COMPARATIVE PROFITABILITY AND RESOURCE USE EFFICIENCY ANALYSIS BETWEEN SUMMER TOMATO AND WINTER TOMATO IN SOME SELECTED AREAS OF CUMILLA DISTRICT

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This is to certify that the thesis entitled **"COMPARATIVE PROFITABILITY AND RESOURCE USE EFFICIENCY ANALYSIS BETWEEN SUMMER TOMATO AND WINTER TOMATO IN SOME SELECTED AREAS OF CUMILLA 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 (MS) IN AGRICULTURAL ECONOMICS** embodies the result of a piece of *bona-fide* research work carried out by **ABU ROYHAN,** Registration No. **15-06859** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

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

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ABSTRACT

Vegetables are essential for giving nutrition, generating cash, and creating work possibilities in Bangladesh, a South Asian nation that is heavily dependent on agriculture and is both extremely impoverished and densely populated. To assess the profitability, contribution of factors to production, and changes in the socioeconomic status of the farmers, a study was conducted in Rarirchar, Borogovindapur and Madhaya villages of Chandina Upazilla to examine the profitability, contribution of factors in yield, and socioeconomic status of tomato (Lycopersicon esculentum) producing farmers. The study was conducted used a straightforward random sampling technique. To evaluate the effects on tomato output, the major production parameters included seeds, labor, land preparation, fertilizer, manure, irrigation, and pesticides were taken into account. Summer tomatoes produced by farmers brought in the best profit of the two varieties. Summer tomato gross returns per hectare was Tk. 1206555 and net return was Tk. 557838, while winter tomato gross returns were Tk. 825538, and the equivalent net returns were Tk. 204984. The benefit cost ratio for summer tomatoes was 1.86 while the benefit cost ratio for winter tomatoes was 1.33. The coefficient of determination (R^2) was approximately 0.68 for summer tomatoes, indicating that the independent variables can account for about 68 percent of differences in tomato production and R^2 was 0.671 for winter tomatoes and indicating that the independent variables can account for about 67 percent of differences in tomato production. The results showed that the variables for irrigation, fertilizer, and insecticides had a significant favorable impact on tomato output for both summer and winter tomatoes. In terms of resource efficiency, hired labor and irrigation are overutilized for both summer and winter tomatoes. However, for both types, less manure, fertilizer, and land preparation is underutilized

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The Author

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ABBREVIATIONS AND ACRONYMS

AEO	Agriculture Extension Officer
BARI	Bangladesh Agricultural Research Institute
BBS	Bangladesh Bureau of Statistic
BCR	Benefit Cost Ratio
BDT	Bangladeshi Taka
BER	Bangladesh Economic Review
BS	Block Supervisor
CV percent	Percentage of Coefficient of Variation
DAE	Department of Agricultural Extension
Df	Degrees of Freedom
et al.	and others (at elli)
etc.	Etcetera
FAO	Food and Agricultural Organization
FY	Financial Year
GDP	Gross Domestic Product
GM	Geometric Mean
GoB	Government of Bangladesh
GR	Gross Return
Ha	Hectare
HIES	Household Income and Expenditure Survey
HYV	High Yielding Variety
IOC	Interest on Operating Capital
Kg	Kilogram
Ln	Natural logarithm
Max.	Maximum
MFC	Marginal Factor Cost
MoP	Muriate of Potash
MPP	Marginal Physical Product
mt	Metric Ton
MVP	Marginal Value Product
NGO	Non-Government Organization

ABBREVIATIONS AND ACRONYMS (continued)

T	Ton
TC	Total Cost
TFC	Total Fixed Cost
Tk.	Taka
TSP	Triple Super Phosphate
TVC	Total Variable Cost
US	United States
$	US Dollar

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Bangladesh has a modest economy but reaps several economic benefits, including a climate that is good for growing a broad variety of crops and plants, fertile soils, a large population to manage agricultural output, plenty of water for irrigation and fish farming, among other things. Despite the fact that agriculture's percentage of the national economy is declining, its overall national value has been rising in Bangladesh's economy in recent years. The crop sector makes up the greatest proportion of the total agricultural output in a country with an agro-based economy like Bangladesh. From the agricultural sector, the gross domestic product (GDP) at market price is 511745 crore Tk. in FY 2021-22 which was 4106614 crore Tk. in FY 2020-21 and 3804464 crore Tk. in FY 2019-20 (base year 2015-16) **(BER, 2022).**

Table: 1.1 GDP contribution of the agriculture sector at the current market price (In crore taka)

Particulars	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**	**2020-21**	**2021-22**
A. Agriculture	279505	301167	329380	353443	380446	410661	439834
a. Crops and Horticultur	138280	148669	162333	173378	186116	199631	211886
b. Animal and farming	46655	49516	53186	56290	59715	63293	67189
c. Forest and related services	37188	39864	43563	46639	50399	55916	62577
d. Fishing	57382	63118	70298	77136	84216	91822	98182

Source: BER, 2022

Bangladesh is an agricultural nation with incredibly fertile soil. In terms of vegetable production, Bangladesh comes in third following China and India with 16 million tons (1 crore 60 lakh) produced per year. In our nation, 60 different types of vegetables are currently produced by 16.2 million farmer families. In terms of acreage, production, yield, and vitamins, tomato is one of the most important vegetables among all other vegetables (FAO, 2019).

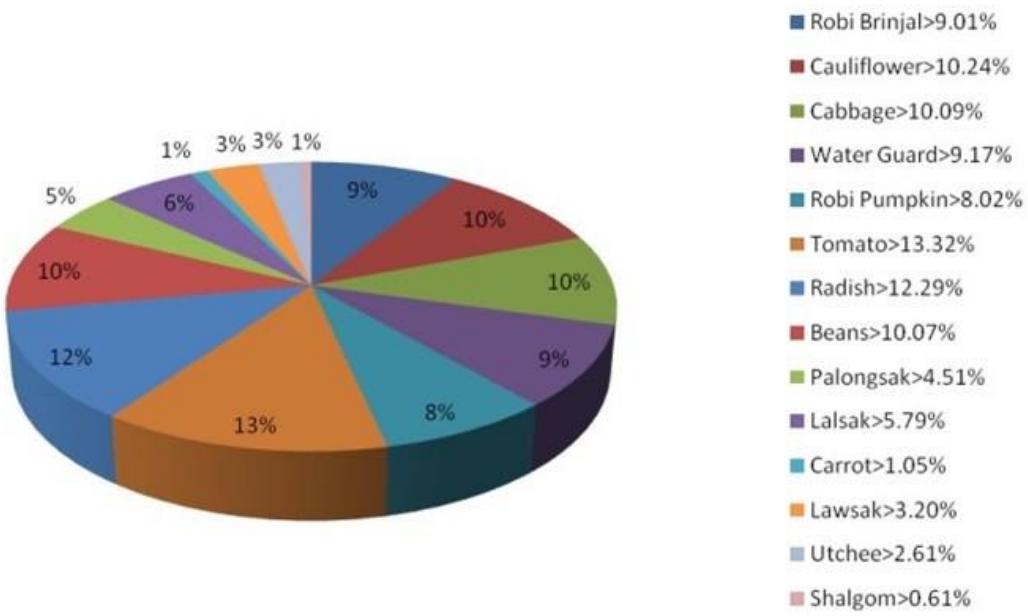

Fig 1.1: Area under of winter vegetables cultivation in Bangladesh, 2020-2021 Source: BBS, 2021.

Where tomato is in the highest position, radish and cauliflower is in the second position, arum is in the third position for the FY2020-21

The area and production of tomatoes are expanding daily. The area used for tomato cultivation in 2016–17 was around 68366 acres, with a yield of 5686 kg per acre and a total production of 388725 mts; in 2020–21, the area was approximately 72878.64 acres, with a production total of 447815 mts (BBS 2021). In the last five years, the overall production of tomatoes has increased by around 15 percent while the acreage used for their cultivation has expanded by about 6 percent. The need for home and international markets has grown significantly, and a wide range of new potential kinds are also accessible. It also contributes positively to the food processing industry, and its nutritional benefits are not insignificant.

1.2 Importance of Tomato Among the Vegetable Crops

Vegetables are essential parts of a healthy diet, and regular consumption can help to fend against serious illnesses like some types of cancer. Around 11 percent of strokes and 31 percent of ischemic heart disease are thought to be caused by low fruit and vegetable intake globally. If fruit and vegetable consumption were

adequately increased, it is estimated that up to 2.7 million lives may be saved annually.

According to the FAO (2017), global vegetable output has increased by a factor of five over the previous fifty years, producing about one billion tons of vegetables.

Table 1.2: Per capita consumption of vegetables in different country:

Name of the country	Per capita consumption of vegetables (g/day)
Bangladesh	**56.00**
China	**292.05**
India	**278.76**
Indonesia	**117.53**
Japan	**432.6**
Republic of Korea	**684.38**
Thailand	**257.53**

Source: FAO, 2017

Asia is the continent that has the greatest per capita intake of vegetables, although Bangladesh is in very last place with 56 g per day, compared to China (292.05 g per day), India (278.76 g per day), Indonesia (117.53 g per day), Japan (432.6 g per day), the Republic of Korea (684.38 g per day) and Thailand 257.53 (Table 1.2). The second most important vegetable crop after potatoes is the tomato (*Lycopersicon esculentum*). The tomato is a very common fruit or vegetable that is eaten by people all over the world and is used in many different types of cuisine. Originating in Central and South America, the plant species. These fruits are low in dietary elements and offer a moderate source of vitamin C. Tomatoes are used in a variety of ways in various international cuisines, including raw in salads and as tomato soup and ketchup. Over 160 million tons of fresh tomatoes are produced annually on a global basis; in contrast, three times as many potatoes and six times as much rice are planted globally (FAO, 2016). By employing high yielding varieties (HYV) and enhanced production techniques, the overall production and per-hectare yield of this vegetable can be boosted (Gonzales et al., 1993).

Table 1.3: Worldwide tomato productions in 2022

Name of the Countries	Quantity (Tones)
China	61,631,581
India	19,377,000
USA	12,612,139
Turkey	12,150,000
Egypt	6,624,733
Iran	6,577,109
Italy	5,798,103
Spain	4,768,595
Mexico	4,559,375
Brazil	4,110,242
Bangladesh	385,038

Source: Atlas Big

The top five tomato-producing countries, including China, India, the United States, Turkey, and Egypt, account for about 60 percent of global production. Yet, according to figures on international trade published by the United Nations, Mexico, the Netherlands, and Spain are the top three exporters of fresh tomatoes.

The table of tomato-producing and tomato-exporting nations illustrates the wide range of production practices among rivals on the world tomato marketplaces. Tomatoes are grown in open fields, greenhouses, or under plastic coverings in tropical, subtropical, and temperate areas. They can either be harvested manually or by machine (for processing) (for fresh markets).

