COMPARATIVE PROFITABILITY AND RESOURCE USE EFFICIENCY OF ONION AND GARLIC PRODUCTION IN SOME SELECTED AREAS OF SHARIATPUR DISTRICT

PROSANTO MANDOL

DEPARTMENT OF AGRICULTURAL ECONOMICS

SHER-E-BANGLA AGRICULTURAL UNIVERSITY

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BY

PROSANTO MANDOL

REGISTRATION NO: 15-06861

Email.com: Prosantosau530@gmail.com

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Approved by:

…….
Dr. Md. Mosharraf Uddin Molla
Member Director (CC)
Agricultural Economics and Rural Sociology Division
Bangladesh Agricultural Research Council
Dhaka-1215
Supervisor

…….
Dr. Monoj Kumar Majumder
Associate professor
Department of Agricultural Economics
Sher-e-Bangla Agricultural University,
Dhaka-1207
Co-Supervisor

……
Dr. Monoj Kumar Majumder
Chairman
Department of Agricultural Economics
Sher-e-Bangla Agricultural University, Dhaka

Department of Agricultural Economics
Sher-e-Bangla Agricultural University
Dhaka-1207, Bangladesh

Fax:
+88028155800
Web site:
www.sau.edu.bd

CERTIFICATE

This is to certify that thesis entitled, **"COMPARATIVE PROFITABILITY AND RESOURCE USE EFFICIENCY OF ONION AND GARLIC PRODUCTION IN SOME SELECTED AREAS OF SHARIATPUR DISTRICT"** *submitted to the Department of Agricultural Economics, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of* ***MASTER OF SCIENCE IN AGRICULTURAL ECONOMICS****, embodies the result of a piece of bona fide research work carried out by* ***PROSANTO MANDOL*** *bearing Registration No.* ***15-06861*** *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.

Date: June, 2022

Dhaka, Bangladesh

……

Dr. Md. Mosharraf Uddin Mollah
Member Director (CC)
Agricultural Economics and Rural Sociology Division
Bangladesh Agricultural Research Council
Dhaka-1215
Supervisor


Dedicated
To
My Beloved Parents

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ABSTRACT

This piece of research was undertaken in order to assess the comparative profitability and resource use efficiency of onion and garlic production in Shariatpur District. A total number of 60 farmers were randomly selected. Necessary statistical analyses were performed to achieve the objectives of the study. The Cobb-Douglas production function was used to determine the effects of individual inputs on and resource use efficiency of onion and garlic production. Per hectare total return for onion and garlic was about Tk.557023 and Tk. 665706, gross margin was about Tk. 361507 and Tk. 447925 and the net return was about Tk. 286487 and Tk. 371438 respectively. The undiscounted benefit cost ratio (BCR) was 2.06 and 2.26 for onion and garlic production respectively. The results indicated that garlic production was more profitable than the onion production. The net return was influenced by most of the factors included in land preparation, human labor, seed, fertilizer, irrigation and machinery. The return to scale of onion and garlic production was 1.46 and 1.10 respectively. This implies that the production function exhibits increasing return to scale. Resource use efficiency indicated that all of the resources were under used for onion production except overutilization of seed or bulb and zinc fertilizer. On the other hand, it indicated that all of the resources were under used for garlic production except overutilization of MoP fertilizer. Farmers producing onion and garlic faced problems related to production and marketing of the crops. It may be concluded that the farmers should be encouraged to grow more garlic rather than onion as a means of increasing farm income through diversification of crop production in the area under study.

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ABBREVIATIONS

AEZ	Agro-Ecological Zone
BARI	Bangladesh Agricultural Research Institute
BARC	Bangladesh Agricultural Research Council
BBS	Bangladesh Bureau of Statistics
BER	Bangladesh Economic Review
CV%	Percentage of coefficient of variance
cv.	Cultivar
DAE	Department of Agricultural Extension
DAS	Days after sowing
^{0}C	Degree Celsius
et al	And others
FAO	Food and Agriculture Organization
g	gram(s)
ha^{-1}	Per hectare
HI	Harvest Index
HIES	Household Income and Expenditure Survey
kg	Kilogram
Max	Maximum
mg	Milligram
Min	Minimum
MoP	Muriate of Potash
N	Nitrogen
No.	Number
NS	Not significant
%	Percent
SAU	Sher-e-Bangla Agricultural University
SRDI	Soil Resources and Development Institute
TSP	Triple Super Phosphate
UPOV	Union for the Protection of Plant Varieties
Wt.	Weight

CHAPTER I

INTRODUCTION

1.1 General Background of the Study

Bangladesh is a lower middle-income nation primarily focused on agriculture. Crop production is closely associated with the agriculture sector. With 169.8 million people living there, the nation is vast, spanning 147570 square kilometers (BBS, 2023). According to BBS (2020), 61.82 percent of the nation's population resides in rural areas. As a result, there is a direct correlation between economic development and agricultural sector performance. Key economic goals including the creation of jobs, the reduction of poverty, the development of human resources, and food security are significantly impacted by the performance of this sector. Due to inheritance laws, unequal land ownership distribution, and population growth, farms are frequently very small. An agricultural system that is profitable, sustainable, and ecologically friendly is necessary to guarantee the people's access to sustainable food security. The sectoral contributions to employment in Bangladesh's agriculture, industry, and service sectors are 40.6%, 20.40%, and 39%, respectively, as shown in Figure 1.1 (MoF, 2022).

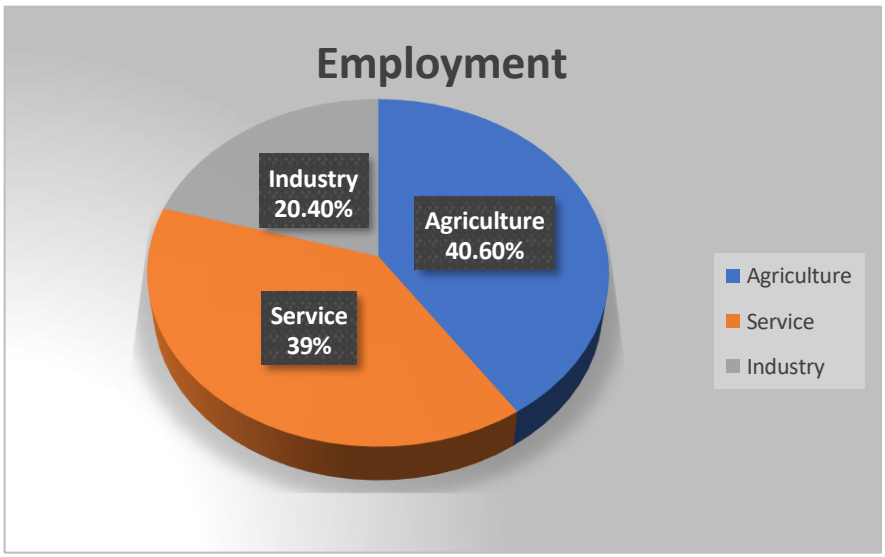

Figure-1.1: Sectoral Share of Employment in Bangladesh Source: (Ministry of Finance, 2022)

1.2 Present Status of Spices in Bangladesh

Spices have many uses in both cooking and medicine. They enhance the distinct flavor of food and can be used to alter the color of food to make it look more appetizing. Since ancient times, spices have played a significant role in food preparation, and nearly everyone uses them now. They come in different flavors and aroma. Some spices are boiled in water to make tea. Some of them grow in the wild and are very good. Species are also used as natural food preservatives. Pharmaceutically they have been used to flavor medicines. Spices are a broad term used to describe herbal by- products that add flavor and aesthetic, aromatic and therapeutic treatments to food, drink and other items. Taken from the leaf, flower, roots, bark or nuts of a plant, spices are usually dried and ground to be mixed with other ingredients. Spices appeal to the five senses and influence cultures and societies through trade and daily use (Kumar *et al*. 2011). The most widely used spices are Chilies (inter), Chilies (summer), Onion, Garlic, Turmeric, Ginger, Coriander Seed, Coriander Leaf, Black Cumin, Capsicum, Fenugreek plant, Mint, Joyeen etc. Spices have the potential to significantly improve Bangladesh's social development, increase farmers' income, generate jobs, end poverty, guarantee food security, and empower women.

Table 1.1 Area and Production of Onion and Garlic in Bangladesh

Spices and Condiments		Total Spices and Condiments	Onion		Garlic	
			Production	Percent of Total	Production	Percent of Total
2021-2022	Production (M.tons)	4014940.62	2517070.76	62.69	526819.16	13.12
	Area (acre)	1057707.33	507557.05	47.98	178435.56	16.87
2020-2021	Production (M.tons)	3191730.19	2268754.08	71.08	501611.52	15.71
	Area (acre)	1305539.56	480105.91	36.77	180034.75	13.79

Source: (BBS, 2023)

1.3 Origin and Status of Onion

Onion (*Allium cepa L.*) belongs to the family Alliaceae and it is one of the most important spices in Bangladesh (Ali *et al*., 2007). It covers almost 43% of the total areas under spices. The yield of onion in Bangladesh is low (9.734 t/ha) compared to world average of 19.20 t/ha (FAOSTAT-2019). China, India, the United States, Russia, Egypt, and Turkey are the top producers of onion (FAOSTAT-2019). In Bangladesh, onion are the most widely grown spice crops with 4.58 lakh hectares planted and 19.54 lakh metric tons produced annually. (BBS 2020).

During winter, onion is cultivated almost all districts in Bangladesh and widely in commercial base in the greater districts of Pabna, Rajshahi, Faridpur, Dhaka, Dinajpur, Jessore, Kushtia and Rangpur. According to BBS (2020), Faridpur has the largest area under cultivation (65991 hectares) and the highest yield (2.7 lakh metric tons) of onion in Bangladesh during the 2019–20 planting season. Local varieties like Faridpuri and Taherpuri yield the highest production, ranging from 7.48 to 8.98 tons per hectare. In addition, farmers are more likely to embrace these kinds since they yield larger returns on investment than earlier crop types did. Bangladesh has to import onion and garlic from different countries in every year to meet our annual demand.

1.4 The Beneficial Properties of Onion

Onion was used to be a medicine in the ancient period of time. In 16th century, doctors were prescribed of eating onion to fertile the infertility of women. The gladiators of Greece and Roman believed that the balance of blood could be lifted and their muscles could be firmed up by eating onion. Onion provide iron and calcium residues, vitamin B, and trace amounts of vitamin C. The edible portion of 100 gm of onion contains 1.10 gm protein, 9.34 gm carbohydrate, 23 mg of calcium and 40 kilocalories.

Table 1.2 Biochemical properties of Onion and Garlic (Value per 100 gm)

Name of Substances	Onion	Garlic
	Quantity	Quantity
Energy	40 kcal	149 kcal.
Protein	1.10 gm	.6.36 gm
Total lipid (fat)	0.10 gm	0.5 gm
Carbohydrate	9.34 gm	33.06 gm
Fiber, total dietary	1.7 gm	2.10 gm
Sugars, total	4.24 gm	1 gm
Calcium, Ca	0.023 gm	.181 gm
Potassium, K	0.146 gm	.401 gm
Iron, Fe	0.00021 gm	0.0017 gm
Vitamin C, total ascorbic acid	0.0074 gm	.0312 gm
Vitamin B1, Thiamin	0.000046 gm	0.0002 gm
Vitamin B2, Riboflavin	0.000027 gm	0.00011 gm

Source: (FAOSTAT, 2019)

1.5 Origin and Status of Garlic

For over 5,000 years, people have used garlic as food, a condiment, and a medication. It is thought to have come from central Asia and then been brought to the Mediterranean area. The Amaryllidaceae family includes garlic (Allium sativum L). Garlic is grown in approximately 9280000 MT of the world, making it the third most produced spice globally. In Bangladesh, the crop is grown extensively during the winter months. Garlic is ranked third among bulb spices in terms of area (44000 ha) and you (8234,000 MT). In comparison to the global average of 11.07 MT per hectare produced by garlic-cultivating nations, the average yield of garlic in our bangladesh is 5.32 MT per hectare, which is extremely low (BBS, 2014).

1.6 The Beneficial properties of Garlic

Garlic has a big and well-deserved reputation for such a small vegetable. This cousin of onion, leeks, and chives, and a member of the Amaryllidaceae family, can add bold, aromatic flavor to any dish and make it nutritious. According to Table 1.2, garlic is a great source of manganese, as well as a very good source of vitamin B, vitamin C, and selenium. Additionally, ajoene, an organosulfur compound present in garlic, may be helpful in the medicare of skin cancer. Allicin, the most powerful active ingredient in garlic, has been demonstrated to prevent weight gain in addition to lowering blood pressure. (Elkayam *et al*., 2003).

