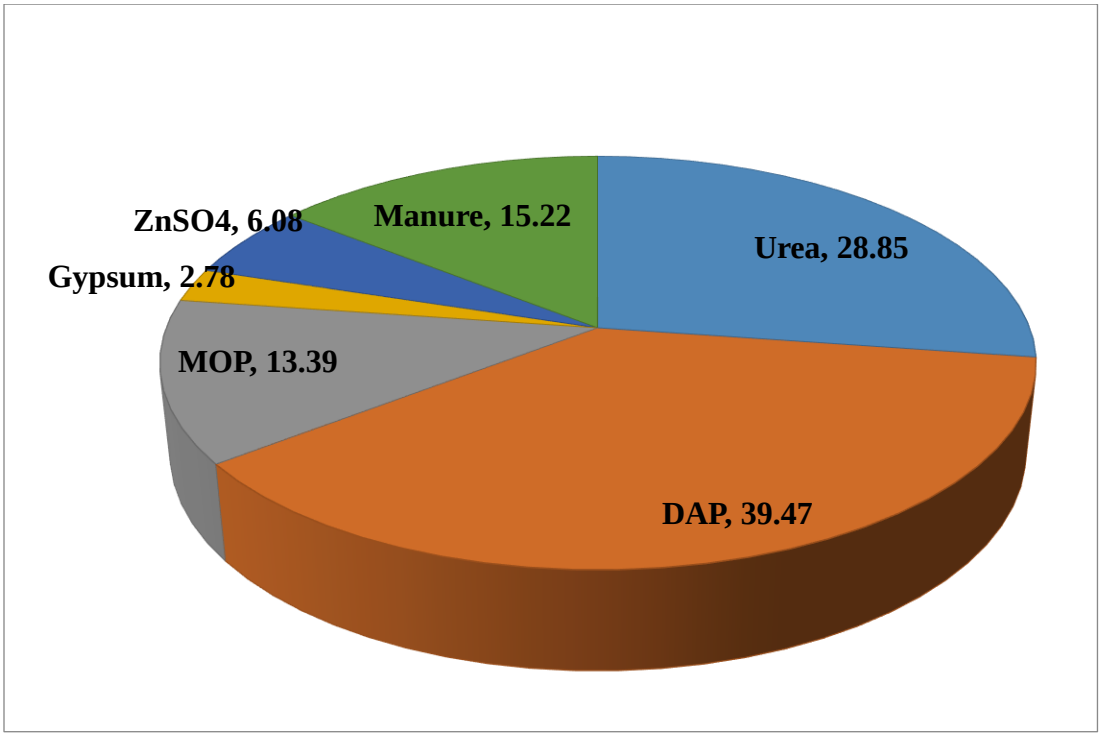


**Figure 6.1 Percentages of Fertilizer and Manure Cost for Garlic Cultivation**

Source: Field Survey, 2018

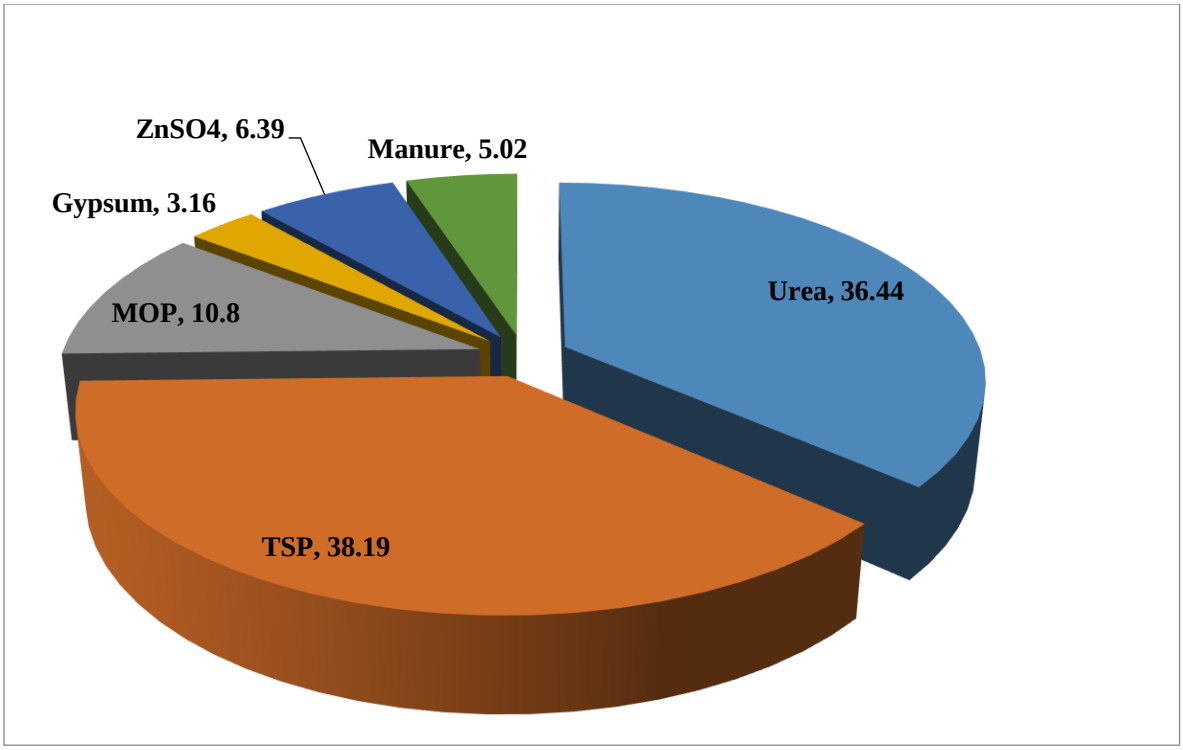


**Figure 6.2 Percentages of Fertilizer and Manure Cost for Boro Paddy Cultivation**

Source: Field Survey, 2018

### 6.2.5 Cost of Irrigation Water

Irrigation is considered as the leading input of production. Right doses application of irrigation water help to increase bulb diameter, number of cloves, number of leaves, and plant height. As a result, yield per hectare is being increased. It appears from Tables 6.3 and 6.4 that per hectare cost of irrigation water of garlic and boro paddy production was Tk. 9104 and Tk. 22324 covering 3.3 and 17.11 percent of total cost, respectively. For boro paddy it is slightly lower irrigation cost than the national level. The respondent farmers used surface water for irrigation from Chalan Beel area for their boro cultivations.