1.3 Origin and Nutritional Status of Tomato

In our nation, tomatoes are mostly used as a form of vegetable fruit. The tomato is the edible fruit of *Solanum lycopersicum*, often known as the tomato plant. The species was first found in Western South America, Mexico, and Central America. The Nahuatl word for tomato from Mexico was the source of the Spanish phrase tomate, which gave rise to the English word tomato. It's probable that the domestication and usage of this plant as a farmed food came from the indigenous peoples of Mexico. Tomatoes were used in Aztec cooking at the time of the Spanish invasion of the Aztec Empire. Through what is known as the Columbian exchange,

the Spanish brought the tomato to Europe after first encountering it during their conquest of the Aztec Empire. In the sixteenth century, the tomato spread from that location to other regions of the world that had been colonized by Europeans.

One important source of umami flavor is tomatoes. They are eaten in a variety of meals, sauces, salads, and beverages, both fresh and cooked. Although tomatoes are technically considered berries by botanists, they are frequently utilized in cooking as a vegetable element or side dish.

Lycopene is a chemical that is abundant in tomatoes. In addition to giving them a brilliant red hue, it shields them from the sun's UV radiation. In a similar vein, it can aid in preventing harm to your cells. Vitamins B and E, potassium, and other minerals can be found in tomatoes. Lycopene and other antioxidants protect your cells and immune system from free radicals, which are chemicals that can damage them. As a result, eating lycopene-rich foods like tomatoes may reduce your risk of developing stomach, lung, or prostate cancer. According to some studies, they may also aid in preventing the disease from spreading to the cervix, breast, colon, throat, and pancreas.

Lutein and zeaxanthin, which are found in tomatoes, may help shield your eyes from blue light produced by digital gadgets like computers and smartphones. They might also help prevent eye fatigue and reduce headaches caused by eyestrain. Furthermore, studies suggest that they might potentially lower your risk of developing a more severe case of the primary cause of blindness. Increased consumption of tomatoes may lower your risk of stroke, a condition in which blood flow to a portion of the brain is interrupted.

Table 1.4: Nutrient combination of tomato (nutrient values per 100g)

Principal	**Nutrient Value**	**Principal**	**Nutrient Value**
Energy	18 Kcal	Minerals	
Protein	0.9 g	a. Calcium	10 mg
Total fat	0.2 g	b. Iron	0.03 mg
Cholesterol	0 mg	c. Magnesium	11 mg
Dietary Fiber	1.2 g	d. Manganese	0.15 mg
Vitamins		e. Phosphorus	24 mg
a. Folates	15 µg	f. Zinc	0.17 g
b. Niacin	0.594 mg	Phyto-nutrient	
c. Pyridoxine	0.08 mg	a. Carotene-β	449 µg
d. Thiamin	0.037 mg	b. Carotene-α	101 µg
e. Vitamin A	833 IU	c. Lutein-zeaxanthin	123 µg
f. Vitamin C	13 mg	d. Lycopene	2573 µg
g.Vitamin E	0.54 mg		
h.Vitamin K	7.9 µg		
Electrolytes			
a. Sodium	5 mg		
b. Potassium	237 mg		

Source: USDA, 2019

1.4 Importance of Tomato within the Economy of Bangladesh

Bangladesh is a nation that prioritizes agriculture and relies heavily on crop farming. A subtropical monsoon climate prevails in Bangladesh. The production of a variety of tropical crops, such as rice, wheat, maize, potatoes, jute, legumes, oilseeds, tomatoes, sugarcane, and others, is well-known for Bangladesh. The country's population has grown significantly and the majority of Bangladesh's population now resides in rural areas. Rural residents usually live-in poverty and make barely enough money to support their family. It is a hard reality of existence that is built on inadequate infrastructure and centralized communication networks because of seasonal dryness, monsoon rains, and winter waves. Increased agricultural output is contrasted by high population growth, which exacerbates food insecurity and poverty.

Because tomatoes are a high value crop that requires extensive cultivation techniques, more money and manpower must be invested in their production than is

typical for staple crops. In addition to growing in popularity, this fresh vegetable is heavily employed in the domestic food processing industry. According to information from Table 1.5, the production of tomatoes increased from 255 thousand mts in 2011–12 to 447 thousand mts in 2020–21 after 10 years. Consequently, in recent years, tomato output has been increasing quickly.

1.5 Tomato Cultivation Areas and Production of Bangladesh:

Sun Gold Tomato, Amish Paste Tomato, Black Krim Tomato, Brandywine Tomatoes, Cherokee Purple Tomato, Green Zebra Tomato. Mortgage Lifter Tomato, San Marzano Tomato are some popular tomato varieties in our country. Recently, BARI generated some variants, including, Ratan, Manik, Bahar BARI Tomato -3, BARI Tomato-5, Chaiti,Apurba, Shila, Anupama and Binatomato-2. The summer season is also a good time to cultivate BARI Tomato-4 and BARI Tomato-5 and Anupama. Bahar is a high yielding winter variety. There are two types of tomato plants. Tomato plants that are determined grow smaller and resemble bushes. Their typical height is five feet, making them ideal for container gardening or tiny gardens. Tomato plants that are indeterminate can reach heights of 8 to 10 feet and have a structure more like to a vine.

The land area used for the production was highest in Chittagong, Rajshahi, and Dhaka. Table 1.5 demonstrates that, with the exception of the divisions in Mymensingh and Barishal, tomato cultivation is rising continuously. Through profitability, resource usage efficiency, and issues with cultivation practices on a small scale in the Comilla region, this study helps to determine the challenges and prospects of tomato growing practices Chandina Upazilla.

Table 1.5 Annual cultivation of tomato in 2018-19 to 2020-21

Division	2018-19		2019-20		2020-21	
	Area (Acre)	Production (mt)	Area (Acre)	Production (mt)	Area (Acre)	Production (mt)
Dhaka	10260	49250	9933	59321	10180.98	64885.73
Chittagong	15192	62515	15541	73754	15756.25	77964.02
Khulna	7670	32640	7747	33285	7780	36401.33
Mymensingh	5331	37403	6150	32761	7275	41598
Rajshahi	14242	94205	14528	92897	15064.58	96161.53
Rangpur	9124	76195	9051	86555	9161	88166
Sylhet	4964	28224	4568	29946	4970.53	35640.83
Barisal	2914	7221	2942	6975	2690.30	6997.99
Bangladesh	69697	387653	70460	415494	72878.64	447815.43

Source: BBS, 2021

1.6 Significance of the Study

In the study region and Cumilla district, the research will advance scientific understanding of the critical social and psychological factors that influence industrial-scale tomato production and cultivation. The traditional farming methods used by Bangladeshis have changed recently. A technological advance has been made as a result of the development of high yielding seed varieties, rising fertilizer use, increased use of pesticides and insecticides, installation of pumping sets and use of tractor. A guarantee of remunerative prices to the farmers is a must to maintain this speed and pace of increased production through technical improvement, and this guarantee can be provided to the farmer by creating an effective marketing system

The informative data on tomato production that this study produced will assist the relevant authorities in developing sensible policies and strategies as well as in making well-informed decisions to intervene in the expansion of the tomato return. This study will also help to understand the profitability differences between summer and winter tomatoes. It will also highlight the issues that farmers confront and offer suggestions for how to improve their situation. The results of the study could help producers, traders, consumers, and marketing experts make judgments.

1.7 Justification of the Study

Cereal crops including rice, wheat, and maize are the mainstays of Bangladesh agriculture. Yet, growing vegetables like tomatoes helps address major concerns like hunger, malnutrition, unemployment, and poverty. On the other hand, in order to increase their income, most farmers aim to make the best use of their resources, including land, labor, money, water, and other inputs. Some farmers may use additional inputs to boost productivity, while others may deplete the soil's fertility and disregard environmental concerns. Costs associated with farming could so go up. This research has not been carried out in this region before. In the chosen regions in the Cumilla district, this study analyzes the comparative profitability and resource use efficiency of summer and winter tomato cultivation. A large population can find job and economic growth opportunities in agriculture.

1.8 Objectives of the study

a. To investigate socio-demographic profile of tomato growers.

b. To estimate comparative profitability between summer and winter varieties of tomato

c. To assess technical efficiency in summer and winter varieties of tomato production

d. To investigate risk factors in tomato production.

1.9 Organization of the Thesis

There are nine chapters or parts in this thesis. The backdrop, global production, reasoning, and study objectives are covered in Chapter I's introduction, worldwide tomato production, importance of tomato in the economy of Bangladesh, significance and justification of the study. Chapter II follows with a review of the literature. The study's research approach which is methodology is described in Chapter 3. Chapters 4, 5, 6, 7, and 8 describe the study's findings and debate. The

summary findings, limitations of the study and policy recommendations of the study are then presented in Chapter 9.

CHAPTER 2

REVIEW OF LITERATURE

2.1 Introduction

This section includes a review of the literature on the many financial studies that are used to gauge the profitability and technical efficiency of tomato production. This chapter's main objective is to review a number of studies that are pertinent to Bangladesh's tomato production. Very few studies have been conducted to far on the technical effectiveness and financial profitability of Bangladeshi tomato cultivation. Their conclusions, analytical techniques, and recommendations have a positive influence on the current study, even though part of the research may not be entirely pertinent to it.

2.2 Tomato Production Related Studies

Haque *et al*. (2004) conducted research on the relative economic and technical viability of growing cauliflower, tomatoes, and potatoes in a specific area of the Netrokona district. According to the study, potato had the highest overall cost per hectare, followed by tomato and cauliflower. Potato, tomato, and cauliflower had gross returns per hectare of 68915, 91495, and 60061, respectively. Potato, tomato, and cauliflower had gross margins per hectare of Tk 44591, Tk 74766, and Tk 42198, respectively. Due to lower production costs, the tomato yield was the highest. On the other hand, because to greater production costs, the benefit cost ratio was lowest for potatoes and cauliflower.

Zaman et al. (2006) carried out a study in which they conducted a return of summer tomato cultivation experiment using data from the experiment plot of the regional Agricultural research Station, Jamalpur. With a yield of 28240 kg per hectare, the BARI Tomato -10 (Anupama) variety had the best performance. The entire variable cost for growing summer tomatoes on one hectare of land was BDT 29236, and the total cost of output was BDT 297936. Based on the benefit-cost ratio (BCR) of 3.32, the net return or profit of BDT 690464, the gross margin of BDT 695464, and other factors, they concluded that summer tomato cultivation is beneficial for the Jamalpur region.

Mohiuddin *et al*. (2007) conducted a study in the Patiya and Satkania Upazilla in the Chittagong district in 2005–2006 to find out how well the farmers accepted the enhanced tomato variety and what agronomic practices they used. The top-ranked enhanced varieties growing in the study region include Ruma VF, Ratan (a BARI variety), and Surokka (an Indian variety). When considering variable cost and cash cost separately, the gross margin was Tk 101566 per hectare and Tk 140015 per hectare, respectively. it was observed that farmers' awareness of better tomato farming was rising. The net profit from tomato farming was Tk. 100338 per hectare. Returns on labor and returns on irrigation were calculated based on variable cost and were determined to be Tk. 483 and Tk. 13.33, respectively. The key factors that led to increased tomato production were higher yields, enormous fruit sizes, longer durability, thick fruit skins, and high prices because of the gorgeous color and size. Better tomato varieties were accepted by farmers, but they faced many challenges, such as a scarcity of premium seed, adverse weather, poor quality pesticide and fertilizer, and a high input cost that was noted as one of the biggest problems for tomato growers.

