A COMPARATIVE ECONOMIC ANALYSIS OF GARLIC AND BORO RICE IN SOME SELECTED AREAS OF NATORE DISTRICT

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CERTIFICATE

This is to certify that thesis entitled, "**A COMPARATIVE ECONOMIC ANALYSIS OF GARLIC AND BORO RICE IN SOME SELECTED AREAS OF NATORE DISTRICT**" submitted to the Faculty of Agribusiness Management, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE IN AGRICULTURAL ECONOMICS in THE DEPARTMENT OF AGRICULTURAL ECONOMICS**, embodies the result of a piece of *bona fide* research work carried out by **MD. SAZZAD HOSSAIN** Registration No. 07-02345 under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

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

3 December, 2015
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DEDICATED TO MY BELOVED PARENTS

ABSTRACT

This study was undertaken to assess the comparative profitability of garlic and boro rice production. A total of 60 farmers (30 for garlic growers and 30 for boro rice growers) were selected randomly from three villages namely: Jogendranagar, Durgapur and Khubjipur under Gurudaspur Upazila in Natore district. Tabular technique and statistical analysis were done to achieve the objectives of the study. The Cobb-Douglas production function was used in this study to determine the effects of individual inputs on garlic and boro rice production.

The major findings of the study were that the cultivation of garlic and boro rice was profitable from the view point of farmers. The total return per hectare for garlic and boro rice were Tk. 469056.23 and Tk. 195712.24 respectively. The gross cost of garlic was Tk. 278085.08 and for boro rice was Tk. 145960.9. Again the net return of garlic and boro rice were Tk. 190971.15 and Tk. 49751.34, respectively. The undiscounted Benefit Cost Ratio (BCR) was 1.69 and 1.34 for garlic and boro rice production, respectively. The results indicated that garlic production was more profitable than the boro rice production. It was also evident from the study that per hectare net returns were influenced by most of the factors included in model namely: human labor, seed, fertilizer and manure, insecticides and pesticides, power tiller, and irrigation. These factors were directly or jointly responsible for influencing per hectare net returns for garlic and boro rice production. The study also showed that farmers producing garlic and boro rice faced some problems, mainly 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 rice as a means of increasing farm income through diversification of crop production in the area under study.

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which different models were employed to evaluate the efficiency of farming activities. Their invaluable cooperation during my data collection process is highly acknowledged.

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ACRONYMS AND ABBREVIATIONS

µg	:	Microgram
BAU	:	Bangladesh Agricultural University
BBS	:	Bangladesh Bureau of Statistics
BDT	:	Bangladeshi Taka
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
g	:	gram
ha	:	Hectare
HIES	:	Household Income and Expenditure Survey
HYV	:	High Yielding Varieties
IOC	:	Interest on Operating Capital
k. Cal.	:	Kilo Calories
kg	:	Kilogram
mg	:	Milligram
mm	:	Millimeter
MoP	:	Murate of Potash
MT	:	Metric Tons
Rs.	:	Rupee symbol
SFYP	:	Sixth Five-Year Plan
SPSS	:	Statistical Package for Social Science
Sq. km	:	Square Kilometer
Tk.	:	Taka
TSP	:	Triple Super Phosphate

CHAPTER 1
INTRODUCTION

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INTRODUCTION

1.1 Background of the Study

Bangladesh is primarily an agricultural country dominated by crop production. As a developing country, it has been striving for rapid development of its economy. The country has a population of 155.8 million encompassing an area of 147570 sq. km (BER, 2015). About 76.75 percent of total population of this country lives in rural areas (BBS, 2014). 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 almost self-sufficiency in rice production, the main cereal crop for the people. 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 (24.47%), with most of the poor concentrating in the rural areas (BER, 2015).

1.2 Status of Bangladesh Agriculture

At present, despite some diversification, most of the agricultural production is still concentrated on a limited number of crops and rice 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 (BBS, 2014). On the other hand, production of spices and tea has been increased. Production of fruits and vegetables has also improved. In the non-crop sector, poultry, dairy and seafood have seen considerable growth.

Agriculture provides employment to nearly about 47.30 percent of its total labor forces (BER, 2015). 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). Broad agriculture sector which comprises crops and horticulture, animal farming, forest and related services and fishing contributes 16.50 percent to the Gross Domestic Product (GDP) as a whole in the FY 2013-14 (BER, 2015). Despite increase in the shares of fisheries, animal farming, and forestry, crops and horticulture sector alone accounts for 56.24 percent share of agricultural GDP in FY 2013-14 (BER, 2015) (Figure 1.2). In FY 2013-14, within the broad

agricultural sector, the provisional growth rate of agriculture and forestry sector stood at 2.46 percent according to the base year 2005-06, which was 1.47 percent in FY 2012-13. Of this growth performance, the growth of crops and horticulture sub-sector scaled up from 0.59 percent in FY 2012-13 to 1.91 percent in FY 2013-14. The estimated total production of cereals (rice, wheat and maize) was 380.83 lakh MT in FY 2013-14, which increased by 8.17 lakh MT compared to 372.66 lakh MT of the previous fiscal year. According to provisional data, the production of aus, amon and boro stood at 23.26 lakh MT, 130.23 lakh MT and 190.06 lakh MT in FY 2013-14, respectively, which was 7.78 percent, 0.98 percent and 1.21 percent higher than that of previous fiscal year (BER, 2014).