### 6.2.6 Cost of Insecticides and Pesticides

Garlic and boro paddy growers used different kinds of insecticides and pesticides to keep their crop free from diseases. It was found that per hectare cost of insecticides and pesticides for garlic and boro paddy production were Tk. 2709 and Tk. 1537 covering 0.97 and 1.18 percent of total cost, respectively (Table 6.3, Table 6.4).

### 6.2.7 Tillage Cost

In the study area power tiller has widely been used. Table 6.4 shows that per hectare power tiller cost of boro paddy production was Tk. 5495. While there was no cost for garlic production in this purpose. Tillage cost covered 4.21 percent of total cost of producing boro paddy.

## 6.3 Fixed Costs

### 6.3.1 Interest on Operating Capital (IOC)

It may be noted that the interest on operating capital was calculated by taking into account all the operating costs incurred during the production period of garlic and boro paddy. Per hectare interest on operating capital was Tk. 4355 and Tk. 3816 for garlic and boro paddy production, respectively (Tables 6.3 and 6.4).

### 6.3.2 Land Use Cost

Land use cost was a fixed cost for garlic and boro paddy production. Average rental value of land per hectare for the study year was considered as land use cost. Per hectare value was estimated at Tk. 36292 for both garlic and Tk.31798 boro paddy growers. Land use cost covered 16.12 and 20.47 percent of total cost of garlic and boro paddy production, respectively (Tables 6.3 and 6.4).

**Table 6.3 Per Hectare Costs and Return of Garlic**

| Cost Items | Quantity (unit) | Price Per unit (Tk.) | Value(Tk.) | Percentage of Total |
|---|---|---|---|---|
| A. Gross Return | 9485.32 | 28.94 | 274464 | |
| Variable Cost | | | | |
| Seed | 804.4 | 45.31 | 35307 | 12.69 |
| Human Labor | 370 | 305.71 | 113113 | 40.04 |
| Urea | 355.33 | 16 | 5685 | 2.04 |
| DAP | 257.6 | 30 | 7780 | 2.80 |
| MOP | 176 | 15 | 2640 | 0.78 |

| Cost Items | Quantity (unit) | Price Per unit (Tk.) | Value(Tk.) | Percentage of Total |
|---|---|---|---|---|
| Gypsum | 54.8 | 10 | 548 | 0.19 |
| $ZnSO_4$ | 6 | 200 | 1200 | 0.43 |
| Manure | 10 | 300 | 3000 | 1.08 |
| Total Fertilizer and Manure | | | 19708 | 7.49 |
| Irrigation Charge | | | 9104 | 3.3 |
| Insecticides and Pesticides | | | 2709 | 0.97 |
| B. Total Variable Cost | | | 179940 | 79.89 |
| Fixed Cost | | | | |
| Interest on Operating Capital | | | 4355 | 3.99 |
| Land Use Cost | | | 36292 | 16.12 |
| C. Total Fixed Cost | | | 40647 | 20.11 |
| D. Total Cost (B+C) | | | 220587 | 100 |
| E. Gross Margin (A-B) | | | 94524 | |
| Net Return (A-D) | | | 53877 | |
| G. BCR | | | 1.24 | |

Source: Field Survey (2018)

### 6.4 Total Cost

In order to estimate total cost per hectare all the resources used in garlic and boro paddy production has been recaptured together. It can be seen from Tables 6.3 and 6.4 that per hectare total cost of production of garlic and boro paddy were Tk. 220587 and Tk. 130444 respectively.

### 6.5 Yield and Gross Return

Per hectare average yield of garlic and boro paddy were estimated 7651.94 kg and 9485.32 kg, respectively. Gross return per hectare was calculated by multiplying the total amount of products by average farm gate price. By product was included for boro paddy production. Per hectare gross return of garlic and boro paddy was Tk. 274464 and

Tk.137828, respectively (Tables 6.3 and 6.4). Figure 6.3 shows that per hectare gross return of garlic were higher than that of boro paddy.

### 6.6 Gross Margin

Gross margin is the gross return over variable cost. Gross margin is obtained by deducting total variable cost from gross return. Per hectare gross margin was estimated Tk. 94524 and Tk. 42751 for garlic and boro paddy, respectively (Tables 6.3 and 6.4). It is evident from Figure 6.3 that gross margin of garlic was higher than that of boro paddy.

### 6.7 Net Return

Net return is a very useful tool to analyze or compare performance of enterprises. It is calculated by subtracting total cost from total return. Per hectare net return of garlic and boro paddy were Tk. 53877 and Tk. 7383, respectively (Tables 6.3 and 6.4). Figure 6.3 shows that per hectare net return of garlic were higher than that of boro paddy.

**Table 6.4 Per Hectare Costs and Return of Boro Paddy**

| Cost Items | Quantity | Price Per Unit (Tk.) | Value (Tk.) | Percentage of Total |
|---|---|---|---|---|
| A. Gross Return | | | 137828 | |
| Product | 7651.94 | 17.03 | 130311 | |
| By Product | | | 7517 | |
| Variable Cost | | | | |
| Seed | 41.06 | 35.83 | 1471 | 1.13 |
| Human Labor | 130.32 | 390.12 | 50841 | 38.97 |
| Tillage Cost | | | 5495 | 4.21 |
| Urea | 224.32 | 16 | 3589 | 2.75 |
| TSP | 157.24 | 24 | 3774 | 2.89 |
| MOP | 124.49 | 15 | 1799 | 1.38 |
| Gypsum | 60.95 | 10 | 609 | 0.47 |
| $ZnSO_4$ | 4.71 | 200 | 943 | 0.72 |

| Cost Items | Quantity | Price Per Unit (Tk.) | Value (Tk.) | Percentage of Total |
|---|---|---|---|---|
| Manure | 4.07 | 300 | 1224 | 0.94 |
| Total Fertilizer and Manure | | | 11938 | 9.15 |
| Irrigation Charge | | | 22324 | 17.11 |
| Insecticides and Pesticides | | | 1537 | 1.18 |
| B. Total Variable Cost | | | 94831 | 72.70 |
| Fixed Cost | | | | |
| Interest on Operating Capital | | | 3816 | 2.93 |
| Land Use Cost | | | 31798 | 24.38 |
| C. Total Fixed Cost | | | 35614 | 27.30 |
| D. Total Cost (B+C) | | | 130444 | 100 |
| E. Gross Margin (A-B) | | | 42751 | |
| Net Return (A-D) | | | 7383 | |
| G. BCR | | | 1.06 | |