Agele *et al.* (2008) studied how certain tomato cultivars that are grown with the application of both inorganic and organic manures react to meteorological events during the cropping seasons in terms of growth, fruit output, and nitrogen utilization efficiency. The tomato cultivars selected for evaluation of dry season and early crops in the humid rainforest region of Nigeria. The tomato cultivars varied in their capacity to uptake and accumulate nitrogen (N) from organic and mineral fertilizers in the shoot and fruit tissues during both cropping seasons. Additionally, strong genotype by environment interactions and seasonal and/or genotype-specific N utilization efficiency set the cultivars apart. Actually, compared to tomato plants grown in unmanured plots, tomato plants grown in plots treated with NPK and poultry manure produced higher values of fresh and dry weights of root and shoot biomass. Delays in planting resulted in lower dry matter crop yields but did not appreciably reduce N intake.

Karim *et al.* (2009) conducted a study to assess the profitability, the impact of production-related factors, and changes in the socioeconomic status of the farmers involved in summer BARI hybrid tomato farming in the Jessore area of Bangladesh in Bagherpara thana. About 42% and 21%, respectively, of the total variable cost

was allotted for tunnel preparation and labor use. The average yield of BARI hybrid tomatoes was found to be 32.78 taka per hectare. The average return per hectare over variable expenses was Tk. 11, 44,387 on a full cost basis and Tk. 12, 07,481 on a cash cost basis. The average benefit cost ratio was 4.19 on a full cost basis and 5.09 on a cash cost basis. A kilogram of hybrid tomatoes cost Tk 10.94 to raise, while one kilogram of tomatoes brought in Tk 45.83 in profit. The results of the functional analysis show that MP and TSP significantly increased hybrid tomato yield, while human labor, hormones, irrigation, and seed had a negative significant impact. It was found that the sample farmers' overall socioeconomic situation had improved by 20.33 percent. Insect and disease attacks, timely hormone shortages, high labor costs, and the high cost of tunnel materials were the main problems facing tomato production.

Tijani *et al.* (2010) looked into the production limits of the tomato (Lycopersicon esculentum Mill.), using data collected from 80 respondents in Ogun State, Nigeria, local government areas through the use of business budgeting analysis and descriptive statistics. After calculating the gross margin (in Nigerian money) to be 43,350.29 and the net profit to be 36,382.68, it was concluded that tomato production was profitable. There is still cause for concern in the tomato production industry, according to additional assessments of the net returns to total expenses ratio (27 percent), the operational expense ratio (72 percent), and the net farm income ratio (21 percent). Major obstacles included price instability, high input prices, and limited access to finance facilities. In order to boost the output and profitability of tomato farming in tropical climates, it is recommended that farmer groups and cooperatives be formed, access to formal and informal credit be made available, agricultural price support programs be implemented to ensure fair output pricing, and input subsidies be provided.

Begum *et al*. (2011) carried out research to determine the costs and benefits related to cultivating specific crops in different locations. For the production of maize, groundnut, mung bean, sweet potato, cabbage, cauliflower, tomato, cucumber, and okra, she found that the benefit cost ratios over total expenses were 1.61, 1.72, 1.62, 3.55, 1.90, 2.17, 3.72, and 2.64, respectively. The sample farmers stated that the primary barriers to higher crop productivity were the high costs of insecticides and fertilizers.

Ibitoye *et al.* (2015) conducted a field study on the effectiveness of resource usage by tomato producers in Nigeria's Kogi State. Using purposive sampling, the information from 240 respondents was gathered in 2014.The major tool for gathering data was a questionnaire design. Simple descriptive statistics, OLS regression analysis, and efficiency ratio were used to analyze the acquired data. The production of tomatoes produced in the State was found to be favorably influenced by the educational status of farmers, their farming experience, their interactions with extension workers, and the size of their farms. This relationship was significant at 1percent.In Kogi State, resources including labor, pesticides, years of education, seed volume, and farm size were all positively and significantly correlated with tomato yield.While labor and farm size were found to be underutilized, pesticide, seed, and fertilizer quantities were found to be overused.It is advised that the government implement measures to encourage tomato farmers in Kogi State to use agricultural resources effectively.

Samshunnahar *et al.* (2016) carried out a field investigation to assess the socioeconomic situation and profitability of small-scale tomato farmers in a few chosen regions of Bangladesh. To determine the effects on tomato production, the key production factors including seeds, labor, tillage, fertilizer, irrigation, and insecticides were taken into account. Tiny tomato producers made the most money out of three groups based on farm size. While their corresponding net returns were Tk. 46978, Tk. 45356, and Tk. 5354, small, medium, and big farms reported gross returns per acre of Tk. 104180, Tk. 95000, and Tk. 82600, respectively.Large farmers had the lowest undiscounted benefit-cost ratio (1.74), whereas medium farmers had a higher ratio (1.82) than small farms. About 69% of the variations in tomato output may be explained by the independent variables, according to the coefficient of determination (R2), which was approximately 0.694. The results showed that tillage and human work were significantly positive, suggesting that the various independent inputs employed to increase tomato output had a major influence. Ultimately, it was shown that the introduction of small-scale commercial tomato production significantly affected the farmers under study's household income and financial status. Effective policies and first-rate extension services are required to increase the income and prospective income of tomato growers.

Ali *et al.* (2016) conducted research on the efficiency of resource use and return to scale in the Punjab province of Pakistan's off-season tomato production. A straightforward random sample approach involving 70 tomato growers who are not in season was used to collect primary data. The Cobb-Douglas function was used to analyze the production elasticity of different inputs, and the results showed that the model was generally good (R2) (0.693) and f- statistics (11.888). Production elasticity was positively and significantly impacted by age, education, experience, irrigation, labor-man days, usage of polythene sheets, use of tractors, and engagement with extension agents. It was discovered that whereas NPK, seed quantity, chemical sprays, and worker days were overutilized, polythene sheets, tractor hours, and irrigation were underutilized. When all inputs are used efficiently, the return on scale will increase even if it is now declining. The results showed that changing the way inputs are used can increase output, which is helpful information for policy makers developing horticulturally oriented agricultural strategies.

Parvin (2017) carried out research on the profitability and production costs of tomato growers in the Rangpur district. A simple random sample method was used to gather data from 100 farmers. When asked about their socioeconomic characteristics, the tomato farmers expressed that most of them (20–35 years old) were young, came from medium-sized families, had only completed basic school, and owned small farms (0.01–0.33 acre). The study found that small farmers were nearly always more profitable than larger ones. The main concerns raised by tomato growers were lower tomato prices during harvest, a scarcity of premium seed, higher input costs, a lack of government support, etc. In the end, the findings will support planners and policy makers in developing macro- or micro-level policies to increase the country's tomato output.

Islam *et al*. (2017) carried out a field experiment at the Sylhet Agricultural University's Horticulture Department in Sylhet, Bangladesh, to determine whether tomato production during the 2014 summer growing season, from May to October, was appropriate. Five tomato hybrids, namely BARI tomato-3, BARI tomato-4, NHC-1, NHC-2, and NHC-3, were tested for tomato production in Sylhet throughout the summer. The hybrid tomato-3 from BARI had the highest total soluble solid content among the hybrids at 5.3 percent. The maximum fruit production was produced by the hybrid BARI hybrid tomato-4, followed by NHC-

1. By cultivating tomatoes during the summer in the Sylhet region, one can make more than 4,000 taka per decimal, according to a benefit-cost ratio. According to this study, the Sylhet region has a promising future for tomato production in the summer.

Mukherjee *et al*. (2018) in this field experiment, tomatoes were grown from November to March in 2003–2005 using the following irrigation schedules: rain feeding, irrigation when cumulative pan evaporation (CPE) reaches 50 mm (CPE50) or 25 mm (CPE25), rice straw, white polyethylene, or any combination of these treatments. Fruit output increased with increased irrigation frequency. Mulch boosted fruit output by 23 to 58 percent as compared to no mulch.The cost-benefit (CB) ratio increased as irrigation frequency increased. The most CB ratio (1:3.1) was produced at all moisture conditions by rice straw, which is more affordable and easily accessible. Black polyethylene came in second (1:2.9). Using black polyethylene (rain fed, CPE50) when water is scarce can increase revenue compared to growing plants on bare soil when water is plentiful.

Maitra and Sharmin (2019) carried out a field investigation to find out how profitable and risk-averse Bangladeshi tomato farmers. In order to determine the factors influencing tomato farmers' risk attitudes, 60 sample tomato farmer respondents from the Mymensingh district were chosen. Moreover, financial performance was looked at, and the findings revealed that only 18percent of farmers preferred risk while 42percent were risk adverse. Understanding the need of receiving newly developed technology, timely seed application, irrigation, and fertilizer application, is made easier with training and education. Education helps people admit information from many sources that make them more risk-averse. Tomato cultivation had a benefit cost ratio (BCR) of 2.31, meaning it is completely profitable. Tomato producers' productivity and profitability can increase if they can control the various risks and uncertainty related to their production methods.

2.3 Conclusion remarks

The discussion and review described above show that the majority of studies focus on the cost, return, profitability, and productivity of tomatoes. Moreover, updated data were used in this study's execution to obtain up-to-date production-related information. Maximum studies looked at production-influencing indicators more

than ten years ago. To investigate the subject from the perspective of Bangladesh, it is necessary to include the influence of additional aspects already noted by scholars in other nations. There haven't been many original studies on the relative productivity and efficiency of resource use in tomato cultivation in Bangladesh. In order to address the limitations of previous studies, methodological features were redesigned with the assistance of the literature evaluation. This would help future research and policy makers.

CHAPTER 3

METHODOLOGY

3.1 Introduction

The right approach was applied in the research, which has a significant impact on the survey's proper outcome. The type, context, and study goals decide the appropriate methodology. It also depends on how much money, material, and time are required. The current study was founded on primary information that was genuinely gathered through a field survey and trustworthy sources. Given its lower cost, shorter time commitment, and overall ease of use, the random survey approach was chosen for this investigation. The investigator must rely on the respondents' memories, which is the biggest drawback.

3.2. Selection of the Study Area

In farm management research, one or more areas that are especially well suited to achieving the study's objectives are typically chosen in accordance with the requirements. Chandina Upazilla was chosen for the current study based on her output. The villages of Rarirchar, Brogovindapur, and Madhaya provided the primary data. The following were the main factors considered when choosing the study area:

i. Excellent communication facilities and ease of access.

ii. The number of farmers that grow tomatoes in the study area is available.

iii.Since the researcher is familiar with the area, better cooperation and communication from the farmers were anticipated.

iv. The communities shared certain traits, such as uniform soil and an environment conducive to tomato cultivation.

3.3 Selection of the Samples

The Department of Agricultural Extension of Chandina Upazilla and the Upazilla Agricultural Office provided a list of tomato farmers. There three villages f Chandina Upazilla has been selected, they are Madhaya, Rarirchar and Borogovindapur. The selection of the respondents was made randomly from the given list where 45 summer tomato growers and 36 winter tomato growers were selected as samples. Simple random sampling technique has been used for data

collection.