1.7 Statement of the Problem

Agriculture is a key factor in the nation's economic growth. The spices growing farmers particularly onion and garlic farmers face various constraints in Bangladesh. They may experience issues with irrigation, capital, high-quality bulbs, inputs, and a host of other issues. They might also have issues with low prices. During the growing season for onion and garlic, they do not receive a fair price. They have a few facilities for storage of onion and garlic. The Bangladeshi government ought to take action to improve the lot of farmers who grow spices, particularly onion and garlic. The government ought to guarantee the floor price of onion and garlic in addition to providing input subsidies. More storage space should be provided by the government to keep garlic and onion fresh during the off-season. Our nation can cultivate onion and garlic on its own and meet demand if the government implements this plan effectively.

1.8 Objectives of the Study

The Current study was undertaken to obtain the following objectives:

1 To know the socio-economic status of onion and garlic cultivating farmers in the study area;
2 To measure financial profitability of onion and garlic production;
3 To compare the resource use efficiency of onion and garlic production; and
4 To find out major problems of onion and garlic production in the selected area.

1.9 Justification of the Study

Bangladesh is an agricultural nation, so the expansion of the agricultural sector is crucial to the nation's economic growth. Although Bangladesh's agroclimate is favorable for various plants, 80 percent of the country's crop production is currently limited to grains, particularly rice (Alam, 2015). Bangladesh's climate is also ideal for growing garlic and onion. There are a number of reasons why Bangladesh's onion and garlic yield rates are so low, and the government ought to assist these farmers by offering input subsidies. In the Shariatpur district, the yield, area, and production of onion and garlic have fluctuated over time. The fact that cultivators do not get a fair price for their goods is one of the primary causes. Even they are unable to come to a firm conclusion about whether or not to cultivate onion and garlic the next year.

The financial viability and effective use of resources in the production of onion and garlic have been the subject of a few studies carried out in Bangladesh. In Shariatpur district there was no comparative study of onion and garlic production.

Ultimately, it is guessed that the research's conclusions will help individual farmers increase the efficiency with which they use their resources by managing and operating their farms effectively and by highlighting any shortcomings. They will also help policy makers and extension agents develop practical policies.

1.10 Organization of the thesis

The thesis is divided into Nine chapter. Chapter I showed the General Background of the Study, Current Status of Spices in Bangladesh, Origin and Status of Onion, The beneficial properties of Onion, Origin and Status of Garlic, The beneficial properties of of Garlic, Statement of the Problem, Objectives of the Study, Justification of the Study. Chapter II deals with the review of the literature, following chapter III describes the methodology. Chapter IV describes the socio-economic characteristics of sample farmers. In chapter V describes comparison of financial profitability analysis of onion and of garlic production. Chapter VI describes resource use efficiency of onion and garlic production, following chapter VII are described the problems of onion and garlic production. The summary, conclusion and recommendation are described in chapter VIII and Chapter IX describes references.

CHAPTER II
REVIEW OF LITERATURE

This chapter's primary goal is to review some relevant studies that are relevant to the one being studied right now. To date, very little research has been done on the profitability and resource efficiency of onion and garlics in Bangladesh. Besides, there is very little comparative economic analysis of the production of onion and garlic in the body of existing literature. Additionally, some of these studies might not be entirely applicable to recent research, but the conclusions, analysis technique, and recommendations made in them have a big influence on it. Below is a review of some of the previous research activities that have been done in relation to the current studies. Hasan (2021) studied the profitability of growing onion in particular regions as well as the efficient use of resources. The analysis shows that growing onion is a profitable endeavor. The total cost of cultivation per hectare was Tk. 258581.00. Tk. 512160.00 was the gross return and Tk. 253579.00 was the net return. Onion bulb yields per hectare were found to be 12804.00 kg. According to production function analysis, the variables in the model that affected the gross return on onion cultivation were the cost of the bulb, the total labor cost, and the cost of irrigation. The costs of pesticide and fertilizer, on the other hand, had a negative and insignificant impact.

According to Gul et al. (2018), the average farmer's area under cultivation for garlic was 1.13 hectares. The area used for garlic production made up 18.2% of all farmland. Farmers typically had only completed elementary school. 8,208 kg of garlic were produced by farmers per hectare on average. Garlic has been produced by farmers for over 22 years. The amount of N fertilizer used per hectare was approximately 187 kg, P was 151 kg, and K was estimated to be 105 kg. Garlic was produced with 1412 hours of labor per hectare. The computation of machine power consumption was 25 hours per hectare. Hired labor made up 80.84% of the labor force overall. One kilogram of garlic was produced at a cost of 3.22 TRY.

Rana (2018) conducted the study to evaluate the relative economic viability of producing boro paddy and garlic with zero tillage. Garlic and boro paddy yielded total returns per hectare of Tk. 274464 and Tk. 137828, respectively; gross margins were Tk. 94524 and Tk. 42751, and net returns were Tk. 53877 and Tk. 7383. The findings showed that growing garlic was a more profitable endeavor than growing boro paddy. The majority of the variables, including irrigation, power tilling, fertilizer and manure, seed, and human labor, had an impact on the net returns.

Alam (2015) studied the impacts of nitrogen and planting period on summer onion growth, harvesting, and storage. Since April 11th, a highest yield of 11.32 t/ha has been recorded. The harvesting of summer onion was significantly impacted by nitrogen as well. The data pertaining to May 12th showed the greatest percentages of weight damage (40.72 percent), decay (19.13 percent), and germination (4.72 percent). On April 11, when x BARI Piaz-3 x 0 kg N / ha were planted, the combined treatment resulted in very low percentages of weight loss (22.89 percent), decay (8.17 percent), as well as germination (1.33 percent).

Haile (2015) elucidated the factors that influence the technical, allocative, and economic efficiencies of small-scale onion growers. He discovered that a large portion of technical efficiencies were explained by land-related factors, and that both the technical and productive efficiencies were significantly and favorably impacted by the socioeconomic feathers of the farmers (level of age, market access, training access, experience, farm earning responsibility, as well as field visit). Household age, plot distance, fertility, and irrigation water source.

Grema and Gashua (2014) conducted a study on the economics of onion production with an emphasis on budgeting models, economic activities, descriptive statistics, and inferential statistics, which have had to locate the significant onion-growing experience. Onion production was profitable, according to the farm income analysis (N 98,134/ha). However, the producers deal with a number of issues, including high transportation costs, a shortage of storage facilities, restricted access to improved seeds, and high production input costs. Finally, the best course of action for achieving high onion productivity was to enhance the market structure and transportation infrastructure.

Barakade *et al*. (2014) concentrated an economic analysis of the yields of onion in specific regions of Bangladesh. They calculate the average total benefit to TK. 9931 and the cost of cultivating an acre of onion per Tk. 7376. A average yield of 242 millimeters of onion each hectare has been achieved.

Haque *et al.,* (2013) revealed that the study examined the input-output relationship, relative profitability, and barriers to garlic production in the districts of Magura and Faridpur in 2008–2009. 6.15 metric tons of garlic were produced per hectare. Per hectare, the net return and gross margin were Tk 56914 and Tk 70660, respectively. 1.87 was the benefit-to-cost ratio. In comparison to the cultivation of mustard, groundnuts, and cabbage, the net returns from garlic cultivation were 68%, 59%, and 0.64% higher.

Haque *et al*. (2011) researched the profitability of onion cultivation by taking three main onion growing region in Bangladesh. The cultivation of onion was found to cost Tk. 93517 per hector, with labor costs (24%) and seeding costs (41%) accounting for the majority of the costs. The yield of onion was found to be 9869 metric tons per hector. It was found that the gross return per hectare and the gross margin were Tk. 79487 and Tk. 85308, respectively. The main issues with onion cultivation in the research areas were determined to be the lack of HYV onion seed at the appropriate time, growers' lack of technical expertise, high cultivation costs, and the inability to obtain qualified fertilizer on time. Ultimately, they recommended that both governmental and non-governmental organizations step up and take appropriate action to address these issues.

Ullah (2008) studied the effects of varying sulfur amounts on onion bulb harvesting, tolerance, and economic return through experiments at the Regional Agricultural Research Station, Rahmatpur, Barisal. The maximum bulb yields (19.75 t/ha and 19.88 t/ha) were recorded for two years in a row at sulfur levels between 60 kg/ha as well as 75 kg/ha. The fermentation of the sulfur affected both the increasing weight and the decrease in decay to a great extent. At a sulfur amounts of 60 kg/ha, the maximum rate of average return (AR), or 9146 percent, was achieved with a gross margin of Tk. 181844 / ha.

Arif (2008) carried out research on onion production in Comilla district selected areas. He stated that the total cost was Tk. 64251.10, 65179.58, and 64741.42; the net returns for small, medium, and large fan categories were Tk. 37607.46, 37178.98, and 366617.14, respectively; the gross returns per hectare are Tk. 101858.56, 102358.56, and 101358.56.

Haque (2005) conducted a comparison of the economics of producing onion and garlic in a particular Pabna district area within Santhia Upazila. Garlic and onion were both profitable. Growing onion was a more profitable endeavor than growing garlic. The average yield of garlic and onion per hectare was 4510 kg and 8412 kg, respectively. Onion net return, gross margin, and total cost of production per hectare were Tk. 93567, Tk. 101230, and Tk. 49437, respectively. Conversely, Tk. 49386, Tk. 43693, and Tk. 36304 were the resembling figures for the cultivations of garlic, respectively.

Mahmood (2005) concentrated study on selected spices in the Comilla district of Bangladesh. He gave an example of the relative advantages of some spices over rival crops. Among all the rival crops, including potatoes, lentils, and garlic, onion were the most profitable. The net benifit per hectare of onion was Tk. 26673.7, allowing Tk. 25875.30 for potatoes, Tk. 20652.10 for lentils, and Tk. 16755.49 for garlic.

Harun-or-Rashid (2002) studied the TPS-garlic intercropping system's production potential and profitability at various row and spacing configurations. TPS was spaced 50 x 50 cm, whereas garlic was spaced 10 x 10 cm, 15 x 10 cm, and 15 x 15 cm. The configurations of the rows were alternate, double, and single. Potato + garlic in a double row arrangement with 15 x 15 cm spacing produced the maximum gross return (Tk. 169590/ha), net return (Tk. 74782/ha), LER (1.38), and BCR (1.80).

Akhter *et al*. (2001) carried out research on onion production in selected regions of Bangladesh. This research has demonstrated how profitable onion production is and how it can help farmers make money. Production of onion was more popular than other winter vegetables in terms of profitability. Onion was found to have higher yields per unit and gross returns than other competing plants.

Hossain (2001) showed that the results of co-planting onion and nuts in different crops during the Rabies seasons of 1993–1994 and 1994–1995 at the Agricultural Research Station in Shyampur, Rajshahi, Bangladesh. Six treatments were implemented: one where onion were placed between two rows of nuts (1:1), one where nuts were placed between two rows of alternate nuts (2:2), three rows of modified nuts and two rows of onion (3:2), and four rows of modified nuts and two rows of onion. As an example, only nuts were used in one of the treatments. On their own crop, a large yield of nuts and onion have been discovered.

Saha (2001) examined the relative advantages of various onion varieties in a particular Pabna District area. However, it has been discovered that Faridpuri varieties yield higher profits than other varieties. The taherpuri and Faridpuri onion species yielded total returns per hectare of Tk. 112389.00 and Tk. 135640.89, respectively; the corresponding net returns were Tk. 46756.28 and Tk. 67945.41. It was discovered that human consumption, agriculture, bulbs, fertilizers, pesticides, as well as irrigation water all had a significant impact on the net profit variability.

Awal *et al*. (2001) To ascertain the best use of the resource in the production of onion, a study was carried out to assess the effects of different uses. Research indicates that the return of onion is highly correlated with the following: raw materials, family work, employment, ashes, TSP, MP, and bulbs without irrigation; additionally, it is strongly correlated with animal labor, cattle, urea, and pesticides. These results also show that resource allocation is an area in which onion growers are unsuccessful.

Elias *et al*., (2000) carried out economic studies on the production of onion in particular Bangladeshi regions. According to their calculations, the cost of growing onion is Tk. 7376 per area and Tk. 9931 for the central return. Onion with a medium yield of 242 millimeters per hectare have been harvested.

Bhuyan (1999) carried out a study to determine how irrigation, mulch, and planting timing affected the amount and growth of garlic. According to the experiment, October 25 was the planting date that yielded the highest yield (3.92 mt/ha). November 9 (3.58 mt/ha), November 25 (3.55 mt/ha), and December 8 (3.08 mt/ha) were the next highest yielding dates. December 23 planting yielded the lowest yield (2.31 mt/ha).