Source: Field Survey, 2018

### 6.8 Benefit Cost Ratio (Undiscounted)

Benefit cost ratio (BCR) is a relative measure, which is used to compare benefit per unit of cost. In the study, BCR of garlic and boro paddy was calculated as a ratio of gross return and gross cost. Undiscounted Benefit cost ratio of garlic and boro paddy production per hectare came out to be 1.24 and 1.06 respectively, which implies that Tk. 1.24 and Tk. 1.06, respectively for corresponding crop will be achieved by expending every Tk. 1 (Tables 6.3 and 6.4).

### 6.9 Comparative Profitability of Garlic and Boro Paddy

In this section, a comparison has been made to assess per hectare relative profitability of growing garlic and boro paddy. The summary results having per hectare yield, gross return, gross margin, net return and BCR of garlic and boro paddy were presented in Table 6.5. It is evident that both garlic and boro paddy enterprises were profitable. Moreover, garlic cultivation was more profitable than boro paddy cultivation (Table 6.5 and Figure 6.3).

**Table 6.5 Comparative Cost and Return of Garlic and Boro Paddy Farming**

| Particulars | Garlic (per ha) | Boro Paddy (per ha) |
|---|---|---|
| Average Yield (kg) | 9485.32 | 7651.94 |
| Gross Return (Tk.) | 274464 | 137828 |
| Total Variable Cost (Tk.) | 179940 | 94831 |
| Fixed Cost (Tk.) | 40647 | 35614 |
| Total Cost (Tk.) | 220587 | 130444 |
| Gross Margin (Tk.) | 94524 | 42751 |
| Net Return (Tk.) | 53877 | 7383 |
| BCR (Undiscounted) | 1.24 | 1.06 |

Source: Adapted from Tables 6.3 and 6.4.

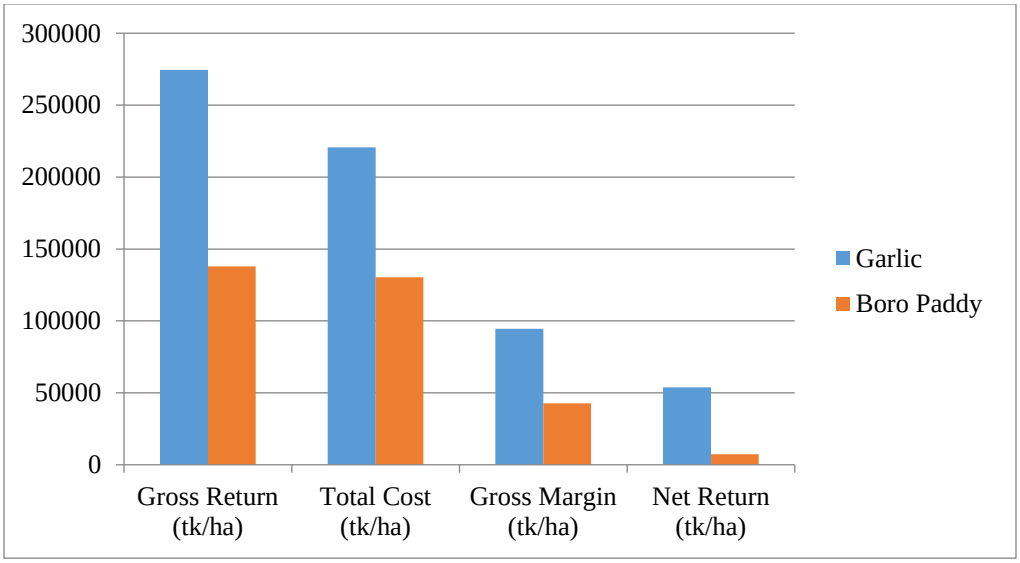


**Figure 6.3 Gross Cost, Gross Return, Net Return and Gross Margin of Garlic and Boro Paddy Production**

Source: Field Survey, 2018

## 6.10 Concluding Remarks

On the basis of above discussions, it could thoughtfully be concluded here that cultivation of both garlic and boro paddy were profitable. However, cultivation of garlic was more profitable than that of boro paddy. Cultivation of both garlic and boro paddy would help growers to increase their income earnings.

# CHAPTER 7
# FACTORS AFFECTING THE PRODUCTION PROCESSES OF GARLIC AND BORO PADDY

## 7.1 Introduction

The focus of this chapter is to identify and measure the effects of some important variables of production on gross return of garlic and boro paddy in the framework of production function analysis. For the purpose Cobb-Douglas production function model, as stated in Sub-section 3.9.3, has been chosen to determine the effects of selected variables on garlic and boro paddy production.

## 7.2 Functional Analysis

Production function is a relation (or mathematical function) specifying the maximum output that can be produced with given inputs for a given level of technology. It applies to a firm or as an aggregate production function to the economy as a whole (Samuelson and Nordhaus, 1995).

Considering the effects of explanatory variables on yield of boro paddy, six explanatory variables namely, seed cost ($X_1$), human labour ($X_2$), fertilizer and manure cost ($X_3$), irrigation cost ($X_4$), insecticides and pesticides cost ($X_5$), tillage cost ($X_6$), were chosen as key independent factors to estimate the quantitative effect of inputs on yield of boro paddy. And for garlic tillage cost were excluded. All these variables have been estimated as per hectare monetary values. However, other important variables such as management, land quality, soil type, sowing time and weather, etc. were excluded in the analysis due to paucity of reliable data.