3.4 Source of Data

The information needed for this inquiry came from both primary and secondary sources. A pre-planned and pretested interview schedule and secondary data from multiple published sources were used to help gather primary data from farmers through the survey method. The Bangladesh Bureau of Statistics (BBS), the Bangladesh Economic Review (MoF), and other relevant Bangladeshi organizations were examples of secondary sources.

3.5 Preparation of the Survey Schedule

Firstly, a survey schedule was designed for recording the desired information with objectives of the study. After preparing a related questionnaire the drafted copy was revised and a date was fixed for covering a face-to-face interview with the respondent. The questionnaire involves the following things:

i. Present socio-economic situation of the farmers.

ii. Cost of using resources and other additional activities.

iii. Return from the yield.

iv. Problems faced by the farmers at the time of production.

3.6 Method of Data Collection

Data on farm management can be gathered in a variety of ways, but the most common ones are surveys, cost accounting, financial accounting techniques, etc. For this study, the survey approach was used since it is more feasible, less costly, less time-consuming, and easier to collect data from.

3.7 Period of Data collection

The whole survey was conducted by the researcher myself during the month of February and March of 2023. Data was collected through several visits by the researcher.

3.8 Collection of Data

Gathering trustworthy and accurate field data is a job that requires commitment and flexibility. The technique used to acquire the data has a significant impact on its reliability. Data were obtained directly from the sample respondents using pre-

planned research schedules in order to guarantee accuracy and dependability. Every interviewee received a synopsis outlining the nature and objectives of the study so they could respond freely and quickly. Care and concern were used when collecting the data in order to ensure its accuracy and dependability. The respondent and researcher established a cordial rapport while taking into consideration the respondent's manner of communication.

3. 9 Processing and Tabulation of Data

Data processing is crucial in order to achieve the study's goals. The answers were examined to determine the amount of mistakes. Data for the study were coded, tabulated, summarized, and processed for analysis after being collected from the field. Using MS Excel, the interview schedule data was converted into an SPSS sheet.

3.9.1Analytical Technique

Data were analyzed on account to achieving the objectives of the study. The following methods were employed for this study:

i) Tabular technique

ii) Statistical analysis

Tabular Technique

Tabular technique was applied to verify data in order to get meaningful findings by using simple statistical measures like means, percentage and ratios.

Statistical Analysis

This part of the financial analysis was created to investigate the variables influencing the productivity of tomato farming and the efficient use of resources. To investigate the requirement and productivity of the various inputs, a production function analysis was conducted. For this analysis, the data were arranged according to hectares.

3.9.2 Financial Profitability Analysis

A farm's principal objective is to maximize profits. Achieving a specific output level or business size, setting aside time for leisure activities, business growth, business survival, and steady operations are a few other objectives.

Gradually. The most popular technique for figuring out and contrasting the profitability of various farm households is cost and return analysis. The profitability

of growing tomatoes is determined in the current study using the following formula:

Gross Return:

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

Gross Return=Quantity of the product * Average price of the product + Value of by-product

Gross margin

To calculate gross margin, subtract variable costs from gross return. Generally speaking, farmers prefer the highest possible return over variable production costs. Because farmers are more interested in receiving returns than variable costs, the gross margin analysis is justified. On a TVC basis, the gross margin was determined. Once variable costs were deducted from gross return, the per hectare gross margin was calculated. That is, Gross margin=Gross return – Total variable cost.

Profit or net return is the variance between total revenue (gross return) i.e., total value product (TVP) and total production cost (TPC). Total factor costs include all kinds of variable and fixed costs involved with the production process. The following traditional profit equation was applied to calculate farmer's profitability level in the study areas

Net return = Gross return – Total factor cost

= TVP- TFC

Net profit, $\pi = (\sum P_t Q_t + \sum P_a Q_a) - (\sum (P_{xi} X_i) + TFC)$

π = Net profit/Net return from tomato cultivation (Tk. /ha)

TVP refers the value of total output,

Total value product, TVP= $\sum P_t Q_t + \sum P_a Q_a$

Where,

P_t = Per unit price of tomato (Tk. per kg);

Q_t = Total quantity of the tomato production (kg per hectare);

P_a = Per unit price of by product (Tk. per kg);

Q_a = Total quantity of by product (kg per ha);

On the other hand, Total factor cost (TFC) of a product adds all kinds of variable

and fixed costs involved in the production process.

Total Factor cost, TFC= P_{xi} X_i + TFC

Where,

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

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

TFC = Total fixed cost (Tk.); and
i = 1, 2, 3,….., n (number of inputs).

Benefit Cost Ratio

Benefit cost ratio was calculated by the following formula

$$\mathbf{BCR}=\frac{\boldsymbol{Total\ Return}}{\boldsymbol{Total\ Cost}}$$

3.10 Functional Analysis

Enhancing the features of the production function is required to specify an explicit functional form, which is required for computation. The Cobb Douglas production function is a frequently utilized production function for empirical estimation. It was created by C.W. Cobb and P.H. Douglas during the 1920s to ascertain the marginal productivities of labor and capital in American manufacturing industries. Cobb and Douglas finally established the function using the time series from the 1930s and 1940s; a cross section of industries was also subjected to the same equation. Its following features alone account for its popularity:

1.It provides the elasticities of production with accustomed to inputs;

2.It permits more degrees of freedom than other algebraic forms (like quadratic function) which allow increasing or decreasing marginal productivities, and

3.It facilitates the calculations by reducing the number of regressions to be handled in regression analysis.

The original form used by Cobb and Douglas was

$$\mathbf{Q=a\ L^{\beta}\ K^{1-\beta}\ U}$$

These forces sum of elasticities is equal to one. Their later modification

$$\mathbf{Q=a\ L^{\alpha}\ K^{\beta}\ U}$$

Where, $\boldsymbol{\alpha+\beta}$ need not to equal one. In agriculture, this form of function has not been used in its primitive form. Neither the sum of elasticities is kept limited to one nor is the number of variables limited to two. Even then as the basic logic of

functional

form was provided by Cobb and Douglas, The Cobb–Douglas production function, in its stochastic form, may be explored as

$$Y= a\ x_1^{b1} x_2^{b2}\ X3^{b3}\ x_4^{b4} x_5^{b5}\ X6^{b6}\ X7^{b7}\ e^{Ui}$$

The input-output relationships in tomato production were analyzed with the help of the following:

$$\ln Y=\ln a+b_1 \ln X_1+b_2 \ln X_2+b_3 \ln X_3+b_4 \ln X_4+b_5 \ln X_5+b_6 \ln X_6+b_7 \ln X_7 +Ui$$

Where,

Y= Gross return (Tk. per hectare); a= intercept value;

X_1= Cost of labour (Tk. per hectare);

X_2 = Cost of land preparation (Tk. per hectare);

X_3 = Cost of seeding (Tk. per hectare);

X_4= Cost of manure (Tk. per hectare);

X_5 = Cost of fertilizer (Tk. per hectare);

X_6 = Cost of insecticide (Tk. per hectare);

X_7= Cost of irrigation (Tk. per hectare);

Ui= Error term;

i= 2, 3, ...80;

$b_1, b_2, b_3, b_4, b_5, b_6, b_7, \ldots$ = Co-efficient of respective variance.

The coefficient of each of the X variables in a log-linear regression model with any number of variables determines the (partial) elasticity of the dependent variable Y with respect to that variable. Constant returns to scale are when output changes uniformly in relation to changes in all inputs; decreasing returns to scale are when output changes less than changes in all inputs; and increasing returns to scale are when output changes more than changes in all inputs.

3.11 Resource Use Efficiency Analysis

In according to test the efficiency, the ratio of Marginal Value Product (MVP) to the Marginal Factor Cost (MFC) for each input were computed and tested for its equalityto 1. i.e,

MVP/MFC = 1.

In this study the MPP and the relevant values of MVP will be obtained as follows:

$MPP_{xi} \times P_{yi} = MFC,$

Where, $MPP_{xi} \times P_{yi} = MVP$,

But, $MPP = b_i \times (Y/x_i)$

So, $MVP = b_i \times (Y/x_i)P_{yi}$

Where, b_i= regression coefficient per resource,

Y_i = Mean output,

X_i = Mean value of inputs,

P_{yi} = price of output,

MFC = price of per unit of input.

Thus, When Resource-use efficiency RUE =1, resources were optimally utilized,
When RUE < 1, resource were over utilized,
and When RUE >1, resources were underutilized.

3.12 Cost Items

An important consideration when making financial decisions for carrying out and revenue-generating activities is the cost of inputs. In the research area, respondents used both home-circulated and purchased inputs. Purchased input costs and home-circulating input costs were not broken out individually in the calculations. The cost of Tomato cultivation can be mainly classified under the following two heads:

a) Variable cost
b) Fixed cost

a) Variable Cost

1. Cost of seed
2.Hired Labour cost
3.Fertilizer's cost
4.Land preparation and irrigation cost
5.Interest on operating capital
6.Manure cost
7.Insecticide cost
8.Additional cost

b) Fixed Cost

1.Land use cost 2. Family labour

Cost of Seed

The cost of seed is assessed using both purchased and home-preserved seed. The price of home supply seeds was approximated using the current market price, and the purchase price was the actual market price.

Fertilizer and Manure Cost

Manure and fertilizer were two important expenses associated with growing tomatoes. The price of fertilizer included zinc, gypsum, MoP, TSP, and urea. The cost of fertilizer was determined using the cash price that farmers were willing to pay per kilogram and computed at the current rates of the local market.

Insecticide Cost

Farmers provided tomato cultivation with supplies such as Thiovit 80 WP and malathion. Based on the price that the farmers pay, these expenses are estimated.

Human Labour Cost

The biggest and most valuable input in the production of tomatoes was labor. Because hired labor was heavily utilized in this cultivation, the cost of labor includes both family labor and hired labor. One man-day was equal to eight hours worked by an adult male, and the opportunity cost principle was developed to calculate the labor wage rate.

Land Preparation and Irrigation Cost

The real expenses incurred by the tomato farmers were factored into the computation of the expenditures for machinery services. Nearly all of the sample farmers in the research area prepared their ground using tractors, power tillers, and other equipment. Their primary tractor was a hired one. Fuel and a driver were provided by the owner of a power tiller for the purpose of preparing the ground, and the cost of the machinery included a service charge.

The cost of fuel and machine rental were included to determine the cost of irrigation.

Land Use Cost

The cost of using a piece of land varied depending on its terrain, location, and soil richness. Four months were dedicated to the cultivation of tomatoes, from the time the soil was prepared to the time of harvest. In the current study, the cost of using land was calculated by deducting the land's cash rental value from the cost of using other land.

Interest on Operating Capital

The amount of money needed to meet the expenses on hired or purchased inputs was determined as operating capital in this study. Interest on operating capital was calculated by using the following formula (Miah *et al*., 2013)

IOC= AIit

Where,

IOC= Interest on operating capital

i= Rate of interest

AI= Total investment / 2

t = Total time period of a cycle

3.13 Return Items

Return items were as follows:

(i) Return from selling Tomato.