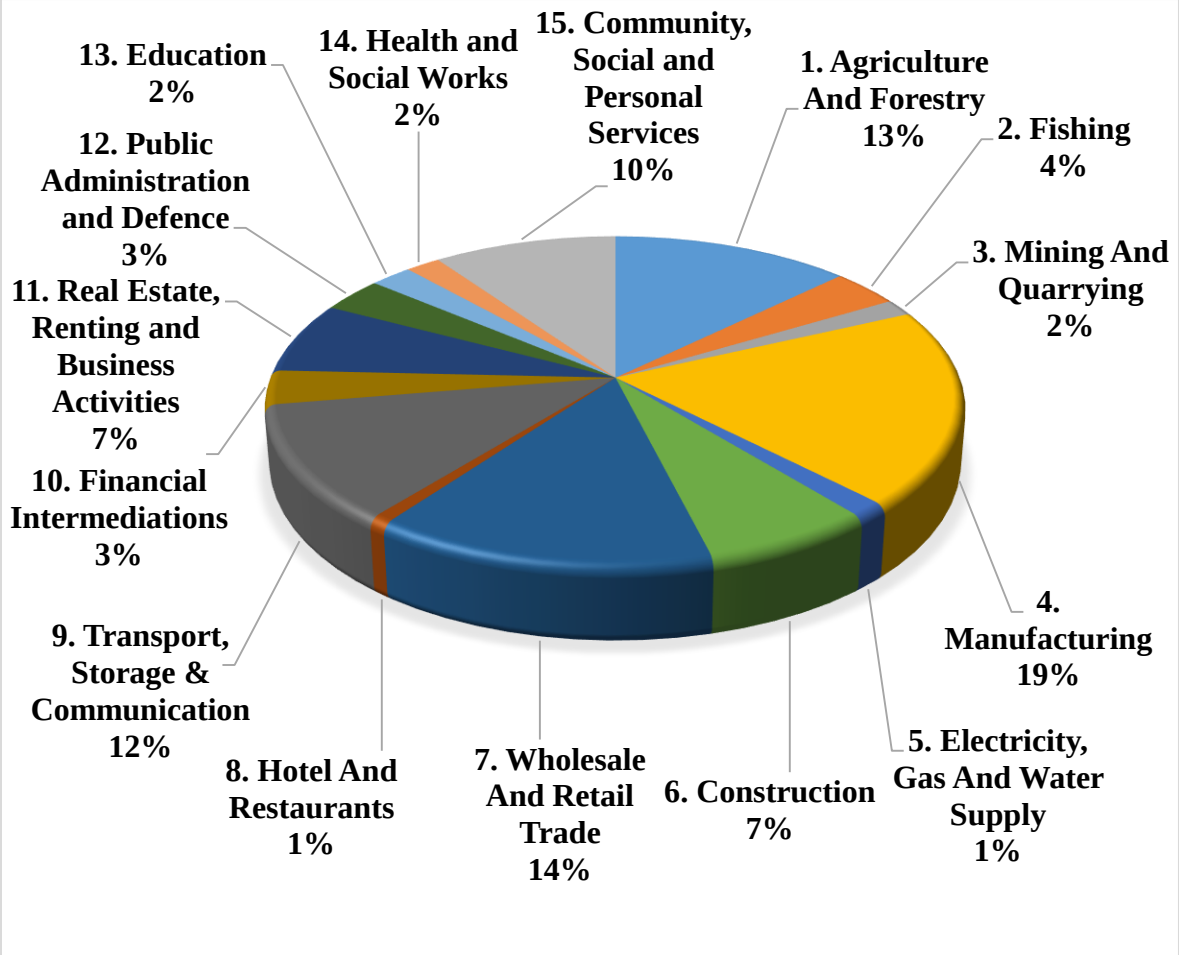

Figure 1.1: Sectoral Shares of Gross Domestic Product at Constant Market Price

Source: BER, 2015

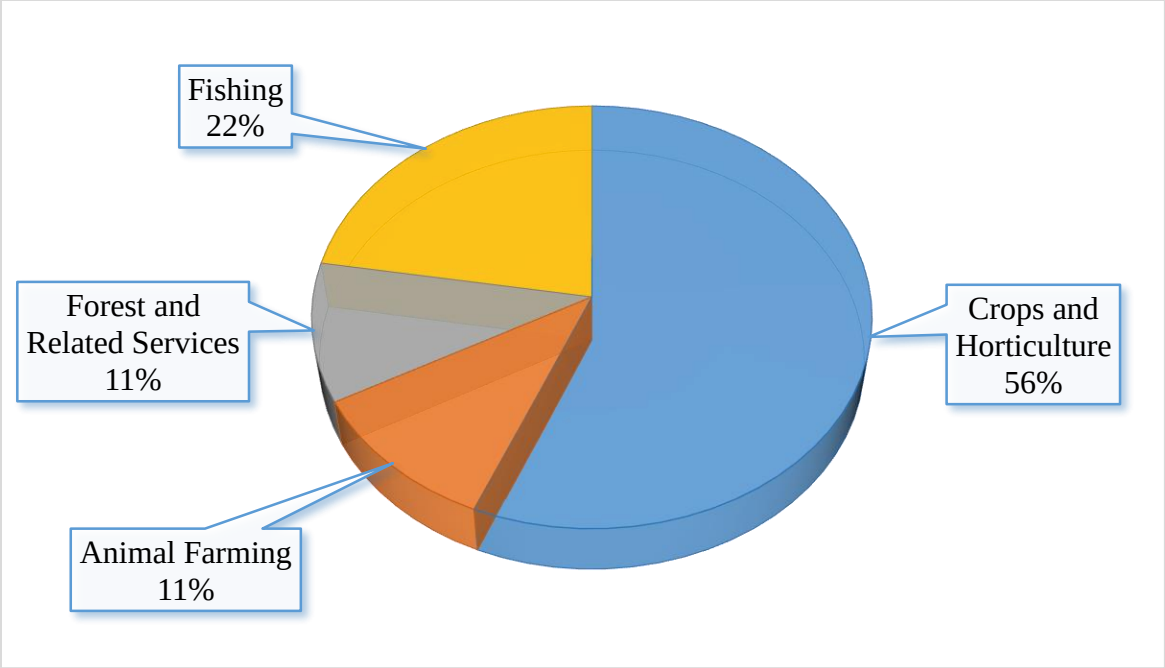

Figure 1.2: Sub-Sectoral Share of Broader Agricultural GDP in 2013-14

Source: BER, 2015

1.3 Importance of Garlic

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 sativum L*) belongs to the Amaryllidaceae family. The world production of garlic is about 9280000 MT and it is ranked third among the spices grown around the world. China leads the world production of garlic (5964000 MT) and also in the area (467000 ha). The highest national yield (21.00 MT/ha) is rerecorded from Egypt. The major garlic producing countries are China, India, South Korea, Egypt, Spain, Thailand, and Turkey (FAO, 1999). The crop is intensively cultivated during the winter season of Bangladesh.

Among the bulb spices, garlic ranks third in terms of area (44000 ha) and production (234000 MT). It covers about 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 world average (11.07 MT per hectare) produced by garlic producing countries of the world (BBS, 2014). 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 2001-02 to 2011-12. Production of garlic is increasing day by day in Bangladesh.

Table 1.1: Acreage and Production of Condiments and Spices, and Garlic by Year

Year	Area ('000' ha)		Production ('000' MT)	
	Condiments and Spices	Garlic	Condiments and Spices	Garlic
2001-02	252	14	418	41
2002-03	253	15	425	43
2003-04	270	21	609	73
2004-05	302	26	1000	90
2005-06	321	27	1182	102
2006-07	348	39	1405	177
2007-08	295	34	1368	145
2008-09	275	35	1212	155
2009-10	286	37	1350	164
2010-11	321	42	1649	209
2011-12	325	44	1756	234

Source: BBS, 2014

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). As a result, the domestic production cannot meet the domestic demand. Hence, Bangladesh has to import large volume of garlic every year to meet the domestic demand at the cost of hard earned foreign currency (Table 1.2). It seems that there is a 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.

Figure 1.3: Picture of Garlic Bulbs

1.4 Importance of Rice

Rice 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 155.8 million people. Keeping this in mind, since the independence all the successive governments have given high priority for attaining self-sufficiency in food production. 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 helped the country to meet the increasing food grain (Hayami and Ruttan, 1985). Among the high yielding varieties boro rice varieties have maximum share to the total rice production which is more or less stable over the last decades. Rice is the staple food for the general people of Bangladesh.

Figure 1.4: Picture of Boro Rice

Accordingly, the demand for rice is constantly rising and 2.3 million people being added each year to its total population. Rice constitutes about 70 percent of total calorie intake for the people particularly for hard working people. Rice covers an area of about 11.53 million hectares and is by far the most important provider of rural employment (HIES, 2005 and BBS, 2006). The area, production and yield rate of rice, in general and boro, in particular, for different years were shown in Table 1.2.

Table 1.2: Area and Production of Rice and Boro Rice by Different Years

Year	Area ('000' ha)		Production ('000' MT)	
	Rice	Boro Rice	Rice	Boro Rice
2001-02	10665.2	3772.87	24300	11766
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

Source: BBS, 2014

1.5 Nutritive and Medicinal Value of these Crops

1.5.1 Garlic

For a small vegetable, garlic sure 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 B_6, 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: Metalgan, 2004

1.5.2 Boro Rice

Rice 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. 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 rice varies based on a number of factors. It depends on the strain of rice, that is between white, brown, red, and black (or purple) varieties of rice, each prevalent in different parts of the world. It also depends on nutrient quality of

the soil rice is grown in, whether and how the rice 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 rice. Almost 90 percent of the population of Bangladesh, Myanmar, Sri Lanka, Vietnam and Kampuchea are rice eaters. Rice 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, p. 32). 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 rice 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 Program (CDP) in the Sixth Five-Year Plan (2011-2015). 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.

1.6 Justification of the Study

In the economy of Bangladesh, Agriculture sector is playing 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 (SFYP). 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. The Government of Bangladesh has been pursuing a crop diversification strategy to reduce the dependency on rice cultivation. The SFYP categorically emphasized the importance of

crop diversification on valid agronomic, nutritional and economic reasons. 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 program. 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 rice based. In 2011-12 food grain production was 36839000 MT. But still there is a deficiency in producing minor agricultural products. It is estimated that annual production of garlic is 234000 MT, respectively against the national demand of 527000 MT, respectively. With the increase of population, the demand for garlic and rice 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, 2014). However, garlic and boro rice production is more labour intensive. So cultivation of these two 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 rice cultivation and trading. By producing garlic and boro rice, 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 rice cultivation and choice making in production of garlic rather boro rice. 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 rice production and to suggest the farmers for copying with those problems.

1.7 Objective of the Study

The specific objectives of the study are as follows

i. To assess the socio-economic characteristics of garlic and boro rice growing farmers
ii. To estimate and compare the cost and returns of producing garlic and boro rice
iii. To identify the factors affecting the returns of producing garlic and boro rice
iv. To identify the problems faced by the farmers producing garlic and boro rice and
v. To suggest some policy guidelines/ recommendations.

1.8 Organization of the Study

The study consists of 9 chapters. Chapter 1 describes introduction of the study. Relevant review of literature, methodology, description of the study area, socioeconomic characteristics of the sample farmers, results and discussion, major factors affecting to the production processes of garlic and boro rice, problems of garlic and boro growers and summary, conclusion and recommendations 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

CHAPTER 2
REVIEW OF LITERATURE

This chapter aims at represent some review of the past research works that are related to the present study. A few researches have been done on garlic and boro rice production in Bangladesh partly. However, comparative economic analysis of garlic and boro rice production is hardly ever found in this country. Some important studies on garlic and boro rice production, which have been conducted in the recent past, are discussed below:

Garlic

Shrivastava (1988) 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.

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, pseudostem and bulb diameter, dry matter content of foliage, bulb weight and bulb yield were found significantly higher for mulched plants.

Trevisan *et al.* (1996) reported that marketable yields and percentage of high quality bulbs were greatest with bulbs planted on 18 May that 27 April and 14 June.

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.

Rahman (2001) studied effect of spacing on the growth, yield and storability of some garlic germplasm. The plant spacing showed significant effect on most of the parameters studied. Wider spacing (20 x 20 cm) give the maximum weight of bulb; the closest spacing (10 x 10cm) produced maximum yield of bulb (9.19 MT/ha), the lowest yield (3.67 MT/ha)) was obtained from wider spacing. The performance of garlic bulb during storage varied significantly due to spacing and different germplasm. Wider spacing showed the lowest result in percentage of insect infested bulbs and weight loss (4.92 percent and 24.01 percent, respectively. The germplasm G_{21} showed minimum percentage of insect infestation and weight loss (8.91 percent and 25.24 percent, respectively).

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.

Hossain (2003) studied the effect of planting time and different mulches on the growth and yield of some garlic germplasm. Results revealed that earlier planting date (November 24) was found to be better for higher yield. And the highest yield (4.32 MT/ha) was obtained from water hyacinth mulch. The combination of November 24 planting and germplasm G_{19} with water hyacinth mulch gave the highest yield (4.61 MT/ha).

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.

Boro Rice

Ali (2000) attempted to measure and compare 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.

Hasan (2000) studied on the economic potential of alok hybrid rice and found that per hectare total cost for hybrid alok was Tk. 36,276.33 per hectare variable cost was calculated as Tk. 2,927.05 and per hectare yield was 6,557.07 kg. The price of alok paddy was Tk.

7.81/kg. Taking the by product into account the gross return of hybrid alok per hectare was Tk. 5,465.02. The net return per hectare was Tk. 18,375.50 and the gross margin was Tk. 26,409.97.

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. Aus rice-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 bom income and employment.

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.

Rahman *et al.* (2002) attempted to measure the technical efficiencies obtained by owner operated farming and share cropping for boro, aus and aman rice were 86 percent, 93

percent and 80 percent, respectively whereas mean technical efficiencies obtained by sharecroppers for boro, aus and aman rice were respectively 73 percent, 76 percent and 72 percent. The study reveals that owner operators were technically more efficient than sharecroppers in the production of all the rice crops. To reduce the difference of technical efficiencies between owner operator and sharecropper a perfect leasing system is inevitable.

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.

Mondal (2005) attempted to measure and compare resource use, efficiency and relative productivity of farming under different tenurial conditions. It is found that total cash expenses as well as total gross cost producing HYV boro rice was highest in owner-cum-tenants owned land than in rented in land. When individual inputs were concerned it was observed that expenses on human labour shared a major portion of expenses in the production of HYV boro rice under all tenure groups. The fertilizer cost in owner's own land was significantly different from that of tenant's rented land. It was found that owner farmers were more efficient than owner-cum-tenant and tenant farmers. Again, owner-cum-tenants were more efficient in production in the case of his owned land than in rented in land.

Islam *et al.* (2007) carried out a study to examine the income and price elasticities of demand for different types of rice in Bangladesh. The total budget for cereal field allocated to aromatic, fine, course rice and wheat was 4.0%, 23.3%, 65.2% and 7.5% respectively.