To explore the input output relationships production function were fitted in all the locations of possible statistical forms, Cobb-Douglas production function, most popular in farm management analysis, was used as this algebraic model provides a compromise between (a) adequate fit of the date, (b) computation feasibility, and (c) sufficient degrees of freedom unused to allow for statistical testing.

Another special advantage of using Cobb-Douglas production function was that the regression under OLS in logarithm, yields coefficients which represents partial elasticities of production and if all the inputs related to the production are taken into account, the sum of the elasticities indicates whether the production process as a whole yields increasing, constant or decreasing returns to scale. In fact, it is widely used by many researchers in their economic studies. The advantages of the model are that it is simple to calculate and the elasticity of production can directly be obtained from the coefficient.

For Garlic, the following Cobb-Douglas production function was used in the present study:

$$Y_i = \alpha X_{1i}^{\beta 1} X_{2i}^{\beta 2} X_{3i}^{\beta 3} X_{4i}^{\beta 4} X_{5i}^{\beta 5} e^{ui}$$

By taking log in both sides the Cobb-Douglas production function was transformed into the following logarithmic form because it could be solved by the ordinary least square (OLS) method:

$$In\ Y_i = In\ \alpha + \beta_1 In\ X_{1i} + \beta_2\ In\ X_{2i} + \beta_3\ In\ X_{3i} + \beta_4\ In\ X_{4i} + \beta_5\ In\ X_{5i} + u_i$$

For boro paddy, the following Cobb-Douglas production function was used in the present study:

$$Y_i = \alpha X_{1i}^{\beta 1} X_{2i}^{\beta 2} X_{3i}^{\beta 3} X_{4i}^{\beta 4} X_{5i}^{\beta 5} X_{6i}^{\beta 6} e^{ui}$$

By taking log in both sides the Cobb-Douglas production function was transformed into the following logarithmic form because it could be solved by the ordinary least square (OLS) method:

$$In\ Y_i = In\ \alpha + \beta_1 In\ X_{1i} + \beta_2\ In\ X_{2i} + \beta_3\ In\ X_{3i} + \beta_4\ In\ X_{4i} + \beta_5\ In\ X_{5i} + \beta_6\ In\ X_{6i} + u_i$$

Where,

Y = Gross return (Tk./ha)

*In* α = Constant or intercept of the function

$X_1$ = Seed cost (Tk./ha)

$X_2$= Human labor cost (Tk./ha)

$X_3$= Fertilizer and manure cost (Tk./ha)

$X_4$= Irrigation cost (Tk./ha)

$X_5$= Insecticides and pesticides cost (Tk./ha)

$X_6$= Tillage cost (Tk./ha)

$\beta_1, \beta_2 \ldots\ldots\ldots\ldots, \beta_6$ = Coefficient of respective variables

Ln= Natural logarithm

i= 1,2, 3……, n(n=30)

$e$ = Base of natural logarithm

$u_i$=Error term.

### 7.3 Estimated Value of the Production Function Analysis

Estimated values of the coefficients and related statistics of the Cobb-Douglas production functions of garlic and boro paddy are presented in the Table 7.1.

The major features of the model are:

i. For testing the significance level of individual coefficient one, five and ten percent probabilities were used;
ii. Total variation of the output was measured by coefficient of multiple determination ($R^2$); and
iii. Overall significance of the model was measured by F-test.

### 7.4 Interpretation of the Results

#### 7.4.1 Garlic

**Seed Cost ($X_1$).** It can be seen from Table 7.1 that regression coefficient of seed cost was 0.52 It was positive and was significant at 5 percent probability level. This indicates that an increase in 1 percent of seed cost, remaining other factors constant, would result in an increase in the gross return by 0.52 percent.

**Human Labour Cost ($X_2$).** The magnitude of the regression coefficient of human labour cost was 0.40 with a positive sign. It was significant at 5 percent probability level. It implies that 1 percent increase of human labour cost, keeping other factors constant, it would lead to an increase in the gross return by 0.40 percent.

**Table 7.1 Estimated Values of Coefficients and Related Statistics of Cobb-Douglas Production Function Model**

| Exploratory Variables | Garlic | | Boro Rice | |
|---|---|---|---|---|
| | Estimated Coefficient | t-value | Estimated Coefficient | t-value |
| Constant | -0.42 | -0.11 | 0.50 | 0.18 |
| Seed Cost ($X_1$) | 0.52** | 2.02 | 0.31*** | 3.58 |
| Human Labour Cost ($X_2$) | 0.40** | 2.12 | 0.20** | 2.11 |
| Fertilizer and Manure Cost ($X_3$) | 0.36*** | 2.082 | 0.43*** | 3.20 |
| Irrigation Cost ($X_4$) | $-0.11^{ns}$ | -1.14 | 0.11** | 2.09 |
| Insecticides and Pesticides Cost ($X_5$) | $0.03^{ns}$ | 0.48 | $-0.02^{ns}$ | -0.21 |
| Tillage Cost ($X_6$) | - | - | $0.22^{ns}$ | 1.36 |
| $R^2$ | 0.58 | - | 0.56 | - |
| F-Value | 6.70 | - | 4.86 | - |
| Return to Scale ($\sum\beta_i$) | 1.20 | - | 1.25 | - |

Source: Field Survey, 2018

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

**Fertilizer Cost and Manure Cost ($X_3$).** It can be seen from Table 7.1 that regression coefficient of fertilizer cost was 0.36. It was positive and was significant at 1 percent probability level. This indicates that an increase in one percent of fertilizer cost, remaining other factors constant, would result in an increase in the gross return by 0.36 percent.

**Irrigation Water Cost ($X_4$).** It can be seen from Table 7.1 that the magnitude of the regression coefficient of irrigation water cost was -0.11. It was negative this indicates that an increase in 1 percent of Irrigation cost, remaining other factors constant, would result in a decrease in the gross return by 0.11 percent. This coefficient was, however, not statistically significant.