(ii) Return from selling by product.

3.14 Procedure for Evaluation of Return

Per hectare gross return was calculated by multiplying the total amount of product by their corresponding average market price. Gross return per hectare composed of the value of main product.Net return was found by deducting all direct cash and non-cash expenses from the gross return

3.15 Constraint Factors Analysis

Tabular and percentage analysis were often employed to determine the constraints factor faced by the growers. Problems arise of tomato farming were calculated using a percentage method of analysis. It is extensively used, easy to comprehend, and has straightforward calculations. Simple measurements like average, percentage, and ratio were obtained using it.

CHAPTER 4
DESCRIPTION OF THE STUDY AREA

4.1 Introduction

This chapter gives a brief overview of the chosen research area. Understanding and evaluating the study's findings require a thorough understanding of the subject matter. Location, topography, physical characteristics, rainfall, population, religion, and culture, as well as agriculture and transportation, are all included in the study area's description.

4.2 Location

The study area includes Cumilla District's Chandina Upazilla. The villages of Rarirchar, Borogovindapur, and Madhaiya were chosen for this project from those Upazilla.The coordinates of Chandina are 23.4833°N 91.0083°E. Its overall area is 201.92 km^2, and there are 46,856 houses there. The Dhaka Chittagong Highway runs through Chandina Township, a class B municipality that is situated in the far north of the Upazilla. The municipality includes the Cahndiara village region, and the value of real estate there has climbed dramatically along with that of the rest of the municipality. (Wikipedia, 2023)

4.3 Physical Features and Topography

Both high and low land comprise the study's region, and the soil types range from sandy loam to sandy clay loam. The soil structure of both locations is remarkably comparable, and the land surface of the research area is plainly fertile and severely acidic. The development of ground water irrigation infrastructure has been promoted by the favorable water level, flat topography, and loamy soil.

Table: 4.1 Land use statistics under rural and urban areas

Owned Area	Operated Area	Homestead Area	Net Cultivated Area	Irrigated Area	Temporary Crops Gross Area	Intensity of Cropping (percent)
22577331	23505192	2166302	19097544	11981329	30485315	173

Source: BBS, 2021

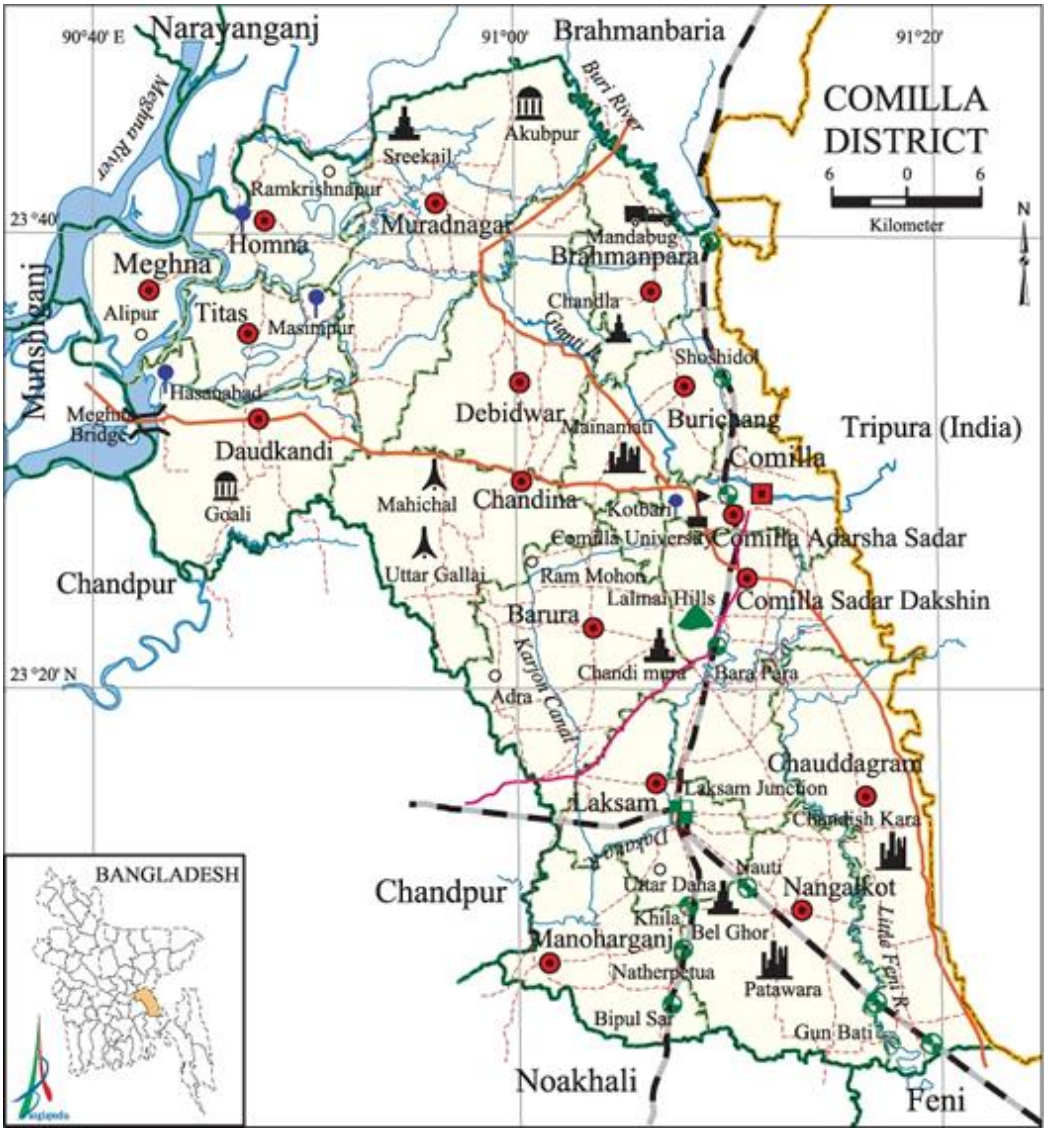

Figure 4.1: Map of Cumilla District

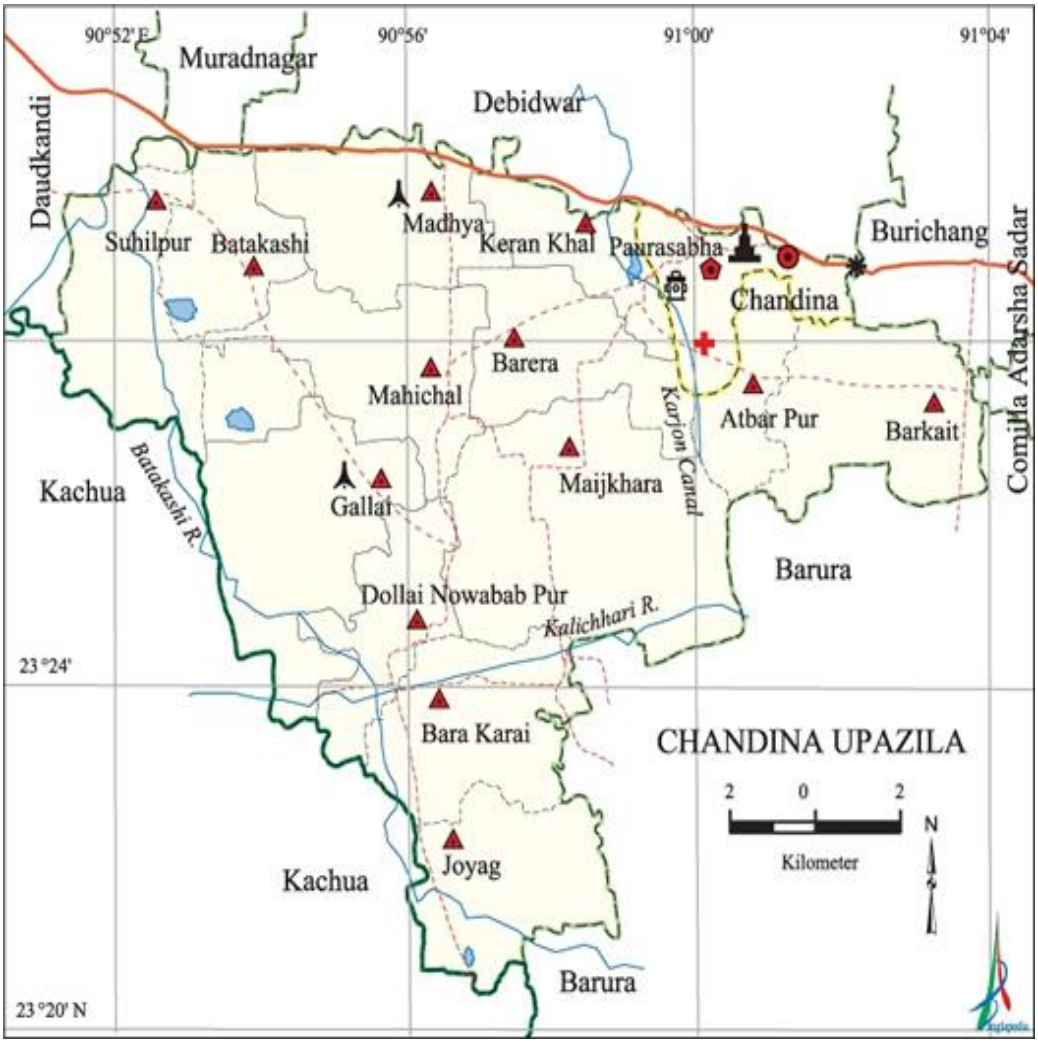

Figure 4.2: Map of Chandina (study area) Upazilla

4.4 Irrigation Facility

Table: 4.2 Area irrigated by different means (area in acres)

Power Pump	Total Tube well(Shallow+ Deep++Hand)	Traditional	Total Irrigated Area	Cropped Area	Irrigated Area (percent)
74	357	12	443	1045	42.39percent

Source: BBS, 2021

Table: 4.3 Area irrigated under different crops (Cumilla)

Crops	Area In Acres
Aman	**12**
Boro	**380**
Wheat	**2**
Sugarcane	**1**
Cotton	**0**
Potato	**12**
Vegetables	**21**
Other Crops	**15**
Total Irrigated Area	**443**

Source: BBS, 2021

Vegetable farming has a lot of potential in the Comilla district. According to BBS district statistics for 2018–19, out of the 443 acres that are irrigated, 380 acres are needed to grow Boro rice, and 21 acres are needed to grow vegetables.

4.5 Religion and culture

In the study area, Muslims make up the majority of the villagers, while Hindus make up the majority of the non-Muslim villagers. The peasants are very devoted to their own religion, and ties between Muslims and Hindus are amicable. Their criteria are straightforward and uncomplicated. They are incredibly cordial with one another at

all kinds of social gatherings, and the villagers' hospitality is noteworthy.