CHAPTER III
METHODOLOGY

3.1 Introduction

A study's methodology is a crucial and essential component. The suitability of the methodology applied in the thesis has a significant impact on the dependability of a particular study finding. It is the author's great responsibility to clearly outline the types of methods and procedures that must be used in the selection of the research regions, data sources, analyses, and interpretations in order to reach a meaningful conclusion. In order to conduct this study, primary data were gathered from particular onion and garlic producers in particular regions of Shariatpur. For the measurement of resource use efficiency as well as financial profitability of onion and garlic cultivation. This chapter presents the methodological framework, which is divided into three main sections. The sampling process, sample frame, sample size, and survey design are all covered in the first section. The process for gathering data, both formal and informal surveys, and primary and secondary data are covered in the second section. The third section provides a detailed description of data analysis techniques.

3.2 Description of the study area

3.2.1 Location

Three areas within the Shariatpur district Shariatpur Sadar, Zanjira, and Noria are home to the chosen sample farmers. The Map 3.1 shows the locations of the upazilla.

Figure-3.1: Map of Shariatpur District.

3.2.2 Area and Population

The population and total area of the chosen areas are 1294561, with 621288 males and 6672722 females per square kilometer. The highest population is 199016 in Shariatpur Sadar (BER, 2022). Then the medium population is Noria and the fewer population density is in Zanjira

3.2.3 Educational and Occupational Status

The typical rate of literacy of Shariatpur district is 72.80 percent, 74.10 percent for male and 71.63 percent for female. 772 primary schools, 83 secondary schools, 19 lower secondary schools,42 madrasas,772, 4 technical schools, 16 colleges,1 university. Agriculture accounts for 58.60 percent of employment in the Shariatpur district, followed by non-agricultural labors (2.88 percent), factory workers (1.07%), and business workers (10.26 percent).

3.2.4 Physical Features, Topography and Soil Type

The Floodplain zone of the Lower Ganges River encompasses the Sariatpur region. Covered in mountains and central highlands, the eastern portion of the powerful Ganges River is known as the Lower Ganges River Floodplain, spanning (7968 sq km). The usual soil types consist largely 13% highland, 29 %medium high land,31% medium low land and 27% others. On average the content of organic matter is medium to high. The fertility rate is medium on average. In this area, the soils range from silty clay loams to heavy clays on lower regions, and from silty clay loams to ridge-top silt loams. The study made it evident that a large amount of spices, particularly onion and garlic lamps, were produced on the high clay soils of Pabna, Faridpur, and Shariatpur as well as the high middle ground of clay soils. The study area has extremely fertile soil that is ideal for raising a wide range of plants.

3.2.5 Transport, Communication and Marketing Facilities

The development of a certain area or nation requires communications and transportation. In the research areas, there are both muddy and paved roads. Farmers frequently do not deceive consumers by offering competitive prices for their produce because of their strong relationships with various markets.

The area's transportation modes include cars, trucks, pickup trucks, bulldozers, rickshaws, and boats. Local bazaars are held every morning and afternoon, and many hats are worn for more than one day each week.

3.2.6 Climate, Temperature and Rainfall

The summers in Shariapur regions are humid, and the winters are mild.. With a maximum temperature of 35.6°C in May and the lowest temperature of 11.6°C in January, the average yearly temperature is 28.5°C. The yearly mean precipitation in Shariatpur is 1325 millimeters. Between May and October, approximately 86.5 percent of the mid-year rainfall occurs. (BBS, 2020)

3.3 Sampling Procedure

It is not feasible to gather data from the entire population for an experimental study. As a result, conclusions drawn by researchers are frequently based on data obtained from a representative sample of the population. Both the quantity and quality of information gathered from the survey are typically influenced by the sample size and degree of variation. It is possible to control both factors by using suitable sampling techniques. (Scheaffer, 1979). The goal is to come up with a sampling plan that is low-cost, simple to use, and yields estimates that are impartial and have little variance (Barnett, 1991). The following is a description of the key elements of sampling theory as they are used in this research.

3.3.1 Sampling Method

Because it is impossible to cover the entire population, choosing a sample from the population is typically employed in economics, marketing, and other fields (Barnett, 1991; Kinnear and Taylor, 1987). The primary barrier to conducting interviews with the entire population, according to the authors, is expense. A sample is a more suitable approach given the constraints in terms of resources (money, time, effort, and data management). Sampling theory carried out an scope to reduce cost and to gain approvable outcomes (Casley and Kumar, 1988; Kinnear and Taylor, 1987). However, a sampling procedure includes the following points: defining the population, sample frame, sample size and sample selection procedure.

3.3.2 Defining the Population

The first step in the sampling process is to separate the population according to the research feature, sample unit, location, and time frame (Kinnear and Taylor, 1987). Growers of onion and garlic in the district of Shariatpur comprised the sample units.

3.3.3 Sampling Frame

To choose a location with extensive onion and garlic cultivation, the sample framework for the current research was chosen. The following factors were considered when choosing research locations because of the high production of onion and garlic.

a) There are lots of growers of onion and garlic, which are growing nicely, and farmers in these research areas are growing onion and garlic on a sizable portion of their land.
b) The topography, soil, and climates that produced spices were similar in these regions.
c) These villages have good communication services and easy access.
d) The researcher was conversant in the local tongue and other socioeconomic factors pertaining to the farmers in the districts that were chosen, and the likelihood of receiving a more accurate data set was indicated by the high expectation of respondents' responses.
e) Performing social and economic study in this area.

3.3.4 Sample Size

"How large should the sample be?" is a common first question that comes up in a sample survey. A good survey sample, according to Casley and Kumar (1988) and Kinnear and Tayler (1987), should have a minimum standard error as well as a small sampling error. You can get this if you have an endless supply of resources.

However, the researcher will always have to choose between the best and aggregable levels of error, reliability, and confidence due to the unavoidable time and financial constraints. To choose a representative sample size of onion and garlic producers, simple guidelines for calculating sample size provided by Poate and Daplyn (1993) were taken into consideration. For this research, sixty farmers were selected randomly (20 per upazila at Shariatpur Sadar, Noria & Zanjira), where thirty are onion cultivating farmers and thirty are garlic cultivating farmers as samples in the study areas.

3.3.5 Sample Selection Procedure

The researcher aims to avoid bias in the sample selection procedure in order to obtain accuracy in the estimates—that is, a small standard error (Kinnear and Taylor, 1987). Using simple random sampling, where each unit of the population has an equal chance of being selected, is the best way to prevent bias in the sample selection method (Scheaffer, 1979). Upazilas with a high concentration of onion and garlic were purposefully chosen from each district. Next, using a straightforward random sampling technique, two villages were chosen from each upazila, and lastly, random sampling was used to choose the final sampling units, or households. The process was thorough and inclusive of the entire population.

3.4 Data Collection Procedure

Primary data was gathered through surveying producers of garlic and onion in the designated areas. The methodology included a field survey, an analysis of earlier research, interviews with experienced growers of onion and garlic, and the researchers' own direct investigation. Assessing the current management techniques, input usage, and marketing strategy of producers of onion and garlic was emphasized during the direct observation.

3.4.1 Informal Survey

This informal survey was designed to collect quick data on a range of study aspects, arrange a field work schedule, assess the validity of the questionnaire, and estimate various cost components, including travel expenses, interview time, and financial costs. This initial survey offered the chance to comprehend the current costs associated with inputs, output, and labor utilization. A group of spice farmers were interviewed about one or more study-related topics during the informal survey, and field notes were created.

3.4.2 Formal Sample Survey

During the fieldwork, gaining the trust of the farmers and gathering precise information was crucial. The majority of the interviews took place in the farmer's home or on the farm. Typically, the interview began with an overview of the researcher's background, the study's goals, and the selection process for the respondent. The conversation began with broad subjects that interested the farmers, like social life, families, the growing and contracting of onion and garlic, etc. The researcher gradually shifted the conversation to the problems and practices surrounding the production of onion and garlic. Next, particular inquiries from the survey were posed, and the responses were documented

3.4.3 Design of Questionnaire

Creating a questionnaire is a challenging task during the survey planning phase (Casely and Lury, 1981). When creating a questionnaire, two primary issues are frequently observed:

a) The questionnaire is frequently lengthy or covers an excessive number of topics;
b) There is a lack of organization in the question sequence.

Given that the survey's success primarily depends on the survey schedule's creation, a draft schedule for pre-testing was created in order to confirm the questions' applicability and the farmers' response patterns. Following were the heads that were included in the questionnaire design for this study:

i. Sample farmer profile;
ii. Sample farmer family composition;
iii. Sample farmer occupation and educational background;
iv. Land information;
v. Onion and garlic production cost;
vi. Capital source;
vii. Onion and garlic yield; and
viii. Issues encountered by the farmers in cultivating onion and garlic.

Although the questionnaire was in English, the respondents were asked questions in their native tongues.

3.4.4 Data Collection Techniques

While secondary data was obtained from statistical bulletins, publications, primary data was obtained through field surveys. The lack of producer records pertaining to farm operations meant that data collection relied on a variety of techniques, some of which rely on memory recall for fundamental details like labor costs, wages, and input usage.

3.4.4.1 Primary Data Collection

The researcher needs to ascertain how well the data from a specific year, particularly with regard to crop yields, annual production, and price level, represents the typical or average conditions. In general, farmers plant garlic and onion in mid-December to early January, harvesting the crops after three months. The information used in this study was gathered between March and April of 2023. In order to obtain a better understanding, perceptions, and thought about growing and marketing programs in the study region, farmers' fields were also visited. Production activity was estimated using the primary data that was gathered from the farmers.

3.4.4.2 Secondary Data Collection

Secondary data were gathered from a range of research papers and related publications.

- Bangladesh Economic Review
- Bangladesh Statistical Yearbook,
- Agricultural Statistical Yearbook of Bangladesh
- National Zilla Batayan as well as
- National and international journals, articles, and books

3.5 Accuracy of the Data

Enough precautions were taken to reduce the possibility of errors during the data collection process.

The actions followed were

• Inbuilt evaluation mechanism

• exploring the site; and

• Independent interviews with respondents.

In order to verify that the data generated was reliable, additional field visits were made to gather additional information.

3.6 Processing, Editing and Tabulation of Data

To ensure compliance and completeness, the gathered data was examined and validated. Every piece of information gathered was condensed and thoroughly examined to ensure that no mistakes remained. To a lesser extent, performance analysis was also used in order to get the desired results. On a computer, data entry was completed, and the appropriate Microsoft Excel software and STRATA software were used for analysis.

3.7 Analytical Techniques

In this investigation, a number of analytical techniques were used. A large portion of the data analysis was done using the tabular approach. Rather fundamental statistical methods, like percentage, arithmetic mean, and geo-metric mean, were used to describe the socioeconomic traits of onion and garlic growers, the use of inputs, the costs and returns of cultivating onion and garlic, and the calculation of the undiscounted benefit cost ratio (BCR).

In line with the theory of production function, the current study will use the Cobb-Douglas production function to estimate the level of resource use efficiency.

3.7.1 Financial Profitability Analysis

The profitability of producing onion and garlic in the study areas was determined by analyzing various cost and return parameters. The following algebraic equation (3.1), as used by Rashid and Matin (2018), was applied to calculate the financial profitability of onion and garlic,

$$\pi_i = \sum P_i\, n_{i=1}\, Q_i - TC_i = \sum P_i\, n_{i=1}\, Q_i - (VC_i + FC_i) \quad (3.1)$$

Here,

π_i = Profit (Tk./ha)

Q_i = Quantity of i^{th} farmers (kg/ha)

P_i = Price of i^{th} farmers (Tk./kg)

TC_i = Total cost (Tk./ha)

VC_i = Variable cost (Tk./ha)

FC_i = Fixed cost Tk./ha)

i = Number of farmers (1,2,3, n)

Through the analysis of several cost and return parameters, the profitability of growing onion and garlic in the study areas was ascertained. Rashid and Matin (2018) calculated the financial profitability of onion and garlic using the algebraic equation (3.1).

The amount of land rented, family labor, interest on OC, and machinery were all considered fixed costs (FC). I did not include DAP, Vermicompost, and Compost fertilizers because they are not used in the research locality.

Gross return: To calculate the gross return during the harvesting period, just multiply the total volume of yields by the price per unit.

Gross margin: The gross margin was computed in order to estimate the difference between gross return and variable costs.

Net return: The net margin was computed by subtracting the gross return from all costs, both fixed and variable.

3.7.1.1 Cost of Land Preparation

Plow work, ladder work, cleaning, and other tasks required to prepare the soil for planting bulbs were part of the land preparation for the production of onion and garlic. It was discovered that the quantity of ploughings differed between farms and between locations.

3.7.1.2 Cost of Human Labor

Generally, human labor is expensive for a variety of reasons. The cost of human labor was calculated by multiplying the recorded man-days per hectare by the wage per man-day for a particular operation.

3.7.1.3 Cost of bulb

The cost of the bulbs was computed using the market prices of reputable onion and garlic bulbs. To determine the cost of bulbs for the research areas, the total number of bulbs required per hectare was multiplied through the bulb's market value.