**Insecticides and Pesticides Cost ($X_5$).** It can be seen from Table 7.1 that regression coefficient of insecticides and pesticides cost was 0.03. This coefficient was, not statistically significant.

**Coefficient of Multiple Determination ($R^2$).** It is evident from Table 7.1 that the value of the Coefficient of multiple determinations ($R^2$) was 0.58. It indicates that about 58 percent of the variations of the gross returns are explained by the explanatory variables included in the model.

**Goodness of Fit (F-Value).** The F-value (6.70) of the estimated production function was highly significant. That is, all the explanatory variables included in the model were important for explaining the variation of boro paddy production.

**Returns to Scale ($\sum\beta_i$).** The summation of all the regression coefficients of the estimated production function of garlic was 1.20 (Table 7.1). This implies that the production function exhibits increasing returns to scale. That is, the farmers were operating their garlic farming in the first stage of production function. In this case, if all the variables specified in the production function were increased by 1 percent, gross return would increase by 1.20 percent.

### 7.4.2 Boro Paddy

**Seed Cost ($X_1$).** It can be seen from Table 7.1 that regression coefficient of seed cost was 0.31. It was positive and significant at 1 percent probability level. This indicates that an increase in 1 percent of seed cost, remaining other factors constant, would result in an increase in the gross return by 0.31 percent.

**Human Labour Cost ($X_2$).** The magnitude of the regression coefficient of human labour cost was 0.20 with a positive sign. It was significant at 5 percent probability level. It implies that 1 percent increase of human labour cost, keeping other factors constant, would lead to an increase in the gross return by 0.20 percent (Table 7.1).

**Fertilizer Cost and Manure Cost ($X_3$).** It can be seen from Table 7.1 that regression coefficient of fertilizer cost was 0.43. It was positive and was significant at 1 percent probability level. This indicates that an increase in one percent of fertilizer cost, remaining other factors constant, would result in an increase in the gross return by 0.43 percent.

**Irrigation Water Cost ($X_4$).** It can be seen from Table 7.1 that the magnitude of the regression coefficient of irrigation water cost was 0.11. It was positive and was significant at 5 percent probability level. This indicates that an increase in one percent of irrigation water cost, remaining other factors constant, would result in an increase in the gross return by 0.11 percent.

**Insecticides and Pesticides Cost ($X_5$).** It can be seen from Table 7.1 that regression coefficient of insecticides and pesticides cost was 0.02 with a negative sign and was non-significant.

**Tillage Cost ($X_6$).** The magnitude of the regression coefficient of tillage cost was 0.22 with a positive sign (Table 7.1). This coefficient was statistically insignificant.

**Coefficient of Multiple Determinations ($R^2$).** It is evident from Table 7.1 that the value of the Coefficient of multiple determinations ($R^2$) was 0.56. It indicates that about 56 percent of the variations of the gross return arc explained by the explanatory variables included in the model.

**Goodness of Fit (F-Value).** The F-value (4.86) of the estimated production function was significant, which implies good fit of the model. That is, all the explanatory variables included in the model were important for explaining the variation of boro paddy production.

**Returns to Scale ($\sum\beta_i$)** the summation of all the regression coefficients of the estimated production function of garlic was 1.25 (Table 7.1). This implies that the production function exhibits increasing returns to scale and the farmers were operating their garlic farming in the first stage of production function. In this case, if all the variables specified

in the production function were increased by 1 percent, gross return would increase by 1.25 percent.

### 7.5 Concluding Remarks

Cobb-Douglas production function model revealed that the key variables included in the model were responsible for variation in gross return or output of garlic and boro paddy. It also revealed that garlic and boro growers allocated their resources in the zone of increasing returns (i.e., in Stage I), which indicates that there was a bright prospect to earn more returns by making optimum use of more inputs in the production.

# CHAPTER 8
# PROBLEMS OF GARLIC AND BORO PADDY GROWERS

## 8.1 Introduction

Farmers faced a lot of problems in producing garlic and boro paddy. The problems were social and cultural, financial and technical. This chapter aims at represent some socioeconomic problems and constraints of producing garlic and boro paddy. The problems and constraints faced by the farmers were identified according to opinions given by them. The major problems and constraints related to garlic and boro paddy cultivation are discussed below:

## 8.2 Lack of Quality Seed

Lack of quality seed was one of the most important limitations of producing garlic and boro paddy in the study area. From Table 8.1 it is evident that about 70 percent garlic and 30 percent boro growers reported this problem. Farmers told that they were cheated by buying so called hybrid seeds from the local markets and from the seed dealers.

## 8.3 Lack of Quality Tillage

Deeply ploughing is essential for successful crop production. Most of the farmers, who use hired power tiller, reported that hired power tiller owners did not till deeply. Nevertheless, they did not use all the tines when they still others land. Table 8.1 shows that 0 percent garlic and 40 percent boro growers reported this problem.

## 8.4 Lack of Scientific Knowledge of Farming

Although modem agricultural technologies have been using in the study area; a large number of fanners have no adequate knowledge of right doses and methods of using modern inputs and technologies of producing their enterprises. In the study area 23.33 percent garlic and 16.67 percent boro growers were encountered this problem (Table 8.1).

### 8.5 Inadequate Extension Service

During the investigation some tanners complained that they did not get any extension services regarding improved method of garlic and boro paddy cultivation from the relevant officials of the Department of Agricultural Extension (DAE). As agricultural extension personnel AEO is the man of technical knowledge to the farmers about their farming problems. But in the study area about 13.33 percent garlic and 10 percent boro growers (Table 8.1) reported that they hardly ever got help from the area.

### 8.6 High Price of Inputs

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

### 8.7 Low Price of Output

Most of the farmers had to sell a large portion of their product at the harvest period to meet various obligations like, household's expenditure and repayment of loan. But harvest time price of garlic and boro paddy remained low because of ample supply. So they could not get reasonable return for their products. It can be seen from Table 8.1 that 90 percent garlic and 83.33 percent boro growers reported this problem.