4.6 Climate, Temperature and Rainfall

Cumilla's climate is generally characterized by monsoons, extreme heat, high humidity, and abundant rainfall. Early in April marks the start of the hot season, which lasts until July. Comilla's yearly mean temperature is 25.5 °C (77.9 °F).Every year, there is about 2,295 mm (90.35 in) of precipitation.

Table 4.4: Monthly min., max., average temperature and rainfall of the studyarea in 2023

	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature °C (°F)	18.7 °C (65.6) °F	22 °C (71.6) °F	25.9 °C (78.6) °F	27.8 °C (82) °F	27.9 °C (82.3) °F	27.6 °C (81.6) °F	27.1 °C (80.8) °F	27.2 °C (81) °F	27 °C (80.7) °F	25.9 °C (78.7) °F	22.9 °C (73.2) °F	19.7 °C (67.5) °F
Min. Temperature °C (°F)	12.3 °C (54.2) °F	15.5 °C (59.8) °F	19.9 °C (67.8) °F	23.5 °C (74.3) °F	24.7 °C (76.4) °F	25.4 °C (77.7) °F	25.2 °C (77.4) °F	25.1 °C (77.2) °F	24.7 °C (76.4) °F	22.6 °C (72.6) °F	17.8 °C (64.1) °F	14 °C (57.2) °F
Max. Temperature °C (°F)	24.9 °C (76.8) °F	28.3 °C (83) °F	31.8 °C (89.2) °F	32.6 °C (90.7) °F	31.9 °C (89.4) °F	30.7 °C (87.2) °F	30 °C (85.9) °F	30.4 °C (86.7) °F	30.4 °C (86.8) °F	29.9 °C (85.8) °F	28.1 °C (82.6) °F	25.6 °C (78) °F
Precipitation / Rainfall mm (in)	7 (0)	23 (0)	95 (3)	195 (7)	342 (13)	373 (14)	365 (14)	293 (11)	284 (11)	177 (6)	36 (1)	10 (0)
Humidity(%)	67%	60%	60%	73%	82%	86%	87%	86%	87%	84%	74%	70%
Rainy days (d)	1	3	6	11	17	20	21	21	19	12	3	1
avg. Sun hours (hours)	8.8	9.4	9.1	8.2	7.5	6.4	6.2	6.9	7.3	8.1	8.6	8.1

Source: Climate Data

Figure 4.3 shows that maximum and minimum temperature in the study area ranged from 32.6°c to 12.3°c. The average maximum temperature was the highest in April which was 32.6°C and the average minimum temperature was found in January which was 18.7°c. The maximum average rainfall is about 373 mm in June and the lowest in January. (Climate-Data.org, 2021)

4.7 Area, Population, Sex ratio and Literacy Rate of Chandina Upazilla

Table 4.5: Area, population, sex ratio and literacy rate of Chandina Upazilla

Name of the Area	Household	Population		Sex ratio	Density Per sq. Km.	Literacy Rate (percent)
		Male	Female			
Chandina	46,856	154160	151894	101:100	3315	50.9

Source:(Bangladesh population census 2001, Bangladesh bureau of statistics cultural survey report of Chandina Upazilla 2007, Banglapedia)

4.8 Non-government Organizations (NGOs)

In the study area, numerous non-governmental organizations (NGO's), including BRAC, ASA, Grameen Bank, Proshikha, etc., are involved in various rural development programs. NGOs have recently started offering technical and financial assistance in areas including livestock, poultry, fisheries, homestead gardening, handicrafts, and others. In addition to participating in educational initiatives, they also give disadvantaged women and landless farmers small loans (microcredit).

4.9 Use of Modern Technology

The majority of persons in the study area work in the agricultural sector. The main crop grown in Chandina Upazilla is rice, which is grown during the Aus, Aman, and Boro seasons. Winter crops like wheat, potatoes, and mustard as well as vegetables like pumpkin, cucumber, bottle gourd, cucumber, and tomato are also cultivated in the study area. Contemporary technology is widely used in the study region, including deep and shallow tube wells, tractors, power tillers, HYV seeds, chemical fertilizers, pesticides, and manure.

4.10 Roads, Communication and Marketing facilities

The main agricultural infrastructure is consisting of transportation and marketing facilities, which are crucial to a nation's agricultural and economic success. The benefits of modern technology are inaccessible to the villagers without a well-developed transportation system. The primary modes of transportation in the research area include buses, bicycles, rickshaws, CNG, and van services. There are many markets and Hat in the study region, thus the marketing systems in these Upazilla headquarters are mediocre at best. Farmers typically buy their daily necessities, such as agricultural supplies, and then sell their produce to middlemen like Paikers, Beparies, and Aratdars as well as to the village markets. On occasion, the peasants get a fair price for their goods.

4.11 Conclusion

An overview of the physical, topographical, demographic, and socioeconomic conditions of the Chandina district in general, and specifically for the study Upazilla, are provided in the brief summary above. The Chandina district has the capacity to produce tomatoes and contribute to the national economy. To increase the productivity of tomato production, efficient management and usage

of the available natural resources are also essential and proper infrastructure needs to be built to get a better output result.

CHAPTER 5
SOCIOECONOMIC CHARACTERSTRICS OF TOMATO FARMERS

5.1 Introduction

The study's discussion of a few of the sample farmers' demographic traits that frequently affect their choice of production strategy is covered in this part. A person's demographic features determine his or her decision-making style. This study took into account a number of significant criteria, including family size and composition, educational attainment, experience, occupation, ownership pattern, etc. The sections that follow provide a brief explanation of these cases.

5.2 Age Distribution and Family size of the sample Farmers

Farmers' ages have an impact on the farming system's output. Older farmers may be more knowledgeable and resourceful, according to some academics. Younger farmers are more likely than older ones to desire to use new technologies, according to other study.

Table 5.1: Age distribution of the respondent

	Summer Tomato		**Winter Tomato**		**Total**	
Age category	**No.**	**Percentage**	**No.**	**Percentage**	**No.**	**Percentage**
Below 30 years	12	18	15	42	27	33
Between 31 to 45 years	25	62	12	33	37	46
More than 45 years	8	20	9	25	17	21
Total	**45**	**100**	**36**	**100**	**81**	**100**
Average family size (No.)	5.43		5.26			
Average male member (No.)	3.2		3.1			
Average female member (No.)	2.34		2.17			
Average earning member (No.)	1		1			

Source: Field Survey, 2023

5.2.1 Age Distribution of the Tomato Farmers

As shown in Table 5.1, all types of farmers in the study area were divided into distinct age groups for the purposes of this investigation. The table makes it clear that the majority of the farmers in the research region were middle-aged. Farmers who grow tomatoes in the summer and winter were divided into three age groups: under thirty, between thirty and forty-five, and over forty-five.

18 percent of all sample farmers in the summer tomato crop were under 30 years old, while 42 percent of all sample farmers in the winter tomato crop were younger than 30 years old. Sixty-two percent of Summer Tomatoes and thirty-three percent of Winter Tomatoes were in the 31–45-year age range. Twenty percent of Summer Tomatoes belonged to the over-45 age group, but among Winter Tomatoes, the ratio was twenty-five percent. This result suggests that the majority of the sample farmers belonged to the age group that was most active, which is 31 to 45 years old. This suggests that they put in greater physical effort when working with roses and winter tomatoes. It is expected that people in this age range have a great deal of energy and can handle risk.

5.2.3 Family Size of the Tomato Farmers

The wife, the sons and their wives, the father, the mother, the brother, and the single daughter are all members of the family. The population of all the families was split into three age groups based on the size of their families. Table 5.1 indicates that summer tomato farmers have an average family size of 5.43 and winter tomato farmers have an average family size of 5.26. Average male and female members of summer and winter tomato farmers are 3.2 and 3.1, respectively, and average earning members of summer and winter tomato farmers are 1 and 1, respectively. The average family size of our country is 4 (BBS, 2022). But in the study area it was found 5.43 for summer tomato farmer and 5.26 for winter tomato farmer, which was larger than average family size of the country.

5.3 Educational Status of Summer and Winter Tomato Farmers

Education is typically seen as a crucial factor in the social progress of a community. Efficiency comes from education, and efficiency helps farmers become more skilled and productive. Out of 45 summer tomato producers, Figure 5.1 reveals that 34 percent had completed primary level (Class 1 to 9) schooling, 46 percent had completed SSC, 8percent had completed HSC, 3percent had completed an honors

degree, 6percent could only write their names, and 3percent were illiterate.

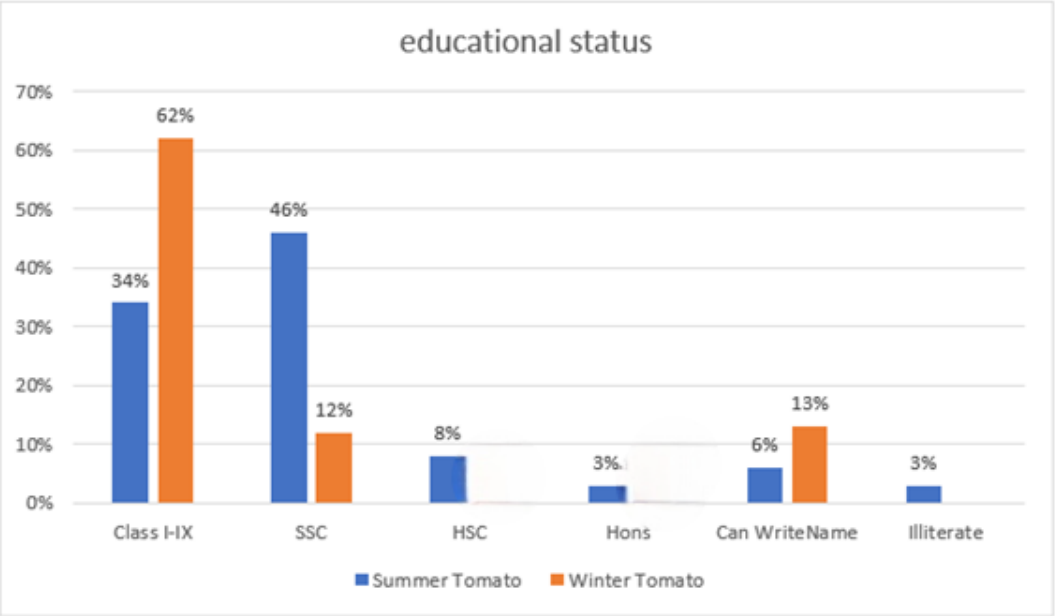

Figure 5.1: Educational status of summer and winter tomato farmers

Source: Field Survey, 2023

Out of 36 winter tomato producers, 62 percent had completed elementary school (Classes 1 through 9), 13 percent had completed the SSC, 13 percent could only write their names, and 13 percent were illiterate.

5.4 Conclusion:

In this chapter, the socioeconomic characteristics of the sample farmers were analyzed. The analysis' findings make it abundantly evident that while the majority of farmers lack a college degree and earn modest annual incomes, they are all well experienced in agriculture.