The estimated expenditure elasticities of demand for those types of cereal were 0.85, 0.79, 0.29 and 0.55 respectively.

Majid and Haque (2007) conducted a study on Monga mitigation for employment and food security increase through early aman rice production and crop diversification in greater Rangpur region of Bangladesh. Introducing of cash crop in potato growing time (early to late November) contributed more productivity (32.4-39.3 MT/ha) than Rice-Non-Rice system as Rice-Rice (13.2 MT/ha). The highest rice equivalent yield associated with early Aman Rice-Potato-Mungbean (37.4 MT/ha) and Early Aman Rice-Potato-Rice (Bolan/older seedling of BRRI Dhan-33) (32.4-32.6 MT/ha). However, early Aman Rice-Potato-Mungbean gave lower productivity than Rice-Potato-Relay Maize/Maize but Mungbean added some biomass in the soil for soil health.

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 rice production. But no comparative economic study on garlic and boro rice production was conducted in Bangladesh. The present study was, therefore, undertaken to determine the profitability of garlic and boro rice production and thereby to facilitate farmers and policy maker’s decision making by providing information on economics of garlic and boro rice production.

CHAPTER 3
METHODOLOGY

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METHODOLOGY

3.1 Introduction

Appropriate methodology is a necessity of a good research. 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 data from individual farmers; collection of data for farm business analysis involves judgment of the analyst in the selection of data collection methods within the limits imposed by the resources available for the work (Dillon and Hardaker, 1993). In this study, "survey method" was employed mainly due to two reasons:

i. Survey enables quick investigations of large number of cases and
ii. Its results have wider applicability.

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

3.2 Selection of the Study 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). A preliminary survey in Gurudashpur Upazila of Natore district was conducted to achieve the objectives of the present study. On the basis of preliminary information, Jogendronagar, Durgapur and Khubjipur villages were selected purposively because a large number of farmers grow garlic and boro rice in these villages.

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

i. The area represented the same agro-ecological characteristics
ii. These were typical garlic and boro rice growing villages with representative soil condition, topography and patterns

iii. Easy accessibility and good communication system existed in the selected villages

iv. 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

v. No socioeconomic study of this type was conducted previously in this area.

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 include all the farmers in the area studied due to limitation of time, money and personnel. A simple random sampling technique was followed in the present study for minimizing cost, time and to achieve the ultimate objectives of the study.

Three villages of Gurudashpur Upazila in Natore district were selected. Two lists of farmers, who cultivated garlic and boro rice, 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 rice, 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 January and harvest after three months and boro rice cultivation begins at

January-February and ends in mid-April-May. The data collection period, therefore, pertained this period of 2014. 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

A set of comprehensive survey schedule was set to collect necessary information from the farmers in such a way that all the factors in the production of garlic and boro rice could be included in conformity with the objectives of the study. As the survey mainly depends on the preparation of the survey schedule, it was, therefore, 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.

3.6 Collection of Data

Obviously, both technical and socioeconomic data are needed in the relevant research. The data were collected 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 ensure the collection of reasonably accurate information from the field. 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:

i. Built-in-check in the interview schedule
ii. Field checking and
iii. Independent re-interviewing of the respondents.

In case of any inconsistency and lapse, 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 data. Data were collected at farmer's house as well as 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 to transfer to master sheets to facilitating 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 and Statistical Package for Social Science (SPSS). It may be noted here that data were collected initially in local units. After necessary checking it was converted into standard international units such as hectare, metric ton, etc.

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. Percentage and arithmetic mean or average were employed to analyze data and to describe socioeconomic characteristics of garlic and boro rice growers, input use, costs and returns of garlic and boro rice production and to calculate undiscounted Benefit Cost Ratio (BCR).

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 rice production the following equation was used in the present study:

$$\pi = P_r Q_r + P_b Q_b - \sum_{i=1}^{n} (P_{xi}.X_i) - TFC$$

Where,

Π = Net return (Tk./ha)

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

Q_r = Quantity of the product (kg/ha)

P_b = Per unit price of by-products (Tk./kg)

Q_b = Quantity of by-products (kg/ha)

P_{xi} = Per unit price of the ith (Variable) inputs (Tk. /kg)

X_i = Quantity of the ith inputs (kg/ha)

i = 1,2, 3…… n (number of inputs)

TFC = Total fixed cost

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.

For garlic, the model specification was as follows:

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

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:

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

Where,

Y = Gross return (Tk./ha)

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)

ln = Natural logarithm

i = 1,2, 3……, n(n=30)

e = Base of natural logarithm

u_i = Error term

$\beta_1, \beta_2 \ldots\ldots\ldots\ldots, \beta_5$ = Coefficient of respective variables.

For boro rice the model specification was as follows:

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

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:

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

Where,

Y = Gross return (Tk./ha)

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 and

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

3.10 Major Cost Items

In this section an attempt has been made to estimate the costs and returns of garlic and boro rice production. To estimate the net returns of garlic and boro rice production, it is essential to estimate the actual costs and returns in appropriate procedures. Input 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 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 rice. 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 that garlic and boro rice production was labour intensive. Human labour was required for different operations like seed bed preparation, seedling preparation, 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 rice. 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 rice 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

In the study region most of the farmers used irrigation water for their garlic and boro rice 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. Irrigation cost was estimated as the actual amount of money paid 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 rice. 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 rice land. The wage rate of power tiller was considered as the actual amount of money paid by the farmers in cash. Garlic Farmers used human labour for cleaning and laddering their land.

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 labour used

their tools and equipment and did not charge for that. Rest of the cost of tools and equipment in producing garlic and boro rice were very negligible and therefore, were ignored in the present 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 rice 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 rice. 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 = AIiT

Where,

AI= (Total investment)/ 2

i = Rate of interest

T = Total time period of a cycle

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

CHAPTER 4

DESCRIPTION OF THE STUDY AREA

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 10 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, Baraigram Upazila on the south, Tarash and Chatmohar upazila's on the east, Natore Sadar 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.