### 8.8 Attack of Pest and Disease

The growers of garlic and boro paddy were also affected by the problem of attack of pests and diseases. Pests and diseases attack reduce crop yield and increase cost of production. In the study area 56.67 percent garlic and 30 percent boro growers reported this problem (Table 8.1).

### 8.9 High Cost of Irrigation Water

Irrigation is the leading input for crop production. Yield of garlic and boro paddy varies with the application of irrigation water. Availability of irrigation water was not a problem in the study area because of portable irrigation devices. But farmers reported that they had to pay higher charge for irrigation water. Table 8.1 shows that 40 percent garlic and 33.33 percent paddy growers reported this problem.

**Table 8.1 Problems and Constraints Faced by Garlic and Boro Paddy Growers**

| Name of the Problems | Garlic Growers | | Boro Paddy Growers | |
|---|---|---|---|---|
| | Number | Percent | Number | Percent |
| Lack of Quality Seed | 21 | 70 | 9 | 30 |
| Lack of Quality Tillage | 0 | 0 | 12 | 40 |
| Lack of Scientific Knowledge of Farming | 7 | 23.33 | 5 | 16.67 |
| Inadequate Extension Service | 4 | 13.33 | 3 | 10 |
| High Price of Inputs | 24 | 80 | 29 | 96.67 |
| Low Price of Output | 27 | 90 | 25 | 83.33 |
| Attack of Pest and Disease | 17 | 56.67 | 9 | 30 |
| High Cost of Irrigation Water | 12 | 40 | 10 | 33.33 |
| Lack of Operating Capital | 26 | 86.67 | 13 | 43.33 |
| Shortage of Human Labour | 25 | 83.33 | 27 | 90 |
| Adulteration of Fertilizers | 7 | 23.33 | 6 | 20 |
| Theft | 3 | 10 | 1 | 3.33 |
| Natural Calamities | 8 | 26.67 | 6 | 20 |

Source: Field Survey, 2018

### 8.10 Lack of Operating Capital

The farmers of the study area had capital constraints. For cultivation of garlic and boro paddy a huge amount of cash money was needed to purchase various inputs like, human labour, seed, fertilizers, pesticides, etc. In the study area 86.67 percent garlic and 43.33

percent boro farmers reported that they did not have sufficient amount of money for purchasing the required quantity of inputs for the relevant enterprises (Table 8.1).

### 8.11 Shortage of Human Labour

Most of the human Labour is being used during seed/seedling plantation and harvesting period of garlic and boro paddy. Garlic and boro paddy are labour intensive spices. Non-availability of human labour was found in different stages of production such as planting, intercultural operates and harvesting. Table 8.1 shows that 83.33 percent of garlic and 90 percent of boro growers reported this problem.

### 8.12 Adulteration of Fertilizer, Insecticide and Pesticide

Chemical fertilizers, insecticides and pesticides are the most important inputs of garlic and boro paddy production. They were being intensively used in garlic and boro paddy production in the study area. Many farmers reported to have been cheated by applying adulterate fertilizers and pesticides in their crop field. It can be seen from Table 8.1 that 23.33 percent garlic and 20 percent rice growers faced this problem.

### 8.13 Theft

During the harvesting period, stealing of garlic and boro paddy from the crop field and from the farmers' premises was also a limiting factor of garlic and boro paddy production in the study area. Table 8.1 shows that 10 percent garlic and 3.33 percent boro growers reported the problem of theft of garlic and boro paddy.

### 8.14 Natural Calamities

It was found that garlic and boro paddy growers faced some acute problems relating to the nature in their production process. Natural calamities like drought hail storm, excessive rainfall, caused substantial damage to the crop in the field. Farmers said that excessive rainfall during the harvesting period reduces both the quantity and storability of garlic and boro paddy. Table 8.1 shows that 26.67 percent garlic and 20 percent boro growers reported this problem.

There are also some important problems for the respondent farmers as the subsidy did not reach to them properly. All the farmers were not under the price support programme and proper procurement system din not cover in the harvest time.

### 8.15 Concluding Remarks

The above mentioned discussions as well as the results presented in Table 8.1 indicates that both garlic and boro paddy growers in the study area have currently been facing some major problems in conducting their garlic and boro paddy farming. These are the major constraints for the producers of garlic and boro paddy in the study area. Public and private initiative should be taken to reduce or eliminate these problems for the sake of better production of garlic and boro paddy. Government's policy of agricultural loan distribution should be implemented properly so that the capital shortage for the cultivations can overcome. Need to attention for proper distribution of subsidy for the farmers. Government authority should monitor the procurement system at the time of harvesting season so that the farmers get the right price.

# CHAPTER 9
# SUMMARY, CONCLUSION AND RECOMMENDATIONS

## 9.1 Introduction

The key findings of the study are summarized in this chapter. Section 9.2 presents a summary of the major findings of the study. Conclusion, policy recommendations, limitations of the study and scope for further study are given in Section 9.3, 9.4, 9.5 and 9.6, respectively.

## 9.2 Summary

Bangladesh is an agricultural country. Agriculture is the main source of income and employment in this country. The country is characterized by high population growth rate, unfavorable land-man ratio and low growth rate in agricultural production. To meet these challenges, the country has to enhance agricultural production through following intensive method of cultivation and diversifying the production of crops. Agriculture sector continues to play a very important role in the economy of Bangladesh. Agriculture contributes about 14.73 percent of the GDP and provides 42.7 percent employment for its labour force. Total area of Bangladesh is about 14.845 million hectares of which 53.89 percent is cultivated, 3.16 percent is current fallow land, rest 42.95 percent is covered by homesteads, rivers, tidal creeks, lakes, ponds, roads, etc.