3.7.1.4 Cost of Urea

Based on the market price that the farmers who responded paid, the cost of urea was calculated. The reported unit of urea per hectare was multiplied by the market price of urea to determine the cost of urea.

3.7.1.5 Cost of TSP

The market price of TSP was multiplied through the recorded unit of TSP per hectare to determine the cost of TSP.

3.7.1.6 Cost of MoP

The recorded unit of MoP was multiplied through the per unit market price of MoP hectare for various operations to determine the cost of MoP per hectare.

3.7.1.7 Cost of Zinc

To commute the cost of Zinc per hectare, the recorded unit of Zinc was multiplied by per unit market price of Zinc hectare for various operation.

3.7.1.8 Cost of Pesticides

To keep pests and diseases away from their crops, farmers apply two to three different kinds of pesticides. The market price of the pesticides applied per hectare in the research locality is the basis for calculating the cost of pesticides.

3.7.1.9 Irrigation cost

The cost of irrigation varies from grower to grower and it was computed by taking into account the cost and frequency of watering times.

3.7.1.10 Interest on Operating Capital

Since no costs were incurred initially or at any point during that time, the operating cost displays the average operating cost during that session. Onion and garlic cultivation was calculated at a three-month interest rate of four percent on average. The following formula is used to calculate interest on operating expenses (3.2).

The Formula is,

$$IOC = AIit \quad \textbf{(3.2)}$$

There, IOC = Interest rate on operating capital, i = Interest Rate, AI = Total Investment/*4, t = Total cycle time

3.7.1.11 Cobb Douglas production function

The technical connection between the input and output elements is represented by the production function. The first form used by Cobb and Douglas was-

$$\mathbf{Q = a\, L^{\beta}\, K^{1-\beta}\, U} \quad \textbf{(3.3)}$$

This forces the expansion amount to one. Their later conversion was

$$\mathbf{Q = a\, L^{a}\, K^{\beta}\, U} \quad \textbf{(3.4)}$$

Where, a+ß it does not have to be equal to one.

There is no restriction on the number of variables to one or to the same amount of flexibility. In its stochastic form, Cobb-Douglas production work is characterized by

There, Y = output

X_2 = labor input, X_3 = capital input

u = the name of the stochastic disorder,

e = the basis of the natural logarithm.

It is evident from Eq. (3.5) that there is a nonlinear relationship between the output and the two inputs. But if we modify this model, we obtain:

$$\mathbf{lnYi = lnß_1 + ß_2\ lnX_{2i} + ß_3\ lnX_{3i} + u_i = ß_0 + ß_2\ lnX_{2i} + ß_3\ lnX_{3i} + u_i} \quad \mathbf{(3.6)}$$

Where, $ß_0 = lnß_1$.

The model is a vertical line model since, when written this way, it is linear in the parameters ß0, ß2, and ß3. However, take note that this line appears in the logs of these variables rather than the Y and X variations. Simply put, (3.6) is the opposing half of the multiple retrospective log two-line log model. It can also be referred to as a log model, double log, or linear line. So, if I have a flexible log-linear model:

$$\mathbf{lnY_i = ß_0 + ß_2\ lnX_{2i} + ß_3\ lnX_{3i} + \ldots\ldots + ß_k\ lnX_{ki} + u_i} \quad \mathbf{(3.7)}$$

Each of the coefficients (partially) of the regression, $ß_2$ to $ß_k$, is the Y's extension (partially) with respect to the X_2 to X_k variable. Assuming that the model (3.6) satisfies the considerationof the retrospective model found retarded by OLS.

3.7.1.12 Specification of the Cobb-Douglas Production Function

The Cobb- Douglas production method was utilized to analyze the input-output relationship in the cultivation of onion and garlic, using the following model specifications.

$$\mathbf{Y=}\ a\ X_1^{b1}\ X_2^{b2}\ X_3^{b3}\ X_4^{b4}\ X\ _5^{b5}\ X_6^{b6}\ X_7^{b7}\ X_8^{b8} e^{ui} \quad \mathbf{(3.8)}$$

In order to solve the Cobb-Douglas production function in the Ordinary Least Square (OLS) format, it has been transformed into the subsequent logarithmic form.

Where,

Y = Total annual Return (Tk/ha);

X_1= Cost of Land Preparation (Tk/ha);

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

X_3= Cost of Urea (Tk./ha);

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

X_5 = Cost of MoP (Tk/ha);

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

X_7= Cost of Irrigation (Tk/ha);

X_8= Cost of Machinery (Tk./ha);

a = Disconnect;

b1……b8 = Coefficient of corresponding fluctuations;

U_i = Error Time;

i = 1, 2,…….....8

3.8 Measurement of Resource Use Efficiency

To assess the efficiency, the ratio of each input's marginal factor cost (MFC) to its marginal value product (MVP) was calculated and checked to see if it equaled 1. i.e., MVP/MFC = 1.

The additional to gross returns in value terms caused by an additional unit of a resource is its marginal productivity, assuming all other inputs remain constant. The marginal physical product (MPP) is multiplied by the product's unit price to determine the MVP. By utilizing the geometric means of resources (Xi) and gross return (Y), the most precise and potentially most valuable estimate of MVP can be obtained.

The MPP and matching MVP values for this study were determined as follows:

MPP_{xi} *Pxi=MFC=1 **(3.9)**

Where,

MPPxi *Pyi = MVP,

But, MPP = bi*(Y/Xi)

So, MVP = bi* (Y/Xi) Pyi

Where,

bi = Regression coefficient per resource

Y = Mean output

Xi = Mean value of inputs

Pyi = Price of output

MFC = Marginal Factor Cost (price per unit of input).

CHAPTER IV
SOCIO-ECONOMIC CHARACTERISTICS OF SAMPLE FARMERS

4.1. Introduction

This chapter addresses the sample farmers' socioeconomic attributes. Twenty (33.33 percent), twenty (33.33 percent), and twenty (33.33 percent) farmers were selected for the study from Shariatpur sadar, Noria, and Zanjira Upazila, respectively. Lastly, the financial aspects of the sample families were assessed. This was age distribution, year of schooling, source of income, agricultural farming experience, total farm size, no. of family member, annual expenditure etc. A precise description of these elements is given below

4.2. Age Distribution of the Farm Families

Family members who farmed onion and garlic were accounted for based on their age at the time of the interview. Members of farmer's family were divided into four types according to their ages (Table 4.1). Regarding onion farmers, the age group with the greatest proportion of family members was between 18 and 60 years old (73.33%), while the age group with the lowest proportion was below 18 years old (6.67) (Table 4.1). Regarding garlic farmers, the age group with the greatest number of family members was 18 to 60 years old (66.67), while the age group with the least number of family members was under 18 years old (3.33) (Table 4.1).

Table 4.1 Age Distribution of the Respondent farmers

Age Category	Onion		Garlic	
	No. Respondent	Percentage (%)	No. Respondent	Percentage (%)
Bellow 18	2	6.67	1	3.33
18-60 Years	22	73.33	20	66.67
Above 60 Years	6	20	9	30
Total	30	100	30	100

Source: (Field Survey 2023)

4.3. Year of Schooling of Respondent Farmers

Education helps people to make right decision relating his production and farm business. It makes a person more efficient of handling scarce resources and hence to gain maximum benefit (Miah, 1990). The educational level of onion and garlic farm family members is shown in Figure 4.1

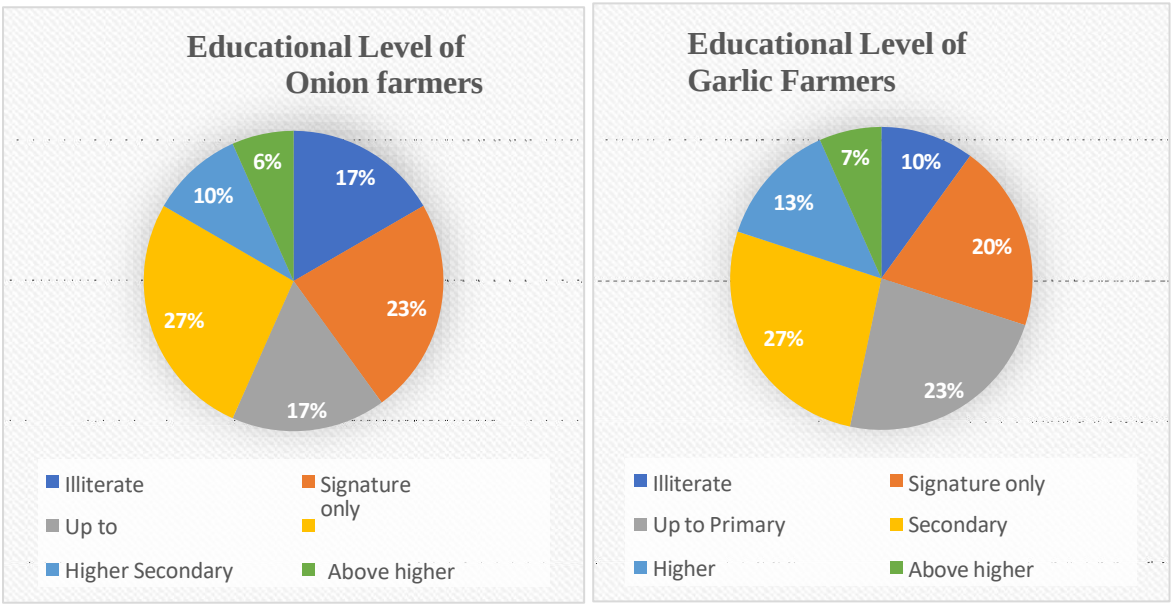

Figure 4.1 Educational Status of the Respondent Farmers

Source: (Field Survey 2023)

Figure 4.1 shows that, among families that farmed onion, 17 percent had no literacy, 23 percent could read and write, 17 percent had completed primary school, 27 percent had completed secondary school, and just 6 percent had completed higher secondary education. According to the above figure, 10% of family members in garlic farm families were illiterate, 20% could sign, 23% had completed primary education, 27% had completed secondary education, 13% had completed higher secondary education, and 7% had completed higher secondary education or above Furthermore, research revealed that the literacy rates of farm families growing onion and garlic were 83% and 90%, respectively. It suggests that farmers who are literate participate in the production process.

4.4 Annual Household Income of the Respondents

Farmers were arbitrarily categorized into three groups: "low," "medium," and "high" groups based on their annual income. A family is classified as low-income if its annual income is less than Tk. 200000, as medium-income if it is between Tk. 200000 and Tk. 400000, and as high-income if it exceeds Tk. 400000. Table 4.2 shows the distribution of farmers based on their income.

4.2 Distribution of Annual Household Income

Category	Basis of Categories ('000'Tk.)	Onion Growers		Category wise Average income (Tk.)	Garlic Growers		Category wise Average income (Tk.)
		No of farmers	Percent (%)		No of farmers	Percent (%)	
Low Income	<200	7	23.33	185430	6	20	194166.66
Medium Income	200-400	18	60	250444	20	66.67	292950
High Income	>400	5	16.67	553600	4	13.33	442500
Total/ Average		30	100	329824.67	30	100	309872.22

Source: (Field Survey 2023)

Table 4.2 shows that of the onion growers, 23.33 percent have low incomes, 60 percent have medium incomes, and 16.67 percent have high incomes. Twenty percent of garlic growers have low incomes, 66.67 percent have medium incomes, and 13.33 percent have high incomes. Here, farmers who grow garlic make a significantly higher living than those who grow onion. In Bangladesh, our per capita income is Tk. 241470 ($ 2824) (BER 2022) and national monthly household income TK. 344222 (HIES 2022). In the study area, 76.67 percent onion producing farmers' income is higher than the national level of income and 80 percent garlic producing farmers' income is higher than the national level of income.

4.5 Land Distribution Pattern

Individuals are considered to belong to distinct tenure classes and have different types of rights regarding the use of land (Bishop and Toussaint, 1958). Yang (1965) states that the total area under cultivation by the farmers is used to calculate the size of the farm. The area rented from and mortgaged in by others is added, and the area given as rent, mortgaged out to, and leased to others is subtracted.

Table 4.3 Average Land Distribution of the Sample Farmers

Category of Land	Onion Growers		Garlic Growers	
	Area per ha	rcent (%)	Area per ha	Percent (%)
Homestead	0.0842	8.42	0.1085	10.37
Own cultivation	0.83877	83.87	0.8152	81.52
Mortgage out	0.009	0.9	0.0085	0.85
Mortgage in	0.009	0.9	0.0072	0.72
Given on Lease	0.0155	1.55	0.0064	0.64
Taken on Lease	0.023	2.3	0.0325	3.25
Fallow	0.0206	2.06	0.0265	2.65
Total	0.95	100	0.975	100

Source: (Field Survey 2023)

Onion and garlic growers' average farm sizes were 0.95 ha and 0.975 ha, respectively, according to Table 4.3. Of the total land area, the growers of onion and garlic cultivated 42.60 percent and 34.40 percent of their crop land, respectively.; homestead (orchard, pond) area were 8.42 percent and 10.37 percent land under own cultivation was 83.87 percent and 81.52 percent, the amount of lease and mortgage and lease was very little, fallow land was only 2.06 percent and 2.65 percent for onion and garlic farmer respectively to the total land area.