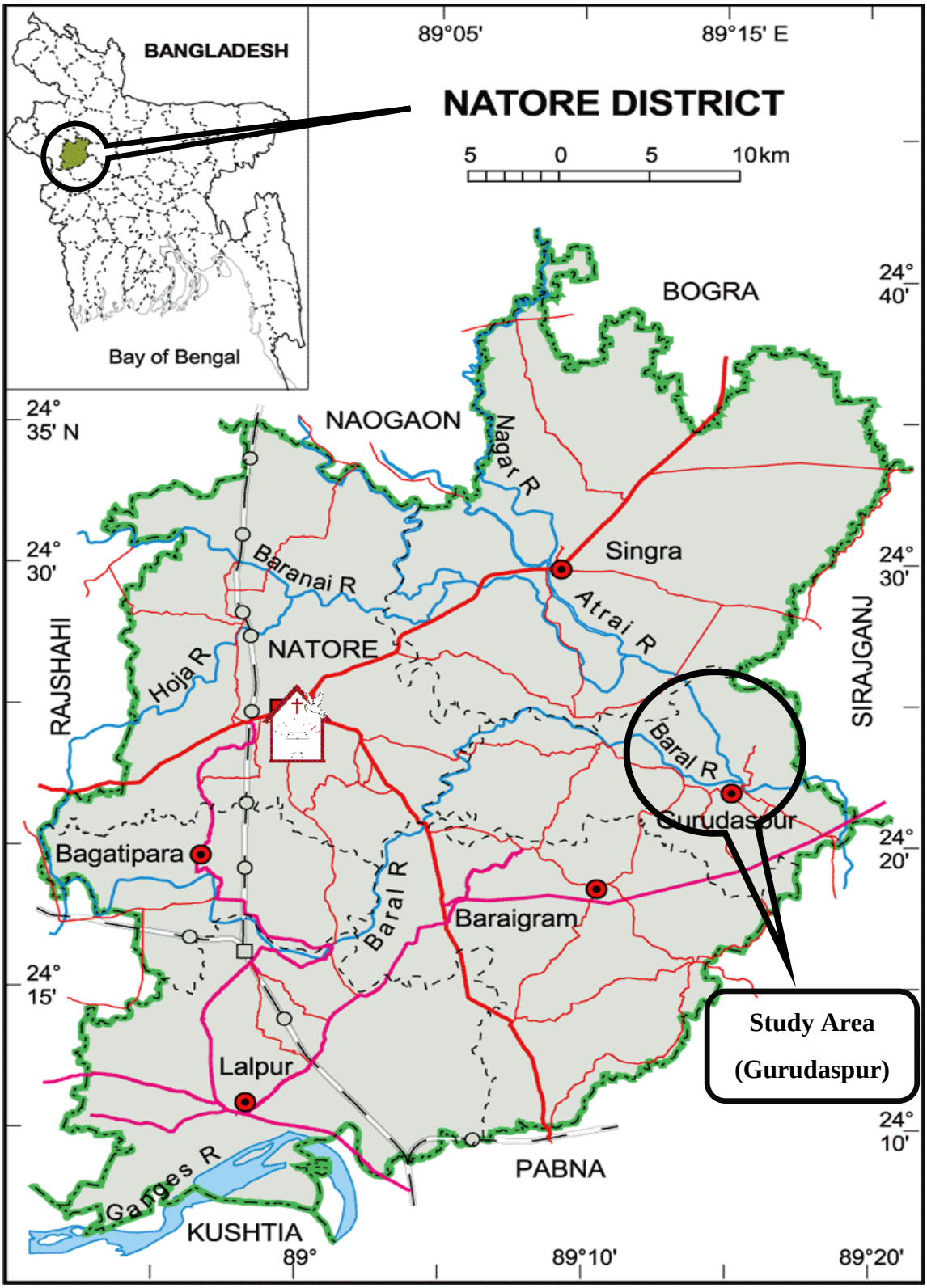

Figure 4.1: Map of Natore District

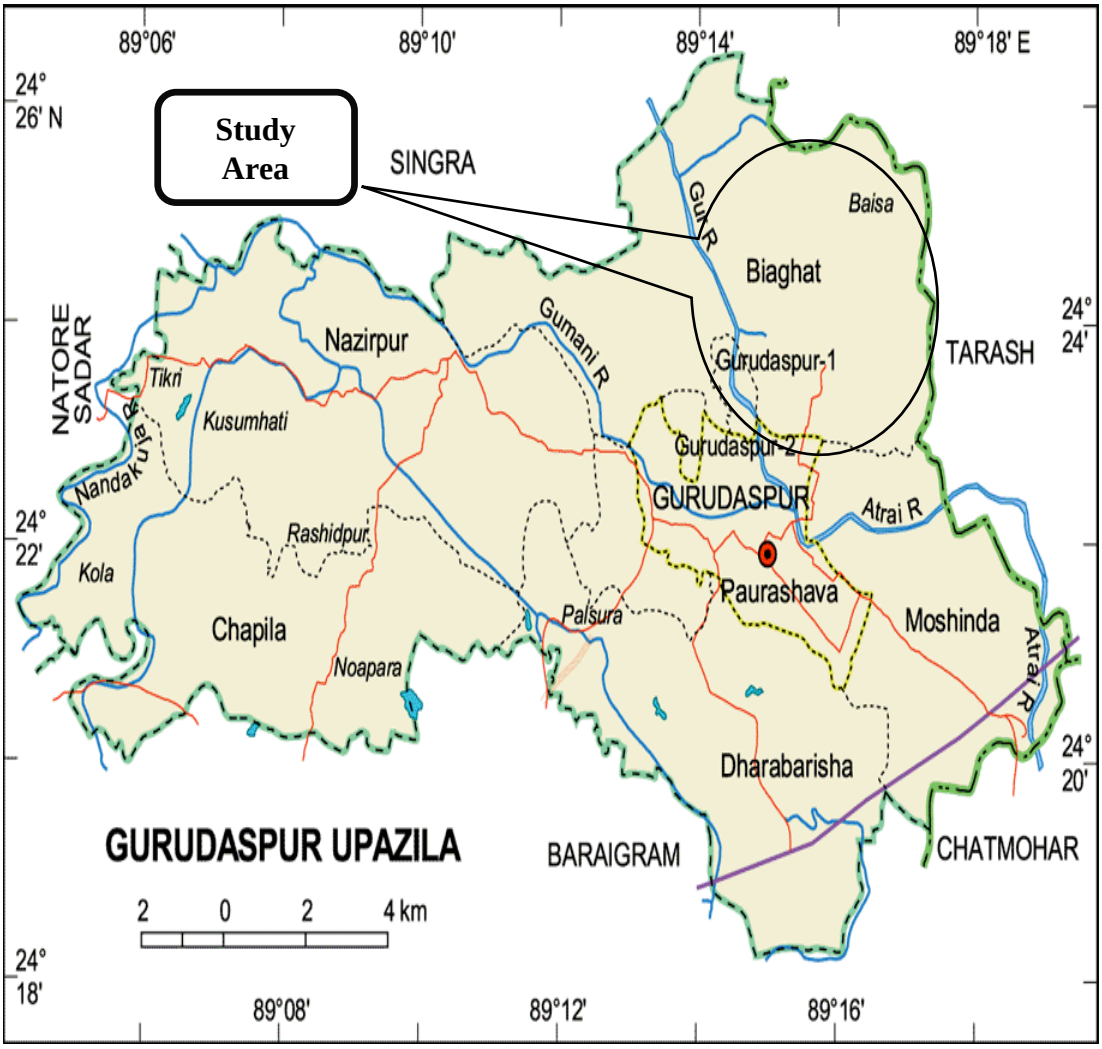

Figure 4.2: Map of Gurudaspur Upazila

Table 4.1: Distributions of Agricultural Land Types (in acre) of Natore District

Upazila	High land	Medium land	Low land	Total land
Bagatipara	16169	9354	2132	27655
Baraigram	22118	28093	9910	60121
Gurudaspur	6036	13938	10384	30358
Lalpur	10808	39537	2470	52815
Nature Sadar	21918	47327	2730	71975
Singra	5538	43898	50809	100245
Total	82587	182147	78435	343169

Source: BBS, 2014

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, 2014).

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, 2014

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. However, number of households in Gurudaspur Upazila was 55000, and total population is 215000 (BBS, 2014).

4.5 Climate

Yield of garlic and boro rice 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 (Farhana, 2010).

The district annual rainfall data shows that it was 1062 mm in 2012 (Table 4.3). Monthly rainfall shows that it ranges from 01 mm to 267 mm (Table 4.4). Heavy rainfall occurs during monsoon while the rainfall is the lowest in November and February. Table 4.3 shows that highest rainfall usually occurred in June. Humidity range is around 79 percent (January) to 87 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 2003-12 (in Millimeter)

Name of Stations	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Ishwardi	1080	1789	1819	1286	1573	1304	1292	893	1736	1062

Source: BBS, 2014

Table 4.4: Monthly Rainfall at lshwardi Station 2013, (In Millimeter)

Name of Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ishwardi	0	0	1	68	187	267	140	233	104	129	0	0

Source: BBS, 2014

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

Name of Stations	2008		2009		2010		2011		2012	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Ishwardi	31.0	21.3	31.90	20.8	32.5	21.1	30.8	20.2	31.3	21.1

Source: BBS, 2014

Table 4.6: Monthly Average Relative Humidity of 2012 by Station (in Percentage)

Name of Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ishwardi	79	66	60	68	71	81	87	86	86	83	80	86

Source: BBS, 2014

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, sugarcane 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, shaddock, 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 NGO, have been operating their programme for several years. Operationally important NGOs of the study area were ASA and Grameen Bank. They provide credit for poultry, livestock and fishery enterprise. Small and marginal farmers often get loan from those NGO.

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, shallow-boat, bi-cycle, motorcycle and also by car. Farmers carry their product mainly by van and by hackney carriage. 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 bazar hat is most popular from all the other markets.

4.10 Concluding Remarks

From the above discussions it is found that the location of the study area near to the Upazila Sadar. Physical features and topography, soil type, temperature and rainfall are favourable for cultivating garlic and boro rice. Therefore, various types of agricultural crops were cultivated in the study area. Communication are good for marketing of agricultural crops.

CHAPTER 5

SOCIO-ECONOMIC CHARACTERISTICS OF SAMPLE FARMERS

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 farmers. Socioeconomic aspects of the farmers can be looked upon from different points of view depending upon a number of variables related to their level 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. Socioeconomic 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 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 daughter, father, mother, brother 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 Rice Growers		All Farmers		National Average Family Size
	Number	Percent	Number	Percent	Number	Percent	
Male	2.4	62.02	2.33	59.29	2.36	60.51	4.44
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, 2014

The average family sizes for garlic and boro rice 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 person in all groups.

5.2 Age Distribution of the Farm Families

Age of garlic and boro rice 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 rice, 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 rice 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).

Table 5.2: Distribution of Family Members by Age Groups

Age Groups (Years)	Garlic Growers		Boro Rice 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, 2014

5.4 Educational Status of Farm Families

Education has its own merits and it contributes to economic and social development, as 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. It helps person to make

right decision regarding his farm business. It makes a man more capable of managing scarce resource and hence to earn maximum profit (Miah, 1990). The educational status of garlic and boro rice farm family members is given in Figure 5.3.

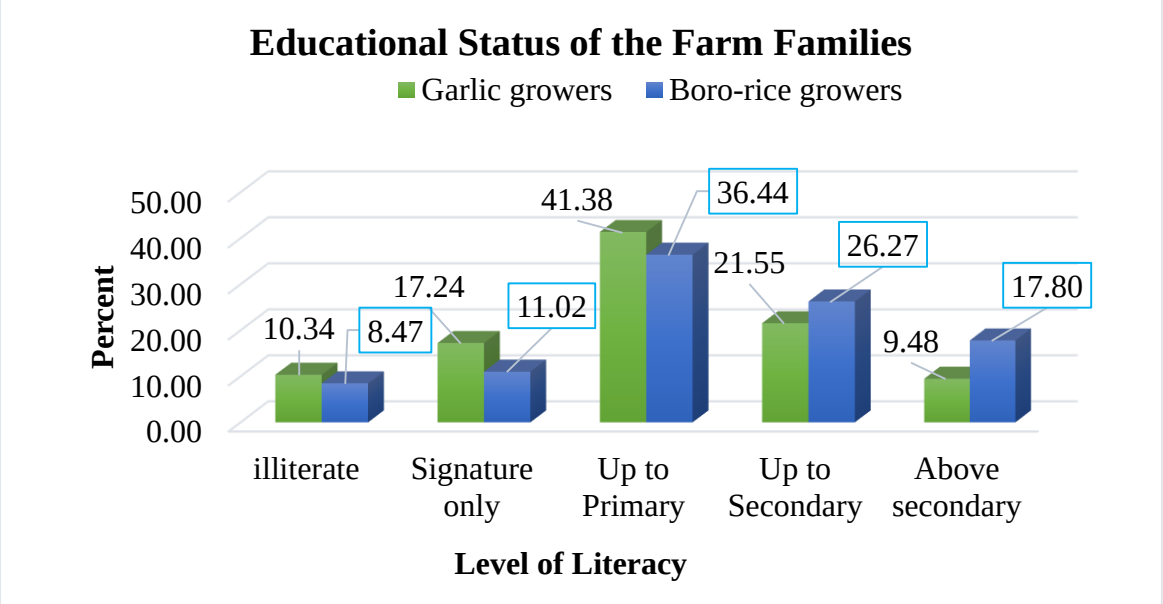

Figure 5.1: Educational Status of the Farm Families

Source: Field Survey, 2014

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 rice 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 rice farm families was 89.65 percent and 91.53 percent, respectively.

5.5 Occupational Status of the Sample Farmers Family

The selected farmers of the study area were engaged in various type 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 (Roy, 1999). Besides agriculture, some farmers were engaged in small enterprise; some were engaged in services like government, semi-government, non-government 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.