Agriculture of Bangladesh is still dominated by rice production. According to the final estimate of BBS, the volume of food grains production in FY2015-16 stood at 388.17 lakh MT of which *Aus* accounted for 22.89 lakh MT, *Aman* 134.83 lakh MT, *Boro* 189.38 lakh MT, wheat 13.48 lakh MT and maize 27.59 lakh MT. In FY2016-17 food grains production stood at 388.14 lakh MT of which *Aus* accounted for 21.33 lakh MT, *Aman* 136.56 lakh MT, *Boro* 180.24 lakh MT, wheat 14.23 lakh MT and maize 35.78 lakh MT .In FY 2016-2017, total area under spices is 412402.60 lakh hectares with the total production of about 2674470 lakh metric tons in our country (BBS, 2017). Spices cover almost 2.16 percent of total cropped area in Bangladesh (BBS, 2017).Thus there is a large gap between demand

and supply. Therefore, every year for meeting deficit, Bangladesh has to import a large volume of garlic and rice at the cost of hard earned foreign currency.

Garlic is nutritious spice crops. Consumption of this can upgrade nutritional status of the people of Bangladesh. Garlic and rice production is labour intensive, so cultivation of these two crops can create more employment opportunity to rural people of Bangladesh. In order to find out the problems, potentials and possibilities of expansion in both the acreage and production of garlic and boro paddy the present study is conducted with the following objectives:

a) to assess the socioeconomic characteristics of farmers growing garlic and boro paddy;

b) to estimate per hectare costs, returns and relative profitability of garlic and boro paddy production;
c) to estimate the contribution of key variables to per hectare yield and income of garlic and boro paddy growing farmers;
d) to identify the socioeconomic problems and constraints faced by the farmers producing garlic and boro paddy; and
e) to suggest some policy guidelines/recommendations.

Three villages of Gurudaspur Upazila in Natore district were selected for the study. In total 60 farmers, 30 for garlic and 30 for boro paddy were randomly selected. 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 socioeconomic characteristics, it was found that average family size of garlic and boro paddy growers was 3.87 and 3.93, respectively and sex ratio was 1.63 and 1.46 for garlic and boro padyy, respectively. The highest percentage of people was in the age group of 15 - 59. Literacy rate of garlic and boro paddy growing families were 89.66 and 91.53 percent, respectively. Percentage of above secondary education was 9.48 and 17.80 respectively. In the study area, 32.76 percent of garlic and 32.20 percent of boro paddy

grower's sole occupation was agriculture and average farm size of garlic and boro growers were 0.95 and 1.63 hectare, respectively.

Relative profitability analysis was done to compare costs and returns of garlic and boro production. It was observed that human labour use per hectare was 370 man-days and 130.33 man-days for garlic and boro paddy respectively. Per hectare cost of human labour for garlic and boro paddy production were Tk. 111353 and Tk. 50841, which represented 40.04 percent and 38.97 percent of the total cost, respectively. Per hectare tillage cost of boro paddy production was Tk. 5495 covering 4.21 percent of the total cost. There was no tillage cost for garlic production in the study area. Total amount of seed requirement per hectare for garlic and boro paddy production was 804.40 kg and 41.06 kg, respectively. Per hectare cost of seed was estimated Tk. 35307 and Tk. 1471 covering 19.52 percent and 1.13 percent of the total cost of producing garlic and boro paddy, respectively.

Per hectare use of Urea, DAP, MOP, Gypsum and $ZnSO_4$ for garlic production were 355.33kg, 257.6 kg, 176 kg, 54.8 kg and 6 kg whose costs were estimated at Tk. 5685, Tk. 7780, Tk. 2640, Tk. 548 and Tk. 1200, respectively. Per hectare use of Urea, TSP, MOP, Gypsum and $ZnSO_4$ for boro paddy production were 224.32 kg, 157.24 kg, 124.49 kg, 60.95 kg and 4.71 kg whose costs were Tk. 3589, Tk. 3774, Tk. 1799, Tk. 609 and Tk. 943, respectively. Per hectare cost of manure for garlic and boro paddy production was Tk. 3000 and Tk. 1224 covering 0.73 percent and 0.49 percent of the total cost, respectively.

Per hectare irrigation water charge of garlic and boro paddy cultivation was calculated Tk. 9104 and Tk. 22324 covering 3.3 percent and 17.11 percent of the total cost, respectively. Per hectare insecticides and pesticides costs of garlic and boro paddy cultivation were estimated Tk. 2709 and Tk. 1537, which constituted 0.97 percent and 1.18 percent of the total cost, respectively.

Land use cost per hectare was Tk.36292 for garlic and Tk. 31798 for boro paddy cultivation. It constituted 16.12 percent and 24.38 percent of the total cost of garlic and boro paddy production, respectively. Interest on operating capital of garlic and boro paddy

cultivation was Tk. 4355 and Tk. 3816 covering 3.99 percent and 2.93 percent of the total cost, respectively. Per hectare fixed cost of garlic and boro paddy production was Tk. 40647 and Tk. 35614, respectively.

Per hectare gross cost of garlic and boro paddy production was Tk. 274464 and Tk. 137828, respectively. Per hectare gross margin of garlic and boro paddy growers was Tk. 94524 and Tk. 42751, respectively. Per hectare net return of garlic and boro paddy production was calculated Tk. 53877 and Tk. 7383, respectively. Undiscounted benefit cost ratio of garlic and boro paddy production was 1.24 and 1.06, respectively.

Cobb-Douglas Production Function model was applied on the basis of the best-fit and significant effects of resources on gross returns. For garlic enterprise five explanatory variables were taken into account to explain variations in production. And for boro paddy enterprise six explanatory variables were taken into account to explain variations in production. The coefficient of multiple determination, $R^2$, was 0.58 in case of garlic production function. This indicates that 58 percent of the variation of output of garlic was explained by the explanatory variables included in the model. The F-value (6.70) of the equation was highly significant at one percent probability level, which indicates good fit of the model. The summation of the estimated coefficients was 1.20, which implies increasing returns to scale and the enterprise was operating in the first stage.

The coefficient of multiple determinations, $R^2$, was 0.56 in case of boro production function. This indicates that 56 percent of the variation of output of boro paddy was explained by the explanatory variables included in the model. The F-value (4.86) of the equation was highly significant at one percent probability level, which indicates good fit of the model. The summation of the estimated coefficients was 1.25, which implies increasing returns to scale and the enterprise was operating in the first stage.