4.6 Composition of the Family Size

The definition of a family used in this study is any group of people who live together, share a kitchen, and are managed by a single-family head. The family was categorized as small, medium and large according to the number of family member.

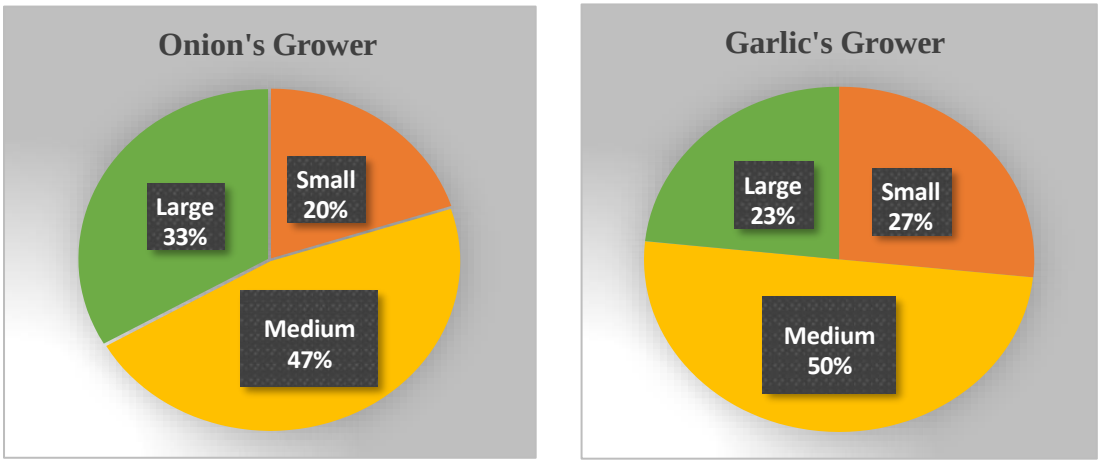

Figure 4.2: Average Family Size of Respondent Farmers

Source: (Field Survey 2023)

According to the figure 4.2 the average family sizes for onion and garlic growers were 4.66 persons and 4.83 persons respectively. Where, family members per household are 4.00 in the last population census (BBS, 2022). In case of onion grower's 20 percent families were small, 47 percent families were medium size and 33 percent family were large size. On the other hand, for garlic growers, 27 percent families were small, 50 percent families were medium size and 23 percent family were large size. On average medium size family was higher in both crops.

4.7 Concluding Remarks

The conversations above make it evident that the socioeconomic traits of onion and garlic growers differ in certain ways and are similar in others. However, the differences were not very significant in size. Garlic and onion cultivars share a very similar socioeconomic profile in the same locality. There are strong indications that growers of garlic and onion were progressive.

CHAPTER V
PROFITABILITY ANALYSIS OF ONION AND GARLIC PRODUCTION

5.1 Introduction

This section projects the costs, returns, and profitability of producing onion and garlic. The cost items for the production of onion and garlic were divided into two types: (i) variable cost as well as (ii) fixed cost, for the purpose of calculating the costs and returns. The cost of all variable components, such as irrigation, fertilizer, insecticides, pesticides, hired labor, seed, weeding, and land preparation, was included in the variable cost. Conversely, the costs associated with land use, family labor, interest on operating capital, and machinery were computed as fixed costs. This section determined the return metrics of gross return, gross margin, net return, and undiscounted benefit cost ratio (BCR).

5.2 Variable Cost

5.2.1 Land Preparation Cost

In the study area for species crops land preparation various activities are done. According to Table 5.1, the cost of preparing land for onion production per hectare was 22200.33 Tk, or 8.21% of the total cost of production per hectare. For this purpose, the cost of producing garlic was tk. 23518.35, or 7.99% of the total cost of production per hectare.

5.2.2 Cost of Bulb

Cost of Bulb of onion and garlic varies basing upon the quality and convenience of bulb. It can be observed from Table 5.1 that per hectare requirement of onion seed was 1701.73 kg and average cost of onion seed per hectare was estimated Tk. 83078.34. In case of garlic use of seed was 480.80 kg and average cost of garlic seed per hectare was measured Tk. 91870.35 (Table 5.2). Seed cost generated 30.71 and 31.22 percent of total cost of producing onion and garlic respectively. It was evident that garlic had comparatively higher seed costs than onion.

5.2.3 Cost of weeding

Weeding was one of the vital practices in producing both onion and garlic. It shared a major part of total cost of garlic and onion production. The cost of weeding was estimated Tk. 9595.13 and Tk. 9345.43 for onion and garlic respectively. The cost of weeding was 3.55and 3.18 percent of total cost of onion and garlic production respectively. It was distinct that cost of weeding was comparatively greater for onion than garlic (Tables 5.1 and 5.2).

5.2.4 Cost of Fertilizer

Fertilizers like urea, TSP, MOP, and ZnSO4 were frequently used. The way that different businesses applied fertilizers varied somewhat. It can be observed from Table 5.1, the corresponding per-hectare uses of urea, TSP, MOP, and ZnSO4 for onion production: 150.61 kg, 243.62 kg, 96.46 kg, and 20.18 kg respectively. The associated costs were Tk 4066.42 tk, 6577.87 tk, 1923.18 tk, and 2784.81 tk, respectively. In case of garlic cultivation, per hectare requirement of urea, TSP, MOP and ZnSO4 were 168.15 kg, 343.50 kg, 142.31 kg and 19.71 kg respectively whose costs were Tk. 4540.08, tk9274.52, tk.2844.84, tk.2720.23, respectively (Table 5.2).

The cost of urea, TSP, MoP and Zinc sulphate were 1.50, 2.43, 0.71 and 1.03 percent of total cost of onion respectively. The cost of urea, TSP, MoP and Zinc sulphate were 1.54, 3.15, 0.97and 0.92 percent of total cost of garlic cultivation respectively. According to Table 5.1, farmers paid the highest percentage (3.75 percent of total cost) for TSP fertilizer and the lowest percentage (.92 percent of total cost) for zinc sulphate fertilizer for garlic production. They also paid the highest percentage (2.43 percent of total cost) for TSP fertilizer and the lowest percentage (.71 percent of total cost) for MoP fertilizer for onion production.

Table 5.1 Variable Cost of Onion per hectare

Cost Items		Quantity	Rate (Tk/Kg)	Cost (Tk/ha)	Percentage of Total Cost
1. Land Preparation				22200.33	8.21
2. Seed or Bulb		1701.73 Kg	48.82	83078.34	30.71
3. Weeding				9595.13	3.55
4.Fertilizers	**Urea**	150.61 Kg	27	4066.42	1.50
	TSP	243.62 Kg	27	6577.87	2.43
	MoP	96.46 Kg	20	1929.18	0.71
	Zinc	20.18 Kg	138	2784.81	1.03
5. Pesticide				3623.46	1.34
6. Irrigation				11940.40	4.41
7. Human Labor (Hired)		103 Man-days	475	48782.51	18.03
8. Others				937.71	0.35
Total Variable Cost (TVC)				195516.16	72.27

Source: Author's Calculation

Table 5.2 Variable Cost of Garlic Per Hectare

Cost Items		Quantity	Rate (Tk/Kg)	Cost (Tk/ha)	Percentage (%) of Total Cost
1. Land Preparation				23518.35	7.99
2. Seed or Bulb		480.80 Kg	191.08	91870.35	31.22
3. Weeding				9345.43	3.18
4. Fertilizers	**Urea**	168.15 Kg	27	4540.08	1.54
	TSP	343.50 Kg	27	9274.52	3.15
	MoP	142.31 Kg	20	2844.84	0.97
	Zinc	19.71 Kg	138	2720.23	0.92
5. Pesticide				3120.62	1.06
6. Irrigation				10469.99	3.56
7. Human Labor (Hired)		114 Man-days	480	54448.31	18.50
8. Others				5628.29	1.92
Total Variable Cost (TVC)				217781.01	74.01

Source: Author's Calculation

5.2.5 Cost of Irrigation

Table 5.1 shows that the cost of irrigation water for the production of onion and garlic was Tk. 11940.40 and Tk. 10469.99 per hectare, or 4.41 and 3.56 percent of the total cost, respectively. Compared to garlic, onion require a marginally higher irrigation budget. The farmers who responded utilized rivers and other sources of surface and subsurface water for irrigation purposes.

5.2.6 Cost of Insecticides and Pesticides

Growers of onion and garlic employed various insecticides and pesticides to prevent disease in their crops. For the production of onion and garlic, it was discovered that the per-hectare costs of pesticides and insecticides were Tk. 3623.46 and Tk. 3120.62, or 1.34 and 1.06 percent of the total cost, respectively (Table 5.1, Table 5.2). It was evident from Tables 5.1 and 5.2 that the price of pesticides for onion was comparatively higher than that of garlic.

5.2.7 Cost of Hired labor

As indicated by Table 5.1, 103 man-days per hectare of labor were employed in the production of onion. The production of garlic required 114 man-days per hectare (Table 5.2), while the total cost of labor was estimated at Tk. 48782.51 and Tk. 54448.31, which accounted for 18.03 and 18.50 percent of the total cost of producing onion and garlic, respectively (Tables 5.1 and 5.2).

5.2.8 Others Cost

In the study area the respondent farmer mentioned some miscellaneous cost items for various activities are done in onion and garlic cultivation. Table 5.1 and 5.2 shows that per hectare Others Cost of onion production was 937.71 Tk. which was 0.35 percent of total cost of production per hectare. In case of garlic production for this purpose the cost was 5628.29 which was 1.92 percent of total cost of yield per hectare respectively.

5.3 Fixed Costs

5.3.1 Land Use Cost

The land use cost of onion and garlic was determined by calculating the average rental value of land per hectare during the study year. Per hectare cost was estimated at Tk. 23724.29 for onion and Tk. 23473.04 garlic growers. According to Tables 5.3 and 5.4, land use cost accounted for 8.77 and 7.98 percent of the total cost of producing onion and garlic, respectively.

5.3.2 Family labor cost

The family supplied labor is useful input and it was also counted as fixed cost item. Tables 5.3 and 5.4 show that 73 man-days per hectare of family labor were utilized in onion cultivation. The production of garlic required 78 man-days per hectare (table 5.4), but the total cost of labor was estimated at TK 34473.82 and TK 37522.04, which accounted for 12.74 and 12.75 percent of the total cost of producing onion and garlic, respectively. It was clear that both type of onion and garlic farmers saved a notable amount of cash money through providing family labor.

Table 5.3 Fixed Cost of Onion per hectare:

Cost Items	Quantity	Rate (Tk)	Cost (Tk/ha)	Percentage (%) of Total Cost
Rental Value of Land			23724.29	8.77
Family Labor Cost	72 Man-days	475	34473.82	12.74
Interest on OC			7820.65	2.89
Machinery Cost			9001.30	3.33
Fixed Cost (TFC)			75020.06	27.73
Total Cost (TC=TVC+TFC)			270536.22	100%

Source: Author's Calculation

Table 5.4 Fixed Cost of Garlic Per Hectare:

Cost Items	Quantity	Rate (Tk)	Cost (Tk/ha)	Percentage (%)of Total Cost
Rental Value of Land			23473.04	7.98
Family Labor Cost	78 (Man-day)	480	37522.04	12.75
Interest on OC			8711.24	2.96
Machinery Cost			6780.98	2.30
Total Fixed Cost (TFC)			76487.30	25.99
Total Cost (TC=TVC+TFC)			294268.31	100

Source: Author's Calculation

5.3.3 Interest on Operating Capital (IOC)

It should be mentioned that all operating expenses incurred during the onion and garlic production periods were factored into the calculation of the interest on operating capital. As shown in Tables 5.3 and 5.4, the per hectare interest on operating capital was Tk. 9001.30 and Tk. 8711.24, representing 3.33 and 2.96 percent of the total cost of producing onion and garlic, respectively.

5.3.4. Machinery cost

Now a day's machinery usage is one of the most vital elements in producing any crop, although mechanization was not adapted fully for onion and garlic production in the study area which shared a larger portion of total cost of garlic and onion production. The cost of machinery was estimated Tk. 9001.30 and Tk. 6780.98 for onion and garlic respectively. The cost of weeding was 3.33 and 2.30 percent of total cost of onion and garlic production respectively. It was evident that the cost of machinery for onion was comparatively higher than that of garlic (Tables 5.3 and 5.4).

5.4 Total Cost (TC)

All of the resources utilized in the production of onion and garlic have been gathered together to estimate the overall cost per hectare. It can be observed from Tables 5.3 and 5.4 that per hectare total cost of production of onion and garlic were about Tk. 270536 and Tk. 294268 respectively.