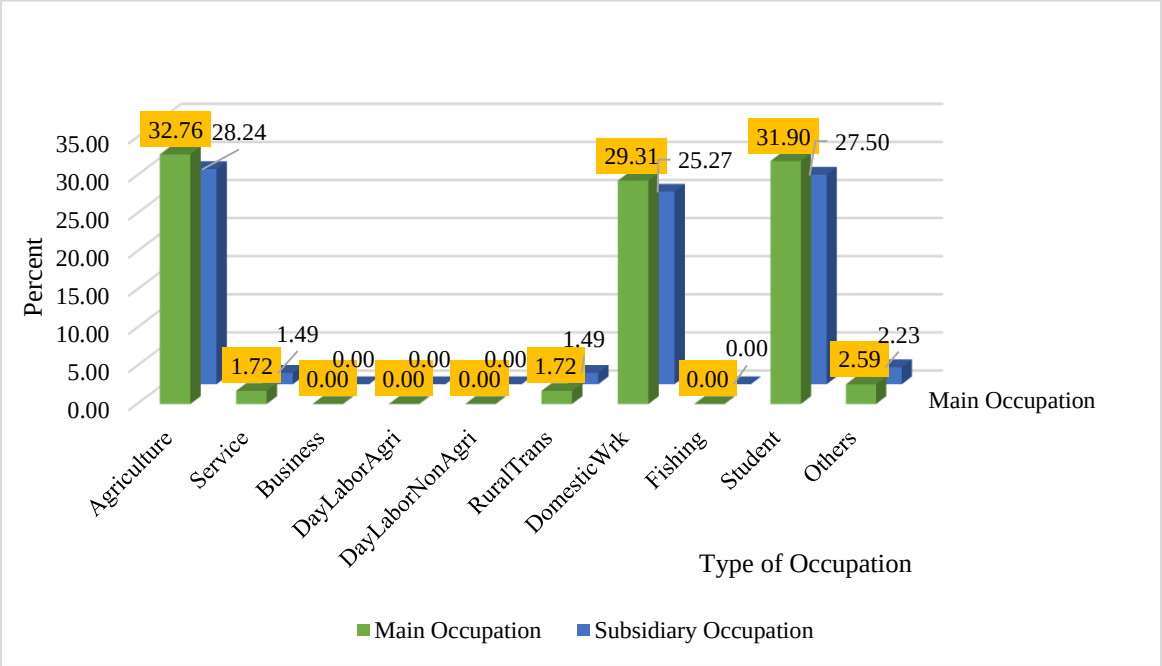

Figure 5.2: Occupation Types of Garlic Grower's Family Members

Source: Field Survey, 2014

It is shown from the figure 5.2 that in case of garlic growers, 32.76 percent of the farmer's family member 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 respectfully as their main occupation.

From the figure 5.3 it is shown that, for boro rice 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.

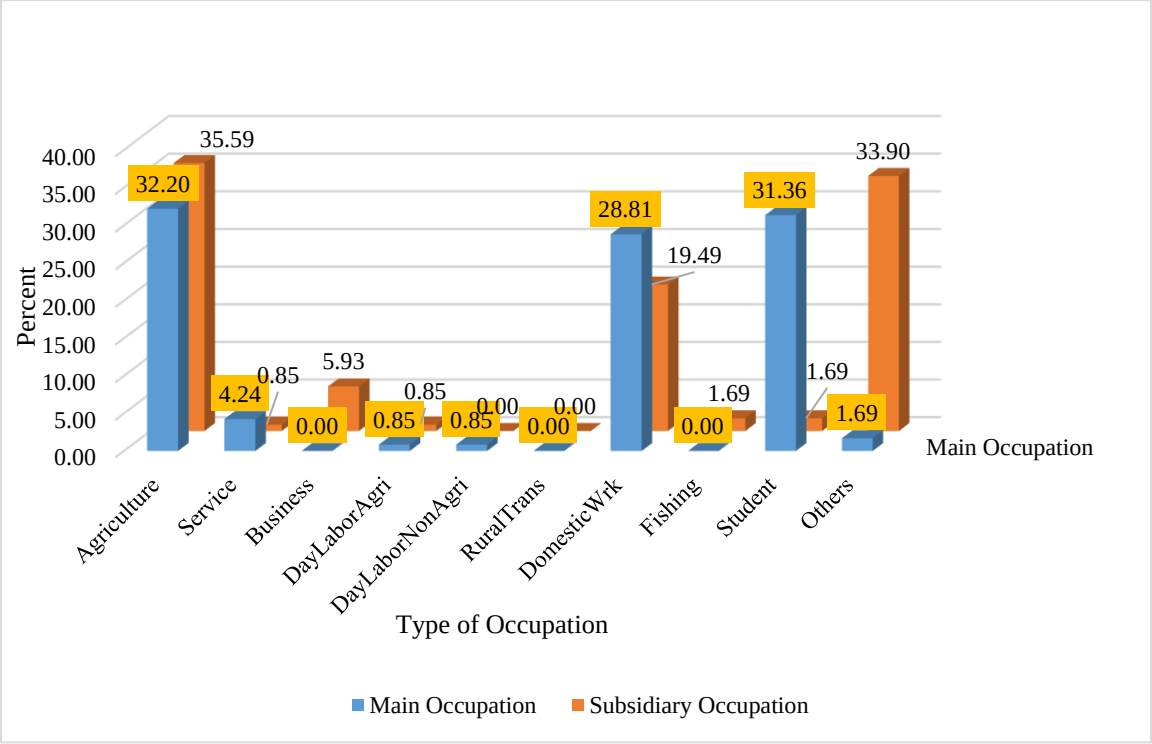

Figure 5.3: Occupation Types of Boro Rice Grower's Family Members

Source: Field Survey, 2014

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.

5.6 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 farmers. 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 5.3: 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, 2014

It appears from Table 5.5 that the average farm size of garlic and boro rice growers was 0.95 ha and 1.63 ha, respectively. Crop land area of garlic and boro rice 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.

5.7 Concluding Remarks

From the above discussions it is clear that there are some variations in socioeconomic characteristics between the garlic and boro rice growers. But the magnitude of the variations was not large. There are substantial indications suggesting that both garlic and boro rice growers were progressive.

CHAPTER 6
RESULTS AND DISCUSSION

CHAPTER 6
RESULTS AND DISCUSSION

6.1 Introduction

The costs, returns and profitability of garlic and boro rice production are projected in this section. For calculating the costs and returns of garlic and boro rice 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 water 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 rice 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 813.56 kg and average cost of garlic seed per hectare was estimated Tk. 54273.91. Per hectare use of boro rice seed was 39.03 kg and average cost of rice seed per hectare was estimated Tk. 1463.63 (Table 6.4). Seed cost constituted 19.52 and 1 percent of total cost of producing garlic and boro rice, respectively. It was clear that cost of seed was relatively higher for garlic than that of boro rice.

6.2.2 Cost of Human Labour

Human labour was the most important and largely used input in producing both garlic and boro rice production. It shared a large portion of total cost of garlic and boro rice production. 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 this was 181.39 man-days per hectare for boro production (Table 6.2). Total cost of human labour was estimated Tk. 136604.83 and Tk. 58558.13 covering 49.12 and 40.12 percent of total cost of garlic and boro rice production, respectively (Table 6.3 and Table 6.4).

Table 6.1: Operation Wise Per Hectare Human Labour Cost of Garlic Production

Operations	Total Labour (Man-days)	Total Cost (Tk.)	Percentage of Total Cost
Land Preparation	27.16	9507.85	6.96
Seedling Plantation	119.58	47830.88	35.01
Fertilizer, Manure and Pesticide Application	6.87	1718.49	1.26
Weeding and Mulching	76.57	26799.86	19.62
Harvesting and Transporting	88.89	35555.63	26.03
Drying, Sorting and Storage	37.98	15192.12	11.12
Total	357.05	136604.83	100

Source: Field Survey, 2014

Table 6.2: Operation Wise Per Hectare Human Labour Cost of Boro Rice Production

Operations	Total Labour (Man-days)	Total Cost (Tk.)	Percentage of Total Cost
Seed Bed Preparation	17.74	5321.14	9.09
Seedling Preparation	10.17	3052.63	5.21
Land Preparation	19.75	5925.89	10.12
Transplanting	25.47	8913.27	15.22
Fertilizer, Manure and Pesticide Application	3.41	853.03	1.46
Weeding	26.21	7863.96	13.43
Harvesting	60.74	21258.97	36.30
Threshing and Storing	17.90	5370.00	9.17
Total	181.39	58558.89	100

Source: Field Survey, 2014

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 (Figure 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 rice production (Figure 6.1).

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. 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 335.79 kg, 249.73 kg, 174.34 kg, 99 kg and 11.91 kg whose costs were estimated at Tk. 5372.64, Tk. 7491.9, Tk. 2179.25, Tk. 792 and Tk. 1429.2, respectively. Per hectare use of Urea, TSP, MOP, Gypsum and ZnSO4 for boro production were 326.98 kg, 182.77 kg, 124.05 kg, 56.70 kg and 7.64 kg whose costs were Tk. 5231.68, Tk. 5483.1, Tk. 1550.63, Tk. 453.6, and Tk. 916.8, respectively (Table 6.4). It was found that farmers paid the highest percentage (39 percent) of fertilizer cost for DAP and lowest percentage (4 percent) of fertilizer and manure cost for Gypsum for garlic production (Figure 6.1) and they paid the highest percentage (36 percent) of fertilizer cost for TSP and lowest percentage (5 percent) of fertilizer and manure cost for Gypsum for boro rice production (Figure 6.2).

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 cowdung from the milk producers. It was found that cowdung application was 20.34 gari and 7.21gari per hectare for garlic and boro rice production, respectively. And the cost of cowdung for garlic and boro rice production was Tk. 2034 and Tk. 721 (Table 6.4).