CHAPTER 6
PROFITABILITY OF TOMATO CULTIVATION

6.1 Introduction

This chapter's purpose is to evaluate the costs, returns, and profitability of growing tomatoes while concentrating on the key variables influencing the return on tomato production. Fertilizer, manure, insecticides, hormones, irrigation, seeds, labor costs, land costs, and operational capital costs in six months are among the cost items. On the other hand, the sales value of the product made up the tomato cultivation's gross return. The calculations were done per hectare, using gross margin, net return, and predicted returns per taka invested on the entire cost.

6.2 Cost of Tomato Production

The cost is the total sum of money spent on the production. The entire costs of tomato production in the present study are shown in tables 6.2 and 6.4. For the summer tomatoes Tk. 427576 in total variable cost and Tk. 221441 in total fixed cost, which accounted for 65.91 and 34.09 percent of the total cost and for winter tomatoes total variable cost was Tk. 409279 and total fixed cost was Tk. 211275 which was calculated 65.95 and 34.05 of total cost. Hence, the following section discusses the costs of producing tomatoes item by item.

6.3 Variable Cost

6.3.1 Hired Labour Cost

Major tasks and administration of the chosen farms, such as land preparation, seeding, weeding, mulching, harvesting, etc. require human labor. Hired labor and family labor were the two categories used to classify human labor. Costs for hired labor can be calculated with ease. The wage rate for labor changes according to geographic location and environmental factors. The computed average rate for tomato production in the research area was 700 Tk per man-days. Table 6.1 indicates the use of human labor and the various costs that were associated with it. The labor cost per hectare for summer tomatoes was Tk.143500 which was 33.56 percent of the total variable cost. The labor cost for winter tomatoes was Tk.122500, which was 29.93 percent of the total variable cost.

Table 6.1: Per hectare variable cost of summer and winter tomato

Variable Cost items	Units	Summer Tomato				Winter Tomato			
		Quantity	Price (Tk.)	Cost (Tk.)	percent of Total Variable Cost	Quantity	Price (Tk.)	Cost (Tk.)	percent of Total Variable Cost
Human Labor	Man-days	205	700	143500	33.56	175	700	122500	29.93
Land Preparation	Tk.			135585	31.71			142698	34.86
Seedling	No.	25523	1.65	42160	9.84	25597	1.64	42038	10.27
Organic manure	Kg.	181	20	3620	0.85	30	20	600	0.14
Urea	Kg.	688	24	16525	3.86	698	24	16756	4.09
TSP	Kg.	1706	22	37533	8.78	1716	22	37754	9.22
MoP	Kg.	800	15	12000	2.80	786	15	11790	2.88
DAP	Kg.	49	30	1470	.34	0	30	0	0.00
Gypsum	Kg.	41	30	1230	0.28	24	30	720	0.17
Total Fertilizer cost				72378	16.95			67620	16.52
Insecticides	GM	30	70	2100	0.49	24	72	1728	0.42
Irrigation	Tk.			4235	.99			4388	1.07
Tunnel Material Cost				15000	3.51			15600	3.81
Interest on Operating Cost(OC)				12618	2.95			12707	3.10
Total Variable Cost				427576	100			409279	100

Source: Field Survey, 2023

6.3.2 Land Preparation Cost

The expense of using machines and animals as labor plays a part in assessing financial sustainability. The utilization of animal power has significantly declined in recent years due to the advancement of machine power. For land preparation and other purposes, people use tractors and power tillers today. The machinery costs for summer and winter tomatoes, respectively, were Tk. 135585 per hectare and Tk. 142698 per hectare, according to table 6.1 which constituted that cost of the machinery for summer tomatoes was 31.71 percent and the cost for winter tomatoes was 34.86 percent.

6.3.3 Cost of Seed

Seeding is more popular among farmers because it is readily available. The cost of seeding is between Tk. 1 and 2. The average cost per sowing for summer tomatoes and winter tomatoes, respectively, was 1.65 and 1.64, according to table 6.1. The total cost for seedling for summer tomatoes was found to be Tk. 42160 per hectare, which represented 9.84 percent of total variable cost and for winter tomatoes, it was Tk. 42038 per hectare which represented 10.27 percent of total variable cost, according to table 6.1.

6.3.4 Fertilizer and Manure Cost

The fertilizer rate per hector was found to be low since most farmers are not aware of the required dosage. The cost of fertilizer was discovered to be extremely high, which was also caused by a lack of market accessibility. According to Table 6.1, the cost of organic manure for summer tomatoes was Tk. 3620 per hectare, whereas the cost for winter tomatoes was Tk 600 per hectare. Table 6.1 once more demonstrates that the total fertilizer expense for summer tomatoes was Tk. 72378 per hectare which making up 16.95 percent of the total variable expense, while the total fertilizer expense for winter tomatoes was Tk. 67620 per hectare which making up 16.52 percent of the total variable expense.

6.3.5 Irrigation Cost

Although they did not apply at the correct time, almost all of the respondents in the research area employed irrigation in their fields. From the table 6.1 it was found that for summer tomatoes irrigation cost is Tk. 4235 per hectare which constituted .99

percent, for winter tomatoes irrigation cost was Tk. 4388 per hectare which constituted 1.07 percent of total variable cost.

6.3.6 Insecticide/Pesticide Cost:

Pesticides, which included insecticides and fungicides, were utilized by test farmers and applied to the field at various rates; the price of pesticides was calculated based on the farmers' real costs. According to table 6.1, it is revealed that for summer tomatoes insecticide cost was Tk. 2100 per hectare which making up 0.49 percent and for winter tomatoes the cost was Tk. 1728 per hectare that made up 0.42 percent of total variable cost.

6.3.7 Interest on Operating Capital

Tables 6.1 makes it clear that the cost of interest on operating costs is Tk 12618 per hectare for summer tomatoes that generated 2.95 percent and Tk. 12707 per hectare for winter tomatoes that made up 3.10 percent of the total variable cost.

6.3.8 Tunnel Material and Mancha Cost

Tunnel material and Mancha cost included khuti, rope, bamboo, nylon, polythene and other small things. For summer tomatoes it was Tk. 15000 which was 3.51 percent of total variable cost and for winter tomatoes it was for Tk. 15600 which was 3.81 percent of total variable cost.

6.3.9: Total variable Cost

The overall variable costs in the experimental area changed from year to year. According to table 6.1, it is revealed that total variable cost in case of summer tomatoes was Tk. 427576 which constituted 65.91 percent of total cost and in case of winter tomatoes total variable cost was Tk. 409279 which constituted 65.95 percent of total cost.

6.4 Total Fixed Cost

6.4.1 Family Labor Cost:

In items with variable costs, family labor costs are not estimated. The cause is that farmers do not pay themselves on their own. Nonetheless, due to its economic worth, it must be estimated. Every farmer who doesn't work in the fields must be replaced by another worker. Yet, family work is less expensive than hired labor. The estimated family labor cost for summer tomatoes, which made up 16.55 percent of

the overall fixed cost is Tk. 36600 per hectare, and for winter tomatoes, which made up 16.32 percent of the total fixed cost and it is Tk. 35400 per hectare.

Table 6.2: Per hectare fixed cost of summer and winter tomato cultivation

Fixed cost items	**Cost (Tk./ha)**		**Percent of total fixed cost (percent)**	
	ST	**WT**	**ST**	**WT**
Family Labor Cost	36600	35400	**16.55**	**16.32**
Land Use Cost	184541	176775	**83.45**	**83.68**
Total fixed costs	**221141**	**211275**	**100**	**100**

Source: Field Survey, 2023

6.4.2 Land Use Cost

The term "rental arrangement cost" refers to the price farmers had to pay to lease land that would be used to grow tomatoes for a specific amount of time. Cost of leasing varies from one area to another based on the location, soil fertility, topography of the soil and distance from the sources of water etc. therefore the value of own property was evaluated as opportunity cost concept. The cost of land used for tomato production was calculated using the area under study's chosen rental rate per hectare. According to table 6.2, the rental value of the land per ha was Tk 184541 for summer tomatoes that constituted 83.45 percent of total fixed cost and Tk. 176775 for winter tomatoes that made up 83.68 percent of total variable cost.

6.4.3 Total Fixed Cost

According to estimates, the total fixed cost per hectare for year-round for summer tomato production in the study area was Tk. 221141 which constituted 34.09 percent and for winter tomato production it was Tk. 211175 which constituted 34.05 percent of total cost.

6.5 Total Cost

In the study, the per-hectare total cost for producing summer tomatoes was Tk. 648717 and total cost for producing winter tomatoes was Tk. 620554 (Table 6.3)

Table 6.3: Per hectare total cost of summer and winter tomato cultivation

Cost items	Cost (Tk./ha)		Percent of total fixed cost (percent)	
	ST	**WT**	**ST**	**WT**
Total Variable Cost	427576	409279	65.91	**65.95**
Total fixed Cost	221141	211275	**34.09**	**34.05**
Total costs	**648717**	**620554**	**100**	**100**

Source: Field Survey, 2023

6.6 Return from Tomato Production

Like all other enterprises, the primary goal of tomato production is to turn a profit by selling fresh tomatoes. Estimating the gross return and net return (Profit) from tomato production is the goal of this section.

6.6.1 Gross Return

Here, the per-hectare gross return was calculated by multiplying the total volume of the commodity by each price. According to Table 6.4, the gross returns for summer tomatoes are Tk. 1206555, while those for winter tomatoes are Tk. 825538.

6.6.2 Gross Margin

The gross margin per hectare was calculated by deducting variable costs from gross return. Gross margin for summer tomatoes is Tk. 778979 and gross margin for winter tomatoes is Tk. 416259 (Table 6.4).

6.6.3 Net return

The net return was derived by deducting the full cost from the gross return. As according Table 6.4, the net return for summer tomatoes was Tk. 557838 and the net return for winter tomatoes was Tk. 204984.

Table 6.4: Gross margin and benefit cost ratio (undiscounted) on full costbasis of summer tomato and winter tomato

Sl. No.	Items			Amount (Tk./hectare)	
				ST	WT
A.	Gross returns (GR) (yield* price)			1206555	825538
		Yield(kg/ha)	Average Price(Tk./kg)		
	ST	34473	**35**		
	WT	58967	**14**		
B.	Total variable costs (TVC)			427576	409279
C.	Total Fixed Cost (TFC)			221141	211275
D.	Total costs (TVC+TFC)			648717	620554
E.	Net return (GR-TC)			557838	204984
F.	Gross margin (GR-TVC)			778979	416259
G.	Benefit-cost ratio (BCR) = GR/TC (Full cost basis)			1.86	1.33
H.	Benefit-cost ratio (BCR) = GR/TVC (Cash cost basis)			2.82	2.02

Source: Field Survey, 2023

6.6.4 Benefit Cost Ratio (Undiscounted)

In the study, table 6.4 indicates the benefit cost ratio for summer tomato production was calculated at 1.86, meaning that investing 1 taka in tomato production would yield a return of 1.86 taka, and the benefit cost ratio for winter tomato production was calculated at 1.33, meaning that investing 1 taka in tomato production would yield a return of 1.33 taka.

Table 6.4 once more demonstrates that, in the case of a cash cost basis, the benefit cost ratio for the production of summer tomatoes was accounted for at 2.82, meaning that investing 1 taka in tomato production would yield a return of 2.82 taka, and the benefit cost ratio for the production of winter tomatoes was 2.02, meaning that investing 1 taka in tomato production would yield a return of 2.02 taka. Hence, it is established that growing tomatoes is profitable for farmers.