5.5 Yield and Gross Return

The average yield per hectare for garlic and onion was measured to be 9936 kg and 15915 kg respectively. The average farm gate price was multiplied by the total amount of products to determine the gross return per hectare. Onion and garlic had gross returns per hectare of roughly Tk. 557023 and Tk. 665706, respectively (Tables 5.5). Garlic had a higher gross return per hectare than onion, as Table 5.5 demonstrates.

Table 5.5 Comparison of Gross Return of onion and garlic Farming

	Items	Quantity (Kg/ha)	Price (Tk/Kg)	Value (Tk)
Gross Return	**Onion**	15914.936	35	557022.79
	Garlic	9935.916	67	665706.40

Source: Author's Calculation

5.6 Gross Margin

The gross return minus the variable cost is the gross margin. The gross margin is calculated by deducting the total variable cost from the gross return. For onion and garlic, the estimated per-hectare gross margin was Tk. 361507 and Tk. 447925, respectively (Tables 5.6). Table 5.5 makes clear that the gross margin on garlic was greater than the gross margin on onion.

Table 5.6 Comparison of Cost and Return of onion and garlic Production

Particulars	Onion (ha^{-1})	Garlic (ha^{-1})
Total Return	557022.79	665706.40
Total Variable Cost (TVC)	195516.16	217781.01
Total Cost (TC)	270536.22	294268.31
Gross Margin (GR-TVC)	361506.64	447925.39
Net Return (GR-TC)	286486.57	371438.09
BCR (undiscounted) (GR/TC)	2.06	2.26

Source: Author's Calculation

5.7 Net Return

A great tool for comparing or analyzing an enterprise's performance is its net return. The computation involves subtracting the total cost from the total return. Onion and garlic had net returns per hectare of roughly Tk. 286487 and Tk. 371438, respectively (Tables 5.6). Garlic had a higher net return per hectare than onion, as Table 5.6 demonstrates.

5.8 Benefit Cost Ratio (Undiscounted)

A relative metric called the benefit cost ratio (BCR) is apply to compare benefits per unit of cost. The research determined the BCR of garlic and onion using a ratio of gross return to gross cost. The production of onion and garlic per hectare yielded an undiscounted benefit cost ratio (BCR) of 2.06 and 2.26, respectively. This means that every Tk. 1 will be expended to produce Tk. 2.06 and 2.26, respectively, for the corresponding crop (Tables 5.6).

5.9 Comparison of Profitability of Onion and Garlic Production

This section compares and evaluates the relative profitability of growing onion and garlic per hectare. Table 5.6 displayed the summary results for onion and garlic, including the per hectare yield, gross return, gross margin, net return, and BCR. It's clear that the businesses growing onion and garlic were successful. Additionally, producing garlic was more profitable than producing onion (Table 5.6).

5.10 Concluding Remarks

It is possible to thoughtfully conclude that growing onion and garlic was extremely profitable based on the discussions above. Onion farming was less profitable than garlic farming, though. Garlic and onion can both be grown, which will help farmers make more money.

CHAPTER VI
RESOURCE USE EFFICIENCY OF ONION AND GARLIC PRODUCTION

This chapter aims to determine and quantify the key factors that affect the production of onion and garlic. To calculate the impact of crucial variables on the onion and garlic production process, the Cobb-Douglas production function was selected. Table 6.1 displays the estimated values of the model.

6.1 Functional Analysis for Measuring Production Efficiency

A production function is a relationship or mathematical function that, for a given level of technology, indicates the maximum output that can be produced with the supplied inputs. Keeping in mind the goals of the study and accounting for the impact of explanatory variables on the yield of garlic and onion cultivation, eight explanatory variables were chosen in order to quantify the impact of inputs on output. Other independent variables that might have had an impact on farm enterprises' production were eliminated from the model based on some initial estimation, including bulb quality, soil condition, time, human labor, rental value, pesticides, etc.

6.2 Estimated Values of the Production Function Analysis

i. To assess the goodness of fit for various input kinds, the F-value was utilized.
ii. The adjusted coefficient of multiple determinations (R2), which is adjusted with degree of freedom, shows the total variations of output explained by the independent variables in the model.
iii. Significant tests were performed at the 1 percent, 5 percent, and 10 percent levels for coefficients with adequate degrees of freedom.
iv. The estimation of the production stage was based on returns to scale, which was the total of the inputs' production elasticity.

Table 6.1 displays the estimated coefficients and associated statistics of the Cobb-Douglas production function for the production of onion and garlic.

Table 6.1 Estimated Co-efficient and Their Related Statistics of Production Function of Onion and Garlic Production

Explanatory Variable		Onion			Garlic		
		Co-efficient	t-values	p-values	Co-efficient	t-values	p-values
Intercept		0.287	0.05	0.958	2.689***	4.39	0
Land preparation		0.106	0.37	0.718	0.401**	2.44	0.024
Seed cost		-0.017	-0.17	0.864	0.314**	2.51	0.02
Fertilizers	**Urea**	0.118***	2.77	0.011	0.059	0.68	0.506
	TSP	0.321**	2.4	0.026	0.040*	1.90	0.072
	MoP	0.227	0.74	0.47	-0.008	-0.1	0.92
	Zinc	-0.103	-0.47	0.643	0.149	1.37	0.185
Irrigation cost		0.645*	1.77	0.092	0.029	1.46	0.16
Machinery cost		0.160**	2.19	0.04	0.113***	2.65	0.015
Adjusted R^2		0.58			0.94		
F- value		6.01***			95.55***		
Return to Scale (∑βi)		1.46			1.10		

Source: Author's Calculation

Note: ***, ** and * indicate significant at 1%, 5% and 10% level respectively.

6.3 Interpretation of the production function

6.3.1 Land Preparation (X_1)

In case of onion, it can be observed from Table 6.1 that regression coefficient of land preparation cost was 0.106. It was positive and this indicates that an increase in 1 percent of land preparation cost, remaining other factors constant, would result in an increase in the gross return by 0.106 percent.

In case of garlic, it can be observed from Table 6.1 that regression coefficient of Land preparation cost was 0.401. It was positive and was significant at 5 percent probability level. This indicates that an increase in one percent of land preparation cost, remaining other factors constant, would result in an increase in the gross return by 0.401 percent.

6.3.2 Seed Cost (X_2)

Table 6.1 shows that the regression coefficient of seed or bulb cost had a magnitude of -0.017. It was negative, meaning that if the other variables remained the same, an increase of 1% in the seed cost would cause the gross return to drop by 0.11 percent. However, there was no statistical significance for this coefficient.

At the five percent significance level, the estimated cost of a garlic bulb was 0.314, making it a significant investment for garlic farming. It suggests that, with all other things remaining constant, 1% increase in bulb cost would result in 0.314 percent increase in gross returns.

6.3.3 Fertilizers Cost

6.3.3.1 Urea Cost (X_3)

Table 6.1 shows that the regression coefficient for the cost of urea was 0. 118. At the one percent probability level, it was significant and positive. This suggests that, with all other things remaining constant 1% increase in the cost of urea fertilizer would result in 0.118 percent increase in the gross return.

Table 6.1 shows that the regression coefficient of urea cost in the case of garlic was 0.059. Although this coefficient was positive, it was not statistically significant. That being said, this suggests that, with all other things remaining constant, 1 percent increase in the cost of urea fertilizer would lead to 0.059 percent increase in gross return.

6.3.3.2 TSP Cost (X_4)

Table 6.1 shows that the regression coefficient of TSP cost in the case of onion was 0.321. At the five percent probability level, it was significant and positive. This suggests that, with all other factor remaining constant, 1% increase in the cost of TSP fertilizer would result in a 0.321 percent increase in gross return.

Table 6.1 for garlic shows that the TSP cost's regression coefficient was 0. 040. At the 10% probability level, it was significant and positive. This suggests that, with all other factor remaining constant, 1% increase in the cost of urea fertilizer would result in 0.040 percent increase in the gross return.

6.3.3.3 MoP Cost (X_5)

Table 6.1 shows that the MoP Cost regression coefficient for onion was positive and had a magnitude of 0.227. This suggests that, with all other factor remaining constant, 1% increase in MoP Cost would result in 0.227 percent increase in gross return. However, there was no statistical significance for this coefficient.

Table 6.1 shows that the magnitude of the regression coefficient of the MoP cost in the case of garlic was -0.008. It was negative, meaning that if all other factors remained the same, an increase of 1% in the cost of MoP would cause the gross return to drop by -0.008 percent. This coefficient, though, lacked statistical significance.

6.3.3.4 Zinc Cost (X_6)

Table 6.1 shows that the regression coefficient of zinc cost for onion had a negative magnitude of -0.103. This suggests that, with all other factor remaining constant, 1% increase in zinc cost would cause a 0.103 percent drop in gross return. However, there was no statistical significance for this coefficient.

Table 6.1 shows that the magnitude of the zinc cost regression coefficient in the case of garlic was 0.149. It was positive, meaning that 1 percent increase in zinc cost would yield 0.149 percent increase in gross return while keeping all other variables unchanged. This coefficient, though, lacked statistical significance.

6.3.4 Irrigation Cost (X_7)

Table 6.1 shows that the irrigation cost's regression coefficient was 0.645. At the 10% probability level, it was significant and positive. This suggests that, with all factor remaining constant, 1% increase in irrigation costs would result in 0.645 percent

increase in gross return. Table 6.1 shows that the irrigation cost regression coefficient for garlic was 0.029. It was positive but this coefficient was not statistically significant. However, this indicates that an increase in 1 percent of irrigation cost, remaining other factors constant, would result in an increase in the gross return by 0.029 percent.

6.3.5 Machinery Cost (X_8)

Table 6.1 displays that the machinery cost regression coefficient for onion was 0.160. At the five percent probability level, it was significant and positive. This suggests that, with all other factor remaining constant, a one percent increase in the cost of the machinery would result in a 0.160 percent increase in the gross return. Table 6.1 for garlic shows that the machinery cost's regression coefficient was 0.113. Additionally, it was significant and positive at the 1 percent probability level. This suggests that, with all other factor remaining constant, a one percent increase in the cost of the machinery would result in a 0.113 percent increase in the gross return.

6.3.6 Adjusted R^2

"Adjusted" in this context refers to adjusting for the degrees of freedom. The adjusted R^2 for the production of onion and garlic was found to be 0.58 and 0.94, respectively, meaning that the explanatory variables taken in the model explained roughly 58 percent and 94 percent of the variations in the output of onion and garlic, respectively. See Table 6.1.

6.3.7 Goodness of Fit (F-Value)

To indicate the general goodness of fit of any fitted model, the F-statistic was calculated. With an estimated F-value of 6.01, the onion cultivation was found to be highly significant. According to Table 6.1, this indicates that the explanatory variables in the model played a significant role in explaining the variation in the gross return on onion production. At the one percent significance level, the estimated F-value for garlic cultivation was 95.55. This indicates that the model's explanatory variables played a significant role in explaining the variation in the gross return on garlic production.

6.3.8 Returns to Scale ($\sum \beta_i$)

Table 6.1 shows that the estimated production function of garlic and onion had a total of 1.10 and 1.46 regression coefficients, respectively. This suggests that there are growing returns to scale in the production function. In other words, the farmers were engaged in the initial stages of production for both their garlic and onion farms. In this instance, the gross return for the production of onion and garlic would rise by 1.46 and 1.10 percent, respectively, if every variable listed in the production function was increased by one percent.

6.4 Concluding Remarks

According to the Cobb-Douglas production function model, variations in the gross return or output of onion and garlic could be attributed to the major variables included in the model. Additionally, it showed that growers of onion and garlic distributed their resources in Stage I, or the zone of increasing returns to scale, suggesting that there was a good chance of increasing returns by maximizing the use of additional inputs in the production process.

6.5 Findings of the Resource Use Efficiency of Onion and Garlic Production

A ratio of one to unity was thought to represent the best use of that factor, and a ratio greater than one would suggest that more resources could be used to increase the yield. This was the thinking behind the classification of resource use efficiency. Farmers overused this variable, so the unprofitable level of resource use was indicated by a value less than unity, and it should be reduced to reduce losses. The negative value of MVP indicates a careless and ineffective use of resources.

The favorable and greater-than-one ratio of MVP and MFC of land preparation (2.537) for onion cultivation (Table 6.2) suggested that the study areas underutilized the costs of land preparation for onion production. To achieve efficiency, farmers should thus greatly increase the cost of land preparation.

The study area's underutilization of land preparation costs for garlic production was indicated by the ratio of MVP and MFC of land preparation (11.31), which was also positive and greater than one in the case of garlic (Table 6.2). Garlic farmers should therefore raise the cost of land preparation in order to achieve significantly higher efficiency.