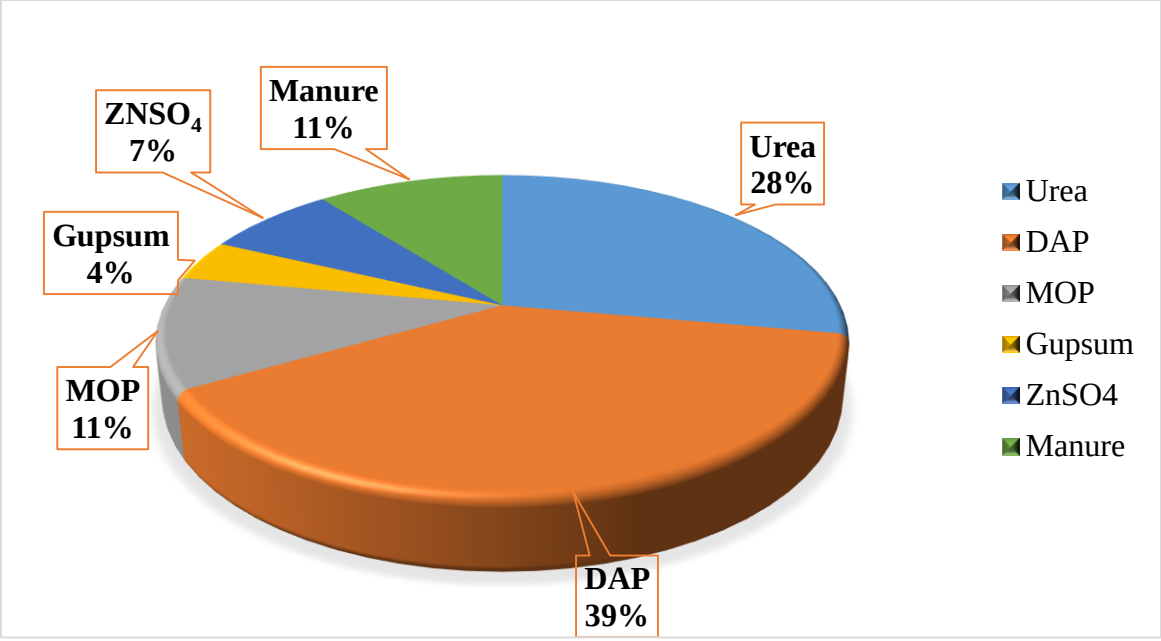

Figure 6.1: Percentage of Fertilizer and Manure Cost for Garlic Production

Source: Field Survey, 2014

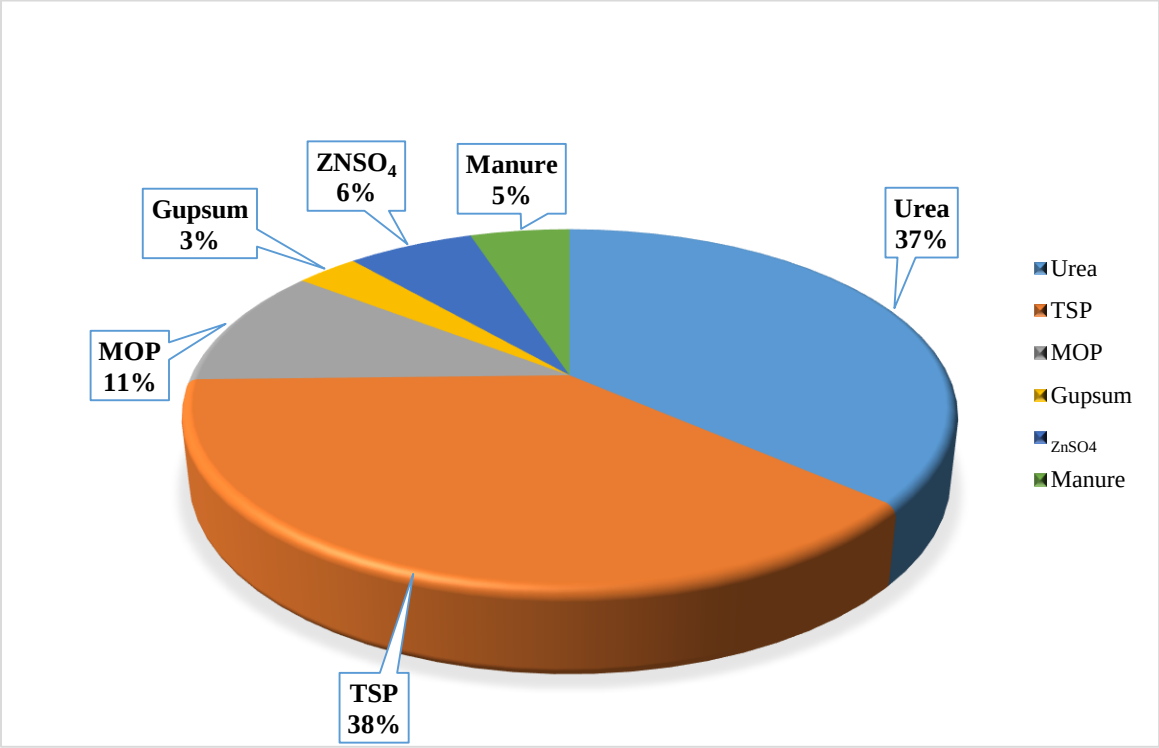

Figure 6.2: Percentage of Fertilizer and Manure Cost for Boro Rice Production

Source: Field Survey, 2014

6.2.5 Cost of Irrigation

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 rice production was Tk. 9163.47 and Tk. 31554.56 covering 3.3 and 21.62 percent of total cost, respectively.

6.2.6 Cost of Insecticides and Pesticides

Garlic and boro rice 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 rice production were Tk. 2815.97 and Tk. 1562.50 covering 1.01 and 1.07 percent of total cost, respectively (Table 6.3 and 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 rice production was Tk. 3057.61. While there was no cost for garlic production in this purpose. Tillage cost covered 2.09 percent of total cost of producing boro rice.

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 rice. Per hectare interest on operating capital was Tk. 11107.91 and Tk. 5527.66 for garlic and boro rice production, respectively (Table 6.3 and Table 6.4).

6.3.2 Land Use Cost

Land use cost was a fixed cost for garlic and boro rice 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. 44820 for garlic and Tk. 29880 for boro rice growers. Land use cost covered 16.12 and 20.47 percent of total cost for garlic and boro rice production, respectively (Table 6.3 and Table 6.4).

Table 6.3: Per Hectare Costs and Return of Garlic

Cost Items	Quantity	Price Per Unit (Tk.)	Value(Tk.)	Percentage of Total
A. Gross Return	9902.16 kg	47.369	469056.23	100
B. Total Variable Cost			222157.17	79.89
Seed	813.156 kg	66.74	54273.91	19.52
Human Labor	357.05 Man-days	382.59	136604.83	49.12
Total Fertilizer and Manure			19298.99	6.94
Urea	335.79 kg	16	5372.64	1.93
DAP	249.73 kg	30	7491.9	2.70
MoP	174.34 kg	12.5	2179.25	0.78
Gypsum	99 kg	8	792	0.28
$ZnSO_4$	11.91 kg	120	1429.2	0.52
Manure	20.34 Gari	100	2034	0.73
Irrigation Charge			9163.47	3.3
Insecticides and Pesticides			2815.97	1.01
C. Total Fixed Cost			55927.91	20.11
Interest on Operating Capital @ of 10% for 6 Months			11107.91	3.99
Land Use Cost			44820	16.12
D. Total Cost (B+C)			278085.08	100
E. Gross Margin (A-B)			246899.06	
F. Net Return (A-D)			190971.15	
G. BCR (Undiscounted)			1.69	

Source: Field Survey, 2014

6.4 Total Cost

In order to estimate total cost per hectare all the resources used in garlic and boro rice production has been recaptured together. It can be seen from Table 6.3 and Table 6.4 that per hectare total cost of production of garlic and boro rice were Tk. 278085.08 and Tk. 145960.9, respectively.

Table 6.4: Per Hectare Costs and Return of Boro Rice

Cost Items	Quantity	Price Per Unit (Tk.)	Value (Tk.)	Percentage of Total
A. Gross Return			195712.24	100
Product	8985.64 kg	20.50	184205.62	94.12
By Product			11506.62	5.88
B. Total Variable Cost			110553.24	75.74
Seed	39.03 kg	37.5	1463.63	1.00
Human Labor	181.39 Man-days	322.83	58558.13	40.12
Tillage Cost			3057.61	2.09
Total Fertilizer and Manure			14356.81	9.84
Urea	326.98 kg	16	5231.68	3.58
TSP	182.77 kg	30	5483.1	3.77
MoP	124.05 kg	12.5	1550.63	1.06
Gypsum	56.70 kg	8	453.6	0.31
$ZnSO_4$	7.64 kg	120	916.8	0.63
Manure	7.21 Gari	100	721	0.49
Irrigation Charge			31554.56	21.62
Insecticides and Pesticides			1562.50	1.07
C. Total Fixed Cost			35407.66	24.26
Interest on Operating Capital @ of 10% for 6 months			5527.66	3.79
Land Use Cost			29880	20.47
D. Total Cost (B+C)			145960.9	100
E. Gross Margin (A-B)			85159	
F. Net Return (A-D)			49751.34	
G. BCR (Undiscounted)			1.34	

Source: Field Survey, 2014

6.5 Yield and Gross Return

Per hectare average yield of garlic and boro rice were estimated 9902.16 kg and 8985.64 kg, respectively. Gross return per hectare was calculated by multiplying the total amount of products by average farmgate price. By product was included for boro rice production.

Per hectare gross return of garlic and boro rice were Tk. 469056.23 and Tk. 195712.24, respectively (Table 6.3 and Table 6.4). Figure 6.4 shows that per hectare gross return of garlic was higher than that of boro rice.

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. 246899.06 and Tk. 85159 for garlic and boro rice, respectively (Table 6.3 and Table 6.4). It is evident from Figure 6.3 that gross margin of garlic was higher than that of boro rice.

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 rice were Tk. 190971.15 and Tk. 49751.34, respectively (Table 6.3 and Table 6.4). Figure 6.3 shows that per hectare net return of garlic was higher than that of boro rice.

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 rice was calculated as a ratio of gross return and gross cost. Undiscounted Benefit cost ratio of garlic and boro rice production per hectare came out to be 1.69 and 1.34 respectively, which implies that Tk. 1.69 and Tk. 1.34, respectively for corresponding crop will be achieved by expending every Tk. 1.00 (Table 6.3 and Table 6.4).