The present study also identified some problems and constraints of garlic and boro paddy production. The major problems and constraints faced by the farmers were lack of quality

seed, low soil fertility, lack of quality tillage, lack of scientific knowledge of farming, inadequate extension service, adulteration of fertilizers, etc.

### 9.3 Conclusion

From the results of the present study, it can be concluded that considerable scope apparently exists in the study area to increase the productivity of garlic and boro paddy to increase income of the growers. Garlic and boro paddy are extensively cultivated spices and food grain in Gurudaspur Upazila of Natore district. The study revealed that garlic growing was relatively more profitable than boro paddy production. The economic profitability analysis demonstrates that Bangladesh enjoys profitability of many non-rice crops, implying that Bangladesh has more profitable options other than production of rice. Several non-cereal crops, including vegetables specially, potatoes have economic returns that are as high as or higher than those of High Yielding Variety (HYV) rice. Furthermore, both garlic and boro paddyare labour intensive enterprises. They are nutritive also. So cultivation of these two crops can help in increasing farm income, employment and nutritional status of farmers. The controlling practices of garlic and boro paddy enterprises in the study area were not found efficient enough. Farmers were not known about the application of inputs in right time with right doses. Therefore, they made over or under use of some inputs. Thus well planned management training in accordance with their problems, needs, goals and resource base can lead to viable production practices and sustainable income from garlic and boro paddy cultivation.

### 9.4 Policy Recommendations

On the basis of the findings of the study it was manifest that both garlic and boro paddy were profitable enterprises and they can generate income earnings and employment opportunity to the rural people of Bangladesh. But some problems and constraints revealed to attain the above mentioned objectives. The policy makers should, therefore, take necessary actions according to the findings of the study; some policy recommendations may be advanced which are likely to be useful for policy formulation:

a) In view of actual field position and experiences gained so far, it is understood that there was an imbalance use of fertilizers in the study area. So public and private

interventions might be required for (i) ensuring balanced use of fertilizers (ii) encourage increasing use of organic and bio-fertilizers and (iii) training the farmers by extension service people in using appropriate doses and combinations of fertilizers. Moreover, farmers reported that they were suffered from adulterated fertilizers. Thus public initiative should be taken to maintain fertilizer quality.

b) Quality seeds of improved varieties in right quantity are recognized to be one of the key elements for enhancing agricultural production. Emphasis should be given on creating facilities and infrastructure support for hybrid garlic and boro rice seed production, marketing and development.

c) Availability of appropriate quantity of irrigation water in time of need and its proper management is the main factor behind the growth of agriculture. So adequate measure should be taken to improve irrigation water management.

d) Actual plant protection activities are pest surveillance, monitoring and early warning against pest attacks, advisory service to farmers, traders and others dealing with pesticides and quality control of pesticides marketed by private sector. Agricultural extension workers are responsible for providing advice to the farmers about appropriate plant protection measures. The integrated pest management (IPM) programme should be expanded to keep garlic and boro paddy free from pests and combat environmental degradation due to pesticide use. Farmers should be given training in the use of different plant protection measure by demonstration.

e) Operating capital is a problem for the resource poor farmers of the study area. Institutional credit programme should be launched aiming at particularly the small and medium farmers. The commercial banks should be encouraged to provide loans at a low interest rate to enable farmers to operate their farming on commercial basis.

f) Crop insurance is new to Bangladesh. It was not experienced in the study area. Farmers opined that if crop insurance could be executed they could be relieved from heavy losses due to natural calamities.

g) Farmers could not get reasonable prices for garlic and boro paddy. Marketing costs are high because of inadequate information, infrastructure, high price risks etc. So appropriate steps should be taken to ensure (i) fair price (ii) quality of agricultural products (iii) floor price and (iv) stability of production.

h) Transfer of technologies, diversification and intensification of crop production programme through appropriate extension service are of essential importance to Bangladesh agriculture. The extension service must be able to render the needed advice, management and technical support to the garlic and boro paddy growers at the appropriate time.

i) The research system needs to strengthen its planning, programme monitoring and coordinating. Problem solving research should be given priority. The following cautious research priority areas have been identified:

   i. Increasing efficiency in water use in garlic and boro paddy cultivation;
   ii. Off season production of garlic and boro paddy;
   iii. Management of soil and plant nutrient with balanced use of organic nutrient;
   iv. Development of hybrid technology for garlic and paddy; and
   v. Post-harvest handling and storage, curing and processing of garlic and paddy.

**9.5 Limitations of the Study**

As a microeconomic study, the study is suffered from a number of limitations. Thus the findings of the study should be considered with a note of a caution. The limitations of the study are discussed below:

a) Most of the farmers did not keep any written documents of their farm business activities. As a result, researcher had to rely fully on the memory and sincerity of the farmers for the accuracy and reliability of data. So possibility of errors could not fully be ruled out.

b) The study was conducted in a limited area of an Upazila taking into account very limited number of sample due to limitation of time and resources. Therefore, the findings of this study should be interpreted cautiously to generalize for the country as a whole.

Despite a few limitations, the findings of the present study may provide some valuable information to the garlic and boro paddy growers, decision makers, extension workers and researchers.

## 9.6 Scope for Further Study

Although the present study is intended to provide some valuable information for the guidance of farmers, extension workers, policy makers as well as researchers, it is not free from criticisms. Due to limitation of time and resources this study could not cover some important areas. The weaknesses of the present study, of course, open avenues for further research which are given below:

a) A broad based study in this line may be undertaken for better understanding not only to study relative profitability of these two enterprises but also with other crops.

b) A further study can be undertaken by taking into account different farm sizes to assess the impact of profitability of garlic and boro rice on income and employment opportunity.

c) The study of other varieties of boro paddy may be conducted individually with garlic to assess their comparative profitability.

d) Acreage response, growth and instability of garlic and boro paddy production can be studied with respect to Bangladesh.

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