The MVP and MFC ratios of seed bulbs were found to be (-0.1128) for onion cultivation, which was less than one, and (2.288) for garlic. These results suggested that the study area overused bulbs for onion production and underutilized them for garlic production (Table 6.2). To achieve a significant increase in efficiency, onion farmers should reduce the number of bulbs they use for onion production while garlic farmers should increase the number of bulbs, they use for garlic production.

In the study area, the recommended dose of urea is 240 kg ha-1; however, Table 6.2 revealed that the ratio of MVP and MFC of total urea cost (16.466) for onion cultivation was positive and greater than one, indicating that the total amount of urea was underused for onion growth. (Ahmed *at al*., 2018). Therefore, in order to reach the desired efficiency level, farmers should apply more urea fertilizer. Regarding garlic, Table 6.2 revealed a positive and greater-than-one ratio between MVP and MFC of the total urea cost (8.840). This suggests that the study area did not use the recommended dose of urea, which is 250 kg ha-1. (Ahmed *at al*., 2018). Therefore, in order to reach the desired efficiency level, farmers should apply more urea fertilizer.

Table 6.2 Resource Use Efficiency of Onion Production

Variable	GM	Y/Xi (GM)	Co-efficient	MVP	MFC	R= MVP/MFC	Comment
Return (Y)	527869.11						
Land Preparation (X_1)	22130.473	23.8526	0.10638	2.54	1	2.537	Underutilized
Seeds (X_2)	81341.003	6.489582	-0.01738	-0.11	1	-0.1128	Overutilized
Urea (X_3)	3773.392	139.8925	0.117705	16.47	1	16.466	Underutilized
TSP (X_4)	5993.229	88.07758	0.321509	28.32	1	28.318	Underutilized
MoP (X_5)	1755.011	300.7782	0.227499	68.43	1	68.427	Underutilized
Zinc (X_6)	2569.558	205.4318	-0.1028	-21.12	1	-21.118	Overutilized
Irrigation (X_7)	11810.616	44.69446	0.645024	28.83	1	28.829	Underutilized
Machinery (X_8)	7211.1	73.20230	0.160235	11.73	1	11.7295	Underutilized

Source: Author's calculation

Table 6.2 and 6.3 displayed that the ratio of MVP and MFC of TSP cost (16.466) and (3.021) for onion and garlic cultivation respectively. It was positive and greater than one for both crops, which indicated that in the study area the use of TSP fertilizer is underutilized for both onion and garlic growth. where recommended dose of TSP is 260 kg ha^{-1} for onion and 320 kg ha^{-1} for garlic (Ahmed *at al.*, 2018). So, farmers should increase the application of TSP fertilizer to gain efficiency level.

Table 6.2 and 6.3 represented that the ratio of MVP and MFC of MoP cost (68.427) and (- 1.985) for onion and garlic cultivation respectively. It was positive and greater than one for onion growth which indicated that in the study area the use of MoP fertilizer is under used for onion growth but it was negative and lower than one for garlic growth which implied that the use of MoP fertilizer in the study area is over used for garlic growth. where recommended dose of Mop is 150 kg ha^{-1} for onion and 130 kg ha^{-1} for garlic (Ahmed *at al.*, 2018). So, the onion farmers should increase the use of MoP fertilizer and garlic farmer should decreased the use of MoP fertilizer for garlic to attain efficiency level considerably.

Table 6.2 and 6.3 showed that the ratio of MVP and MFC of Zinc cost (-21.118) and (36.886) for onion and garlic cultivation respectively. It was negative and lower than one for onion cultivation which indicated that the use of Zinc fertilizer in the study area is over used for onion growing. On the other hand, this ratio was positive and greater than one for garlic growth which indicated that in the study area the use of Zinc fertilizer is under used for garlic growth. So, the onion farmers should reduce the use of Zinc fertilizer for onion and garlic farmer should increase the use of Zinc fertilizer for garlic to obtain efficiency level considerably.

Table 6.3 Resource Use Efficiency of Garlic Production

Variable	GM	Y/Xi (GM)	Co-efficient	MVP	MFC	R= MVP/MFC	Comment
Return (Y)	662424.72						
Land Preparation (X_1)	23499.95	28.19	0.401	11.31	1	11.31	Underutilized
Seeds (X_2)	90957.19	7.28	0.314	2.29	1	2.288	Underutilized
Urea (X_3)	4432.02	149.46	0.059	8.84	1	8.840	Underutilized
TSP (X_4)	8854.51	74.812	0.040	3.02	1	3.021	Underutilized
MoP (X_5)	2723.68	243.21	-0.008	-1.99	1	-1.985	Overutilized
Zinc (X_6)	2669.85	248.11	0.149	36.89	1	36.886	Underutilized
Irrigation (X_7)	10413.06	63.615	0.029	1.87	1	1.873	Underutilized
Machinery (X_8)	5813.25	113.95	0.113	12.85	1	12.852	Underutilized

Source: Author's calculation

The ratio of MVP to MFC of irrigation cost for the production of onion and garlic was found to be 28.829 and 1.873, respectively, as Tables 6.2 and 6.3 demonstrated. For both crops, it was positive and greater than one, suggesting that irrigation was not being used to its full potential in the study area for the production of onion and garlic. Thus, in order to achieve significantly higher levels of efficiency in the production of onion and garlic, both farmers should employ more irrigation.

The ratios of MVP and MFC of machinery for the cultivation of onion and garlic were found to be 11.7295 and 12.852, respectively, as Tables 6.2 and 6.3 demonstrated. It showed that the study area's use of machinery for producing onion and garlic was underutilized because it was positive and greater than one for both crops. Therefore, in order to significantly raise the level of efficiency in the production of onion and garlic, both farmers should employ more machinery.

6.6 Concluding Remarks

The study found that while the total cost of the factors has not been totally utilized, the cost of land preparation, urea, TSP, MoP, irrigation, and machinery have been identified as factors that significantly impact the basic concepts of onion production. By utilizing these resources to their fullest potential, onion farming has the chance to boost output and profits. The cost of irrigation, machinery, TSP, zinc, bulb, urea, and land preparation have all been found in studies to have a major impact on garlic cultivation. However, basic concepts related to these practices, such as the total cost of these factors, have not been fully utilized. So, by maximizing the use of these resources, garlic production has also had the chance to intensify productivity and profitability.

CHAPTER VII
PROBLEMS OF ONION AND GARLIC PRODUCTION

7.1 Introduction

Garlic and onion production presented many challenges for farmers. This chapter seeks to illustrate a few socioeconomic issues or limitations related to the production of garlic and onion. The following section discusses the main issues and limitations associated with the cultivation of onion and garlic:

7.2 Lack of Operating Capital

A significant sum of money was required for the purchase of various inputs, such as machinery, pesticides, seed fertilizers, labor, and others, in order to cultivate onion and garlic. Sixty percent of onion farmers and forty-six percent of garlic farmers in the study area reported this issue (Table 7.1 and Table 7.2). Growers of both types reported that, on average, 53.33 percent did not have sufficient cash to buy the necessary quantity of inputs for the relevant enterprises.

7.3 Lack of Quality Bulb

One of the biggest obstacles to the production of onion and garlic in the research area was a lack of high-quality bulb. It is clear from Tables 7.1 and 7.2 that approximately 46.67 percent of farmers of onion and 36.67 percent of farmers of garlic reported this issue. Of the farmers in this district, approximately 41.67 percent reported having this issue.

7.4 Attack of Pest and Disease

The issue of pest and disease attacks also impacted the growers of garlic and onion. Forty percent of onion growers and fifty percent of garlic growers in the research area reported this issue (Table 7.1 and Table 7.2). In Shariatpur about 45 percent of both farmers had faced this problem during production periods.

7.5 Poor Storage Facilities

In this district there are a few facilities of modern cold storage, so many farmers often kept their onion in their houses. It observes that 53.33 percent of onion, 60 percent of garlic (Table 7.1 and Table 7.2) and allover about 56.67 percent of the sample growers in Shariatpur faced and reported the problem of poor storage. So, it was clear that lack storage facilities are one of the vital problems for this area onion and garlic farmers.

7.6 Shortage of Human Labour

At several production stages, including planting, intercultural operations, and harvesting, there was a shortage of labor. Tables 7.1 and 7.2 reveal that this issue was reported by 30 percent of growers of onion and 43.33 percent of growers of garlic. For 36.67 percent of the two farmers on average, these were significant issues.

Table 7.1 Problems Faced by Onion Producing Farmers

Particulars	Onion Farmers		
	No. of Respondent	Percent (%)	Rank
Lack of operating capital	18	60.00	1st
Poor storage facilities	16	53.33	2nd
Lack of quality bulb	14	46.67	3rd
Attack of pest and diseases	12	40.00	4th
Inadequate extension service and training	12	40.00	5th
Unstable market price	11	36.67	6th
Adulteration of fertilizer, Weedicide and Pesticide	10	33.33	7th
Shortage of human labor	9	30.00	8th
High cost of irrigation water	8	26.67	9th
Natural calamities	6	20.00	10th

Source: Author's calculation

Table 7.2 Problems Faced by Garlic Producing Farmers

Particulars	Garlic Farmers		
	No of Respondent	Percent (%)	Rank
Poor storage facilities	18	60.00	1st
Attack of pest and diseases	15	50.00	2nd
Lack of operating capital	14	46.67	3rd
Shortage of human labor	13	43.33	4th
High cost of irrigation water	12	40.00	5th
Lack of quality bulb	11	36.67	6th
Inadequate extension service and training	10	33.33	7th
Unstable market price	9	30.00	8th
Natural calamities	8	26.67	9th
Adulteration of fertilizer, weedicide and Pesticide	7	23.33	10th

Source: Author's calculation

7.7 High Cost of Irrigation Water

Because there were few portable irrigation devices in the research area, the availability of irrigation water was a moderated problem. Farmers, particularly those who grow garlic, have reported having to pay more for irrigation water. According to Tables 7.1 and 7.2, approximately 33.33 percent of growers overall, 40 percent of garlic growers, and 26.67 percent of onion growers in the study areas reported this issue.

7.8 Adulteration of Fertilizers, Weedicides, Insecticides and Pesticides

Inputs such as chemical fertilizers, weedicides, insecticides, and pesticides are crucial for the production of onion and garlic. It can be observed from Table 7.1 and Table 7.2 that 33.33 percent onion and 23.33 percent of garlic growers faced this problem.

7.9 Inadequate Extension Service and Training

Some farmers complained that they received no training or extension services during the investigation. About 40% of onion and 33.3% of garlic growers in the study area said they rarely received assistance from the local community (Tables 7.1 and 7.2).

7.10 Unstable Market Price

The most of farmers were bount to sell a sizable amount of their produce during harvest season for the purpose of pay for household expenses and loan repayment. The risk of profitability and production costs had increased due to the volatile market price. Tables 7.1 and 7.2 seem to indicate that during the production period, 36.67 percent of onion farmers, 30% of garlic farmers, and roughly 33.33 percent of both farmers reported having to buy and sell some inputs and output at an uncertain price.

7.11 Natural Calamities

Drought, hailstorms, and intense rains are examples of natural disasters that can cause significant damage to crops in fields. Farmers claim that, too much rain during the harvesting time decreases the amount and capacity of onion and garlic to be stored. Table 7.1 and Table 7.2 shows that 20 percent of onion and 26.67 percent of garlic growers reported this problem. About 23.33 percent of both farmers had faced this constraint and compensated their yields.

7.12 Concluding Remarks

Both onion and garlic farmers in the research area are presently facing some significant challenges in carrying out their onion and garlic farming, according to the previously mentioned discussions and the results shown in Tables 7.1 and 7.2. To overcome the lack of capital for cultivation, the government's policy of distributing loans for agriculture should be appropriately implemented.

CHAPTER VIII
SUMMARY, CONCLUSION AND RECOMMENDATIONS

8.1 Introduction

This chapter contains a summary of the research's main conclusions. Section 8.2 provides an overview of the study's main conclusions. Sections 8.3, 8.4, 8.5, and 8.6 provide the conclusion, policy recommendations, study limitations, and area for future research, respectively.

8.2 Summary

Bangladesh's economy still heavily depends on the agriculture sector. About 11.61 percent of the GDP and 40.6% of jobs for the labor force are generated by agriculture. Bangladesh's total area is approximately 14.845 million hectares; of this, 53.89 percent is cultivated, 3.16 percent is fallow land, and the remaining 42.95 percent is made up of homesteads, rivers, tidal creeks, lakes, ponds, and roads, nearly 2.16 percent of Bangladesh's total cropland is used for spices (BBS, 2017). The difference between supply and demand is therefore substantial. Bangladesh must thus annually import a significant amount of onion and garlic at the expense of hard-earned foreign currency in order to cover its deficit.