6.9 Comparative Profitability of Garlic and Boro Rice

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

Table 6.5: Comparative Cost and Return of Garlic and Boro Rice Farming

Particulars	Garlic (per ha)	Boro Rice (per ha)
Average Yield (kg)	9902.16	8985.64
Gross Return (Tk.)	469056.23	195712.24
Total Variable Cost (Tk.)	222157.17	110553.24
Fixed Cost (Tk.)	55927.91	35407.66
Total Cost (Tk.)	278085.08	145960.9
Gross Margin (Tk.)	246899.06	85159
Net Return (Tk.)	190971.15	49751.34
BCR (Undiscounted)	1.69	1.34

Source: Field Survey, 2014

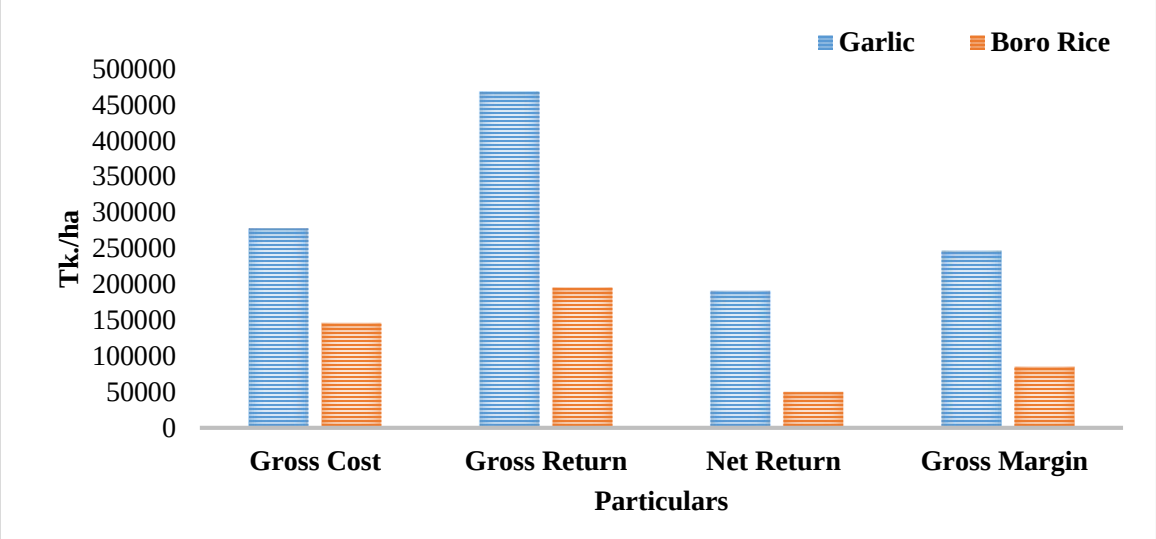

Figure 6.3: Gross Cost, Gross Return, Net Return and Gross Margin of these Crops

Source: Field Survey, 2014

6.10 Concluding Remarks

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

CHAPTER 7

MAJOR FACTORS AFFECTING THE PRODUCTION PROCESSES OF GARLIC AND BORO RICE

CHAPTER 7
MAJOR FACTORS AFFECTING THE PRODUCTION PROCESSES OF GARLIC AND BORO RICE

7.1 Introduction

The focus of this chapter to identify and assess the effects of some important variables of production on gross return of garlic and boro rice 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 rice 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 rice, 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 rice. 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:

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

For Boro Rice, 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:

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

Where,

Y = Gross return (Tk./ha)
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) (for boro rice)
$\beta_1, \beta_2 \ldots\ldots\ldots\ldots, \beta_6$ = 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 rice are presented in the Table 7.1.

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	2.084	1.0198	3.698	2.4421
Seed Cost (X_1)	0.629*	2.879	0.106	1.0766
Human Labour Cost (X_2)	0.094	0.332	0.103***	1.7154
Fertilizer and Manure Cost (X_3)	0.113**	2.082	0.624*	3.0410
Irrigation Cost (X_4)	0.026	0.638	0.039**	2.209
Insecticides and Pesticides Cost (X_5)	0.204***	1.845	-0.001	-0.07915
Tillage Cost (X_6)	-	-	0.0016	0.1123
R^2	0.90	-	0.96	-
F-value	45.350	-	93.321	-
Return to Scale ($\sum\beta_i$)	1.066	-	0.8726	-

Source: Field Survey, 2014

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

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 0.629. It was positive and was significant at 1 percent level. This indicated that an increase in one percent of seed cost, remaining other factors constant, would result in an increase in the gross return by 0.629 percent.

Human Labour Cost (X_2): The magnitude of the regression coefficient of human labour cost was 0.094 with a positive sign. It was insignificant.

Fertilizer Cost and Manure Cost (X_3): It can be seen from Table 7.1 that regression coefficient of fertilizer and manure cost was 0.113. It was positive and was significant at 5 percent level. This indicated that an increase in one percent of fertilizer cost, remaining other factors constant, would result in an increase in the gross return by 0.113 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 0.026. It was positive and non-significant.

Insecticides and Pesticides Cost (X_5): It can be seen from Table 7.1 that regression coefficient of insecticides and pesticides cost was 0.204 that was positive was significant at 10 percent level. This indicated that an increase in one percent of insecticides and pesticides cost, remaining other factors constant, would result in an increase in the gross return by 0.204 percent.

Coefficient of Multiple Determination (R^2): It is evident from Table 7.1 that the value of the Coefficient of multiple determination (R^2) was 0.90. It indicated that about 90 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 (45.350) of the estimated production function was highly significant., which implies good fit of the model.

Returns to Scale ($\sum\beta_i$): The summation of all the regression coefficients of the estimated production function of garlic was 1.066 (Table 7.1). This implied 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 one percent, gross return would increase by 1.066 percent.

7.4.2 Boro Rice

Seed Cost (X_1): It can be seen from Table 7.1 that regression coefficient of seed cost was 0.106. It was positive and was non-significant.

Human Labour Cost (X_2): The magnitude of the regression coefficient of human labour cost was 0.103 with a positive sign. It was significant at 10 percent level. It implied that one percent increase of human labour cost, keeping other factors constant, would lead to an increase in the gross return by 0.103 percent (Table 7.1).

Fertilizer Cost and Manure Cost (X_3): It can be seen from Table 7.1 that regression coefficient of fertilizer and manure cost was 0.624. It was positive and was significant at 1 percent level. This indicated that an increase in one percent of fertilizer cost, remaining other factors constant, would result in an increase in the gross return by 0.624 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 0.039. It was positive and was significant at 5 percent level. This indicated that an increase in one percent of irrigation water cost, remaining other factors constant, would result in an increase in the gross return by 0.039 percent.

Insecticides and Pesticides Cost (X_5): It can be seen from Table 7.1 that regression coefficient of insecticides and pesticides cost was 0.001 with a negative sign and was non-significant.

Tillage Cost (X_6): The magnitude of the regression coefficient of tillage cost was 0.0016 with a positive sign. This coefficient was statistically non-significant (Table 7.1).

Coefficient of Multiple Determination (R^2): It is evident from Table 7.1 that the value of the Coefficient of multiple determination (R^2) was 0.96. It indicates that about 96 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 (93.321) of the estimated production function was highly significant, which implies good fit of the model.

Returns to Scale ($\sum\beta_i$): The summation of all the regression coefficients of the estimated production function of boro rice was 0.8726 (Table 7.1). This implied that the production function exhibits decreasing returns to scale. In this case, if all the variables specified in the production function were increased by one percent, gross return would increase by 0.87260 percent.

7.5 Concluding Remarks

Cobb-Douglas production function model revealed that the key variables included in the model were individually or jointly responsible for variation in gross return of garlic and boro rice. It also revealed that garlic growers allocated their resources in the zone of increasing returns, which indicates that there was a bright prospect to earn more returns by making optimum use of more inputs in the production. On the other hand, boro rice growers allocated their resources in the zone of decreasing returns, which indicates that they were operating boro rice farming in the rational zone of production.

CHAPTER 8

PROBLEMS OF GARLIC AND BORO RICE GROWERS

CHAPTER 8
PROBLEMS OF GARLIC AND BORO RICE GROWERS

8.1 Introduction

Farmers faced a lot of problems in producing garlic and boro rice. The problems were social and cultural, financial and technical. This chapter aims at represent some socioeconomic problems of producing garlic and boro rice. The problems faced by the farmers were identified according to opinions given by them. The major problems and constraints related to garlic and boro rice 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 rice 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 till 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 rice cultivation from the relevant officials of the Department of Agricultural Extension (DAE). As an agricultural extension personnel block supervisor’s the mam advisor of technical knowledge to the fanners 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 block.

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 rice 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 Diseases

The growers of garlic and boro rice 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

Irrigation is the leading input for crop production. Yield of garlic and boro rice 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 rice growers reported this problem.

8.10 Lack of Operating Capital

The farmers of the study area had capital constraints. For cultivation of garlic and boro rice 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).

Table 8.1: Problems Faced by Garlic and Boro Rice Growers

Name of the Problems	Garlic Growers			Boro Rice Growers		
	Number	Percent	Rank	Number	Percent	Rank
Lack of Quality Seed	21	70	5	9	30	7
Lack of Quality Tillage	0	0	12	12	40	5
Lack of Scientific Knowledge of Farming	7	23.33	9	5	16.67	9
Inadequate Extension Service	4	13.33	10	3	10	10
High Price of Inputs	24	80	4	29	96.67	1
Low Price of Output	27	90	1	25	83.33	3
Attack of Pest and Diseases	17	56.67	6	9	30	7
High Cost of Irrigation	12	40	7	10	33.33	6
Lack of Operating Capital	26	86.67	2	13	43.33	4
Shortage of Human Labour	25	83.33	3	27	90	2
Adulteration of Fertilizers	7	23.33	9	6	20	8
Theft	3	10	11	1	3.33	11
Natural Calamities	8	26.67	8	6	20	8

Source: Field Survey, 2014

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 rice. Garlic and boro rice 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 Fertilizers, Insecticides and Pesticides

Chemical fertilizers, insecticides and pesticides are the most important inputs of garlic and boro rice production. They were being intensively used in garlic and boro rice 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 rice from the crop field and from the farmers' premises was also a limiting factor of garlic and boro rice 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 rice.

8.14 Natural Calamities

It was found that garlic and boro rice 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 rice. Table 8.1 shows that 26.67 percent garlic and 20 percent boro growers reported this problem.

8.15 Concluding Remarks

The above mentioned discussions as well as the results presented in Table 8.1 indicates that both garlic and boro rice growers in the study area have currently been facing some major problems in conducting their garlic and boro rice farming. These are the major constraints for the producers of garlic and boro rice 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 rice.

CHAPTER 9

SUMMARY, CONCLUSION AND RECOMMENDATIONS

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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 16.50 percent of the GDP and provides 47.30 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.

Climatic condition of Bangladesh is friendly for agricultural crops. In 2011-12, 44,000 hectares of land were cultivated for garlic and the production was 234000 MT with an average yield rate of 5.32 MT/ha. Whereas, the area under boro rice was 4812150 hectares and production was 18759000 MT with an average yield rate of 3.91 MT/ha.

Agriculture of Bangladesh is still dominated by rice production. According to the BBS final estimate, the volume of food grains production in FY 2012-13 stood at 372.66 lakh MT of which aus accounted for 21.58 lakh MT, aman 128.97 lakh MT, boro 187.78 lakh MT, wheat 12.55 lakh MT and maize 21.78 lakh MT. In FY 2013-14 food grains production stood 381.73 lakh MT of which aus accounted for 23.26 lakh MT, aman 130.23 lakh MT, boro 190.06 lakh MT, wheat 13.02 lakh MT and maize 25.16 lakh MT. In FY 2011-12, total area under spices is 3.25 lakh hectares with the total production of about

17.55 lakh metric tons in our country (BBS, 2014). Spices covers almost 2.16 percent of total cropped area in Bangladesh (BBS, 2014).

According to Bangladesh Bureau of Statistics 2014, in FY 2011-12, annual production of garlic and boro rice were 2.34 and 187.59 lakh metric tons, respectively. Despite having large population, there is a large gap between demand and supply, 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 rice the present study is conducted with the following objectives:

i. To assess the socio economic characteristics of garlic and boro rice growing farmers
ii. To estimate and compare the cost and returns of producing garlic and boro rice
iii. To identify the factors affecting the returns of producing garlic and boro rice
iv. To identify the problems faced by the farmers producing garlic and boro rice and
v. 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 rice 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 rice growers was 3.87 and 3.93, respectively and sex ratio was 1.63 and 1.46 for garlic and boro rice, respectively. The highest percentage of people was in the age group

of 15-59. Literacy rate of garlic and boro rice 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 rice 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 357.05 man-days and 181.39 man-days for garlic and boro rice respectively. Per hectare cost of human labour for garlic and boro rice production were Tk. 136604.83 and Tk. 58558.13, which represented 49.12 percent and 40.12 percent of the total cost, respectively. Per hectare tillage cost of boro rice production was Tk. 3057.61 covering 2.09 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 rice production was 813.156 kg and 39.03 kg, respectively. Per hectare cost of seed was estimated Tk. 54273.91 and Tk. 1463.63 covering 19.52 percent and 1.00 percent of the total cost of producing garlic and boro rice, respectively.

Per hectare use of Urea, DAP, MoP, Gypsum and $ZnSO_4$ for garlic production were 335.79 kg, 249.73 kg, 174.34 kg, 99 kg and 11.91 kg whose costs were estimated at Tk. 5372.64, Tk. 7491.9, Tk. 2179.25, Tk. 792 and Tk. 1429.2, respectively. Per hectare use of Urea, TSP, MoP, Gypsum and $ZnSO_4$ for boro rice production were 326.98 kg, 182.77 kg, 124.05 kg, 56.70 kg and 7.64 kg whose costs were Tk. 5231.68, Tk. 5483.1, Tk. 1550.63, Tk. 453.6 and Tk. 916.8, respectively. Per hectare cost of manure for garlic and boro rice production was Tk. 2034 and Tk. 721 covering 0.73 percent and 0.49 percent of the total cost, respectively.

Per hectare irrigation water charge of garlic and boro rice cultivation was calculated Tk. 9163.47 and Tk. 31554.56 covering 3.3 percent and 21.62 percent of the total cost, respectively. Per hectare insecticides and pesticides costs of garlic and boro rice cultivation was estimated Tk. 2815.97 and Tk. 1562.50, which constituted 1.01 percent and 1.07 percent of the total cost, respectively.

Land use cost per hectare was Tk. 44820 for garlic and Tk. 29880 for boro rice cultivation. It constituted 16.12 percent and 20.47 percent of the total cost of garlic and boro rice production, respectively. Interest on operating capital of garlic and boro rice cultivation was Tk. 11107.91 and Tk. 5527.66 covering 3.99 percent and 3.79 percent of the total cost, respectively. Per hectare fixed cost of garlic and boro rice production was Tk. 55927.91 and Tk. 35407.66, respectively.

Per hectare gross cost of garlic and boro rice production was Tk. 278085.08 and Tk. 145960.9, respectively. Per hectare gross margin of garlic and boro rice growers was Tk. 246899.06 and Tk. 85159, respectively. Per hectare net return of garlic and boro rice production was calculated Tk. 190971.15 and Tk. 49751.34, respectively. Undiscounted benefit cost ratio of garlic and boro rice production was 1.68 and 1.34, 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 was taken into account to explain variations in production. And for boro rice enterprise six explanatory variables was taken into account to explain variations in production. The coefficient of multiple determination, R^2, was 0.90 in case of garlic production function. This indicates that 90 percent of the variation of output of garlic was explained by the explanatory variables included in the model. The F-value (45.350) of the equation was highly significant, which indicates good fit of the model. The summation of the estimated coefficients was 1.066, which implies increasing returns to scale. The coefficient of multiple determination, R^2, was 0.96 in case of boro production function. This indicates that 96 percent of the variation of output of boro rice was explained by the explanatory variables included in the model. The F-value (93.321) of the equation was highly significant, which indicates good fit of the model. The summation of the estimated coefficients was 0.8726, which implies decreasing returns to scale. The present study also identified some problems of garlic and boro rice production. The major problems faced by the farmers were low price of output, high price of input, lack of quality seed, lack of operating capital, shortage of human labour, inadequate extension service 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 rice to increase income of the growers. Garlic and boro rice 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 rice 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 rice are 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 rice 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 rice cultivation.

9.4 Policy Recommendations

On the basis of the findings of the study it was manifest that both garlic and boro rice 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:

i. Quality seeds of improved varieties in appropriate quantity are recognized to be one of the prime 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.

ii. Lack of operating capital is a problem for the resource poor farmers of the study areas. Favourable institutional credit program should be launched aiming at

particularly the small and medium farmers. Specialized and commercial banks should be encouraged to provide loans at a low interest rate to enable farmers to operate their farming on commercial basis.

iii. Farmers could not get reasonable prices for garlic and boro rice. 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.

iv. Shortage of human labour was a major problem for the garlic and boro rice farmers of the study areas. Government and other authorities should take initiative for lessen these problem.

v. Adequate training on recommended use of quality seed, fertilizer dose, insecticides, water management practices, etc., should be provided to the garlic and boro rice farmers which will enhance production as well as resource use efficiency by improving the technical knowledge of the farmers.

9.5 Limitations of the Study

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

i. Maximum of the farmers did not keep any written documents of their farm activities. So that, information gathered mostly through their memories of the farmers which were not always accurate.

ii. In the resource and time constraints, broad and in-depth study got hampered to some extent. Therefore, the findings of this study should be interpreted cautiously to generalize for the country as a whole.

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 etc., 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 roads for further research which are given below:

i. 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.

ii. The study of other varieties of boro rice may be conducted individually with garlic to assess their comparative profitability.

iii. Acreage response, growth and instability of garlic and boro rice production can be studied with respect to Bangladesh.

iv. 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.

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APPENDICES

APPENDICES

Apendice 1: Summary Output of Garlic

Regression Statistics								
Multiple R	0.950940513							
R Square	0.904287859							
Adjusted R Square	0.88434783							
Standard Error	0.044294718							
Observations	30							
ANOVA								
	df	SS	MS	F	Significance F			
Regression	5	0.444892192	0.08897843	45.35037744	1.86574E-11			
Residual	24	0.047088528	0.00196202					
Total	29	0.49198072						
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	2.083863861	2.043334934	1.0198346	0.317977786	-2.13337217	6.30109989	-2.13337217	6.30109989
Seed	0.628975796	0.218480073	2.8788703	0.008259896	0.17805508	1.07989650	0.17805508	1.07989650
labour	0.094290965	0.283643392	0.3324278	0.742452298	-0.49112022	0.67970215	-0.49112022	0.67970215
Fertilizer and Manure	0.112950581	0.054259429	2.0816765	0.048208126	0.00096462	0.22493653	0.00096462	0.22493653
Irrigation	0.025464941	0.039912405	0.6380207	0.529501365	-0.05691021	0.10784009	-0.05691021	0.10784009
Insecticides and Pesticides	0.203917004	0.110533123	1.8448497	0.077436104	-0.02421215	0.43204615	-0.02421215	0.43204615

Source: Field Survey, 2014

Apendice 2: Summary Output of Garlic

Regression Statistics								
Multiple R	0.980073458							
R Square	0.960543982							
Adjusted R Square	0.950251108							
Standard Error	0.019332331							
Observations	30							
ANOVA								
	df	SS	MS	F	Significance F			
Regression	6	0.209266768	0.034877795	93.3212591	5.6157E-15			
Residual	23	0.008595997	0.000373739					
Total	29	0.217862765						
	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	3.69834347	1.51440915	2.44210322	0.02270446	0.5655494	6.83113	0.56554	6.83113
Seed	0.10556894	0.09804884	1.07669742	0.29277991	-0.0972605	0.30839	-0.09726	0.30839
Labour	0.10342654	0.06029104	1.71545464	0.09970500	-0.0212949	0.22814	-0.02129	0.22814
Power Tiller	0.00161774	0.01439566	0.11237742	0.91149920	-0.0281619	0.03139	-0.02816	0.03139
Fertilizer and Manure	0.62434715	0.20530821	3.04102380	0.00580248	0.1996347	1.04906	0.19963	1.04906
Irrigation	0.03878798	0.01755894	2.20901625	0.03740767	0.0024645	0.07511	0.00246	0.075111
Insecticides and Pesticides	-0.00106731	0.01348455	-0.07915117	0.93759701	-0.0289622	0.02682	-0.02896	0.026828

Source: Field Survey, 2014

Apendice 3: Import of Garlic and Requisites in Different Years

Items	**2008-09**		**2009-10**		**2010-11**		**2011-12**	
	Quantity(kg)	Value '000' Tk.	Quantity (kg)	Value '000' Tk.	Quantity (kg)	Value '000' Tk.	Quantity (kg)	Value '000' Tk.
Garlic	63990624	1483791	56520176	2989207	34316235	3872242	48728552	3217971777

Source: BBS, 2014