Garlic and onion are healthy spice crops. By consuming this, Bangladeshi citizens' nutritional status can be improved. Since the production of onion and garlic requires a lot of labor, growing these two crops could give Bangladesh's rural residents additional job opportunities. The current study is carried out with the following goals in mind: to identify the issues, potentials, and opportunities for growth in the area and production of onion and garlic.

a) To assess the socioeconomic characteristics of farmers growing onion and garlic;
b) To estimate per hectare costs, returns and relative profitability of onion and garlic production;
c) To estimate the contribution of key variables to per hectare yield, income and resource use efficiency of onion and garlic growing farmers; and
d) To identify the socioeconomic problems and constraints faced by the farmers producing onion and garlic.

For the study, three Upazilla from the district of Shariatpur were chosen. A total of sixty growers were chosen at randomly, thirty for onion and thirty for garlic. Interview schedules that were quite detailed were used to collect data. In order to process and analyze the data and meet the study's objectives, basic statistical techniques and the Cobb- Douglas production function were employed. Regarding socioeconomic factors, it was discovered that the average family size of growers of onion and garlic was 4.66 and 4.83 members, respectively. The age group of 18 to 60 years old comprised the largest percentage of individuals. Families that grow onion and garlic have literacy rates of 83% and 90%, respectively. Six percent and seven percent, respectively, of respondents had completed higher secondary education.

A comparison of the costs and returns of producing garlic and onion was done using a relative profitability analysis. Onion and garlic were found to require 175.27 and 191.67 man-days of labor per hectare, respectively. For the production of onion and garlic, the cost of hired labor per hectare was Tk. 48782.51 and Tk. 54448.31, or 18.03 and 18.50 percent of the total cost, respectively. The cost per hectare of land preparation for onion production was 22200.33 Tk, or 8.21% of the total cost; similarly, the cost per hectare for garlic production in the study area was 23518.35 Tk, or 7.99% of the total cost. Onion seed requirements totaled 1701.73 kg per hectare, with an average cost of onion seed per hectare. The amount of seed used for garlic was 480.80 kg, and the average cost per hectare was estimated to be Tk. 91870.35. The cost of seeds made up 30.71 percent and 31.22%, respectively, of the total cost of producing garlic and onion.

The amount of urea, TSP, MOP, and ZnSO4 used per hectare for onion production was determined to be 150.61 kg, 243.62 kg, 96.46 kg, and 20.18 kg, respectively. The associated costs were estimated at Tk 4066.42 tk, 6577.87 tk, 1923.18 tk, and 2784.81 tk. For the production of garlic, the per hectare usage of urea, TSP, MOP, and ZnSO4 was 168.15 kg, 343.50 kg, 142.31 kg, and 19.71 kg, respectively. The corresponding costs were Tk 4540.08, tk9274.52, tk.2844.84, and Tk 2720.23. In relation to the total cost of onion, the expenses for urea, TSP, MoP, and zinc sulphate were 1.50, 2.43, 0.71, and 1.03 percent, respectively. MoP, urea, zinc sulphate, TSP, and 3.15 percent, 0.97 percent, and 1.54 percent, respectively, are the costs associated with each of these components of garlic production. It was discovered that, when it came to the production of onion, farmers paid the highest percentage (2.43 percent of total cost) for TSP fertilizer and the lowest percentage (.71 percent of total cost) for MoP treatment.

Comparably, they paid the highest percentage (3.75 percent of total cost) for zinc sulphate fertilizer and the lowest percentage (.92 percent of total cost) for garlic production. The cost of irrigation water per hectare for the production of onion and garlic was Tk. 11940.40 and Tk. 10469.99, which accounted for 4.41 and 3.56 percent of the total cost, respectively. For the production of onion and garlic, the cost of pesticides and insecticides per hectare came to Tk. 3623.46 and Tk. 3120.62, or 1.34 and 1.06 percent of the total cost, respectively. For onion and garlic growers, the estimated per-hectare land use cost was Tk. 23724.29 and Tk. 23473.04, respectively. 8.77 and 7.98 percent of the total cost of producing onion and garlic, respectively, was covered by land use costs. The operating capital per hectare interest was Tk. 9001.30 and Tk. 8711.24, respectively, representing 3.33 and 2.96 percent of the total cost of producing onion and garlic. The fixed costs per hectare for producing onion and garlic were Tk. 75020.06 and Tk. 76487.30, which accounted for 27.73 and 25.99 percent of the total expenses, respectively.

Onion and garlic were produced for about Tk. 270536 and Tk. 294268 per hectare, respectively. Onion and garlic yielded total returns per hectare of about Tk. 557023 and Tk. 665706, respectively; the gross margin was Tk. 361507 and Tk. 447925, and the net return was Tk. 286487 and Tk. 371438. The production of onion and garlic had an undiscounted benefit cost ratio (BCR) of 2.06 and 2.26, respectively.

Creation of Douglas-Cobb Using the function model, gross returns were evaluated based on the resources' significant and best-fit effects. Eight explanatory variables were considered for the onion enterprise in order to explain production variations. Eight explanatory variables were also considered for the garlic enterprise in order to explain production variations. For the onion production function, the adjusted R2 coefficient of multiple determination was 0.58. This indicates that 58% of the variation in onion output was explained by the explanatory variables in the model. A good fit of the model is indicated by the equation's F-value (6.01), which was highly significant at the 1 percent probability level. The enterprise was in the first stage of operation, as indicated by the estimated coefficients' summation of 1.46, which suggests growing returns to scale.

For the garlic production function, the adjusted R2 coefficient of multiple determinations was 0.94. This shows that the explanatory variables in the model accounted for 94% of the variation in garlic output. A good fit of the model is indicated by the equation's F-value of 95.55, which was highly significant at the 1 percent probability level. With an increasing return to scale, the enterprise was operating in the first stage, as indicated by the sum of the estimated coefficients of 1.10.

The efficiency of resource use showed that, with the exception of the overuse of zinc fertilizer and seed bulbs, all resources were underutilized in the production of onion. However, resource use efficiency showed that, with the exception of the overuse of MoP fertilizer, all resources were underutilized for the production of garlic. Therefore, important elements that contribute to the year-round production of onion and garlic had a positive effect.

The current research also identified a few issues and limitations related to the production of garlic and onion. The main problems faced by the farmers were lack of operating capital, lack of quality bulb, attack of pest and diseases, poor storage facilities, shortage of human labor, high cost of irrigation water, adulteration of fertilizer, weedicide and pesticide, inadequate extension service and training, unstable market price, lack of credit, natural calamities etc.

8.3 Conclusion

Considering the results of this investigation, it appears that there is a lot of scope in the research area to boost onion and garlic productivity in order to improve growers' incomes. The Shariatpur district cultivates a lot of onion and garlic as food grains and spices. According to the study, growing garlic was comparatively more profitable than producing onion. The financial profitability analysis shows that many spices and condiments are profitable in Bangladesh, suggesting that producing garlic is a more profitable option for the country than producing onion. Moreover, growing onion and garlic requires a lot of labor. Therefore, growing these two crops can improve farmers' nutritional status, employment, and farm income. Farmers lacked knowledge regarding the proper timing and dosage of input applications. As a result, they either used too many or too few resources. Thus, feasible production methods and a steady stream of income from the production of onion and garlic can result from carefully thought out management training that is tailored to their needs, problems, goals, and resource base.

8.4 Policy Recommendations

Based on the study's findings, it was evident that both onion and garlic could be profitable businesses that would provide Bangladesh's rural residents with jobs and income. Therefore, in light of the study's findings, policymakers ought to take the appropriate measures; in addition, some policy recommendations might be made that are likely to be helpful in the formulation of new policies.

a) Operating capital should be provided

For the resource's impoverished farmers in the research region, operating capital is a challenge. To help farmers run their operations on a commercial basis, low-interest loans from commercial banks ought to be promoted.

b) Storage facilities should be ensured

In the study area both type of farmers has mentioned the unavailability of storage facilities and post-harvest losses regarding it. Both public and private endeavors ought to be undertaken to make available cold storage facilities in Shariatpur region.

c) Market price should be monitored

Farmers were unable to obtain fair prices for their garlic and onion. The lack of proper information, infrastructure, high price risks, etc., all contribute to high marketing costs. In order to guarantee (i) a fair price, (ii) the quality of agricultural products, (iii) the floor price, and (iv) production stability, the necessary actions should be taken.

d) Improved seed quality

Reputably, one of the most important factors in raising agricultural productivity is having the appropriate amount of high-quality, improved variety seeds. Emphasis should be given on availability of quality seeds and bulbs facilities and infrastructure support for onion and garlic production.

e) Adequate extension service and training should be provided

The training and extension services must be able to provide the growers of onion and garlic with the necessary guidance, oversight, and technical assistance when needed.

f) Balanced fertilizer should be used

Interventions from the public and private sectors may be necessary to: (i) guarantee the balanced application of fertilizers; and (ii) train farmers on the proper applications, combinations, and dosages of fertilizers. Furthermore, farmers stated that contaminated fertilizers caused their problems. Therefore, it is important for the public to take action to preserve fertilizer quality.

8.5 Limitations of the Study

The study's conclusions need to be interpreted cautiously. The following is a discussion of the study's limitations:

a. The majority of farmers did not maintain any written records of their agricultural production activities. For the accuracy and dependability of the data, the researcher was forced to completely rely on the farmers' recollections and sincerity. Errors could therefore not be completely ruled out.

b. Due to time and resource constraints, the research was completed in a small area of three Upazilas with a very small sample size. As a result, extra caution should be used when extrapolating the study's results to the entire nation.

Notwithstanding certain constraints, the results of this investigation could offer significant insights to producers of onion and garlic, decision-makers, extension agents, and scholars.

8.6 Scope for Further Study

The current study is not without criticism, despite the fact that it aims to offer some useful information for the advice of researchers, farmers, extension agents, and policy makers. Naturally, the shortcomings of the current study provide opportunities for additional research, some of which are listed below:

a) A thorough investigation in this area could be conducted to learn more about the relative profitability of these two businesses as well as studies involving other crops.

b) It would be possible to conduct additional research accounting for varying farm sizes in order to evaluate the effect of onion and garlic profitability on earnings and job opportunities.

c) Bangladesh can be studied in relation to the increase, growth, and instability of onion and garlic production.

CHAPTER IX

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APPENDICES

Research Questionnaire

An Interview Schedule for the Study and Entitled

COMPARATIVE PROFITABILITY AND RESOURCES USE EFFICIENCY OF ONION AND GARLIC PRODUCTION IN SOME SELECTED AREAS OF SHARIATPUR DISTRICT

Serial number: ☐ **Date:**

Dear Respondent,
All of your information will be kept confidential and will be used for research purpose only.Please provide the following information.

A. General information

Name:
…….....

Address: Village: …….……...…….…… Upazila:
…….…….

District: …….……... Mobile: ……...……

B. Socio-economic information

1. Age of the respondent ..... years

2. Year of schooling: ..... years

3. Source of income (Use code):

Source of income			
Main	Income per year	Secondary	Income per year

(Use code: Crop farming = 1, Livestock rearing = 2, Fish farming = 3, Day labor = 4,Service = 5, Business = 6, others =7)

4. Agricultural farming experience..... years

5. Onion/Garlic farming experience .....years

6. Total farm size

Sl. No.	Types of land use	Area of land	
		Decimal	Hectare
F1	Homestead area (including pond and orchard)		
F2	Land under own cultivation		
F3	Mortgage in		
F4	Mortgage out		
F5	Land given to others on lease		
F6	Land taken from others on lease		
F7	Fallow land or pasture		
Total farm size = (F1+F2+F3+F6+F7) - (F4+F5)			

7. Farm size under Onion/Garlic cultivation.....Hectares

8. Total no. of family member: ……..…..……

Put √ mark (9-11)

9. Do you have access to extension services: Yes / No If yes, how many days……

10. Any information related to the Govt. loan @ 4% for spices crop: Yes / No. If yes, have you taken it from bank? Yes / No

11. Training related to onion/garlic production.....Yes / No

    If yes, how many days…….

C. Profitability related Information

12. Cost of production

a) Variable cost

Activities		Quantity	Cost (Tk)	Total
Preparation of land				
Seeds	Own			
	Purchase			
Weeding				
Fertilizer	Urea			
	TSP			
	MoP			
	Zinc			
Compost				
Vermicompost				
Irrigation				
Pesticide				
Hired labor				
Others (miscellaneous)				
Total				

b) Fixed Cost

Items	Quantity	Cost (Tk.)	Total
1. Land rent			
2. Family labor			
3. Interest on operating capital @4%			
4. Machinery			
Total			

13. Return from production

Output(s)	Quantity	Price / unit	Total
Product (Kg)			
By-product (Unit)			
Total			

14. Please mention the problems in Onion/Garlic Production.

a)
b)
c)
d)
e)

15. Suggest some measures to overcome these problems in Onion/ Garlic Production.

a)
b)
c)
d)
e)

Thank you for your nice cooperation