6.7 Conclusion

The results showed that, for producing tomatoes, the total variable cost per hectare was greater than the total fixed cost per hectare, resulting in higher earnings for farmers. The difference between tomatoes from the summer and those from the winter is due to variable price fluctuation. Also, it is a given that farmers who grow tomatoes in the summer make more money than those who grow them in the winter.

CHAPTER 7
RESOURCE USE EFFICIENCY OF TOMATO PRODUCTION

7.1 Introduction

In the context of functional analysis, this chapter has been written to demonstrate a quantitative link between several important inputs and outputs of tomato production. Cobb-Douglas production function was used based on best fit to analyze the effects of particular inputs on the output of tomatoes.

7.2 Tomato Production and Relative Factors

The link between the inputs of factor services and the output of tomato production is referred to as the tomato production function. The cost of seed, the cost of preparing the ground, the cost of hired labor, the cost of fertilizer, the cost of manure, the cost of insecticides, the cost of hormone use, and the cost of irrigation were all thought to have an impact on tomato production. On the other hand, meal preparation costs, land use costs, and other accoutrements were seen to be unexplained variables.

7.2.1 Functional Analysis

To express the effects of variable inputs both liner and Cobb-Douglas production function models were estimated initially. The results of Cobb-Douglas models appeared to be excellent on theoretical and econometric grounds like

i) Adequate accessibility of the data,

ii) Computation flexibility,

iii) Sufficient degrees of freedom for statistical testing. So, this model was accepted.

Cobb-Douglas production function analysis was done taking 90 tomato farmers. The function was specified as;

$$Y = a\ X_1^{b1} X_2^{b2} X_3^{b3}\ X_4^{b4}\ X_5^{b5}\ X_6^{b6}\ X_7^{b7}\ e^{Ui}$$

The function transformed into the following log liner form:

$$\ln Y = \text{Ina} + b_1 \text{ In } X_1 + b_2 \text{ In } X_2 + + b_3 \text{ In } X_3 + b_4 \text{ In } X_4 + b_5 \text{ In } X_5 + b_6 \text{ In } X_6 + b_7 \ln X_7 + Ui$$

Where,

Y= Gross return (Tk. per hectare);

a= intercept value;

X_1= Cost of labour (Tk. per hectare);

X_2 = Cost of land preparation (Tk. per hectare);

X_3 = Cost of seeding (Tk. per hectare);

X_4= Cost of manure (Tk. per hectare);

X_5 = Cost of fertilizer (Tk. per hectare);

X_6 = Cost of insecticide (Tk. per hectare);

X_7= Cost of irrigation (Tk. per hectare);

Ui= Error term;

i= 2, 3,. 90;

b_1, b_2, b_3, b_4, b_5, b_6, b_7,= Regression co-efficient of respective variables ln =Natural log

7.3 Interpretation of Results

1. The goodness of fit for approved input types was assessed using the F-value.
2. The total fluctuations of the dependent variable explained by the independent variables in the model are shown by the coefficient of multiple determinations (R^2).
3. Coefficients were tested for significance level at 1 percent, 5 percent and 10 percent levels of significant.
4. Using returns to scale, which is the total of the production elasticity of different inputs, the stage of production was estimated.

7.3.1 Cost of human Labour (X_1)

In case of summer tomato, regression co-efficient of human labor was found 0.242 and insignificant for tomato production. On the other hand, for winter tomato regression co-efficient of human labor was found 0.551 and insignificant for tomato production (Table 7.1).

Table 7.1: Estimated value of co-efficient and related statistics of Cobb-Douglas production function of summer Tomato and winter Tomato

Explanatory variables	Summer Tomato			Winter Tomato		
	Coefficient	Standard error	t- value	Coefficient	Standard Error	t-value
Intercept	**9.814**	**6.973**	**1.407**	**43.569*** **	**7.692**	**5.664**
Cost of human labour	**.242**	**.377**	**.641**	**.551**	**.441**	**1.249**
Cost of land preparation	**.235**	**.183**	**1.288**	**.359***	**.204**	**1.756**
Cost of seedling	**.407**	**.590**	**.690**	**3.878*** **	**.606**	**6.399**
Cost of manure	**.021**	**.087**	**.239**	**-.124**	**.089**	**-1.391**
Cost of fertilizer	**1.116** **	**.503**	**2.216**	**3.523*** **	**.572**	**6.164**
Cost of insecticide	**.588** **	**.228**	**2.586**	**-1.461*** **	**.261**	**-5.600**
Cost of irrigation	**1.017** ** **	**.319**	**3.183**	**-1.572*** **	**.404**	**-3.890**
R^2	**0.72**			**0.712**		
Adjusted R^2	**0.68**			**0.671**		
Return to scale	**1.07**			**1.000**		
F- value	**5.139**			**7.324**		

Source: Field Survey, 2023

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

7.3.2 Cost of Land Preparation (X_2)

In case of summer tomato, regression co-efficient of human labor was to be calculated 0.235 and insignificant for tomato production. On the other hand, for winter tomatoes regression co-efficient was 0.359 and significant at 10 percent level which implies that one percent increase in the land preparation, keeping other things constant would result in the gross return by 0.0359 percent for winter tomato production.

7.3.3 Cost of Seedling (X_3)

For summer tomatoes, the regression coefficient of seedling was calculated to be 0.407, meaning that it was not significant for tomato production. Conversely, for winter tomatoes, the regression coefficient of seedling was calculated to be 3.878,

meaning that it was significant at the 1 percent level. This means that for every 1% increase in seedlings, all other things being equal, the gross return would increase by 3.878 percent for winter tomato production.

7.3.4 Cost of Manure (X_4)

Here, we found that the regression coefficient of manure for summer tomatoes was to be estimated as 0.021, and for winter tomatoes, it was to be calculated as -0.124, which was not significant for tomato production.

7.3.5 Cost of Fertilizer (X_5)

Fertilizer's regression coefficient was found to be 1.116, significant at the five percent level. This suggests that, with all other things being equal, a one percent rise in fertilizer costs would result in a 1.116 percent increase in gross return. However, the regression coefficient of fertilizer for winter tomato was found to be 3.523 and significant at the one percent level. This suggests that, with all other things being equal, a one percent increase in fertilizer would result in a 3.523 percent gross return for winter tomato output. (Table 7.1).

7.3.6 Cost of Insecticide (X_6)

The computed regression coefficient for insecticide was 0.588, indicating significance at the 5 percent level. This suggests that a one percent rise in insecticide costs would lead to a 0.588 percent increase in gross return while maintaining the same level of other components. Conversely, for winter tomato production, the regression coefficient of insecticide was found to be -1.461 and significant at the one percent level. This suggests that a one percent increase in insecticide would, under all other conditions, result in a 1.461 percent decrease in return on winter tomato production.

7.3.7 Cost of Irrigation (X_7)

With all other factors held constant, a one percent increase in irrigation costs would result in a 1.017 percent increase in gross return. This is indicated by the regression co-efficient of irrigation, which was calculated to be 1.017 and significant at the one percent level. In contrast, the regression co-efficient of irrigation for winter tomato production was found to be -1.572 and significant at the one percent level. This suggests that a one percent increase in irrigation would, under all other conditions,

result in a 1.572 percent decrease in gross return for winter tomato production (Table 7.1).

7.3.8 Co-efficient of Multiple Determinants (R^2)

For summer tomatoes, the coefficient of multiple determinations was 0.72. It demonstrates that the independent variables included in the model accounted for 72% of the variation in the gross returns. For winter tomato, the co-efficient of multiple determinations was 0.712. It demonstrates that the independent variables in the model accounted for 71% of the variation in the gross returns (Table 7.1).

7.3.9 Adjusted R^2

In order to account for the degrees of freedom, the term adjusted is used. For summer tomatoes, the adjusted R 2 for tomato production was found to be 0.68, meaning that the explanatory factors in the model accounted for around 68% of the fluctuations in the dependent variable. However, for winter tomatoes, the adjusted R 2 for tomato production was found to be 0.671, meaning that the explanatory variables in the model accounted for around 67% of the fluctuations in the dependent variable. (Table 7.1).

7. 3.10 Goodness of Fit (F-value)

The explanatory variable's true significant impact on the dependent variables is determined by the F value. The summer tomato production F-value was 5.139, whereas the winter tomato production F-value was 7.324. These values were highly significant at the 1 percent level, suggesting that all of the explanatory factors included were important in explaining the variation.

7.3.10 Return of Scale

The output will change once all inputs have been changed in the appropriate ways. To compute returns to scale, the tomato production co-efficient was included. The equation's total summer tomato production coefficient was 1.07 in total. This demonstrates that the production function examines expanding returns to scale. The equation's total winter tomato production coefficient was 1.00 in total. This demonstrates that the production function examines expanding returns to scale (Table 7.1)

7.4 Resource Use Efficiency in Tomato Production

In order to test the resource use efficiency, the mathematical formula is-

$$\frac{MVP}{MFC} = 1$$

To accomplish the aim of profit maximization i.e., for efficient allocation of resources, the value of the added product should be greater than the cost of added amount of the resources in producing it.

Table:7.2 Estimated resource use efficiency in tomato production

Variables	Summer Tomato					Winter Tomato				
	GM	MVP	MFC	MVP/ MFC	Comment	GM	MVP	MFC	MVP/ MFC	Comment
Seeding	732.59	4.18	1	4.18	Under Utilized	738.86	0.242	1	0.242	Over Utilized
Land Preparation	1895.57	3.42	1	3.42	Under Utilized	1804.27	2.17	1	2.17	Under Utilized
Fertilizer	1178	22.62	1	22.62	Under Utilized	1327.67	1.54	1	1.54	Under Utilized
Manure	1650.11	1.86	1	1.86	Under Utilized	1993.71	1.98	1	1.98	Under Utilized
Hired Labour	18858.13	.77	1	.77	Over Utilized	17399.55	0.98	1	0.98	Over Utilized
Irrigation	724.66	.88	1	.88	Over Utilized	1123.95	0.32	1	0.32	Over Utilized

Source: Field Survey, 2023

Table 7.2 showed that for summer tomato the ratio of MVP and MFC of Seed (4.18), Land preparation (3.42), Fertilizer (22.62) and Manure (1.86) and for winter tomato the ratio of MVP and MFC of Land preparation (2.17), Fertilizer (1.54) and Manure (1.98) was positive and more than one indicated that in the study area these inputs for tomato production were under used. So, farmers should increase the use of these inputs to attain efficiency level. The ratio of MVP and MFC of hired labour (.77) and Irrigation (.88) were less than 1 and less than one indicated that these variables were over used. Again, for winter tomato the ratio of MVP and MFC of Seedling (0.242), Hired Labor (0.98) and Irrigation (0.32) were found less than 1 which indicates that these variables were over used. So, farmers should decrease the use of this independent input for tomato production to attain efficiency considerably

7.5 Conclusion

According to the estimated R^2 and F-value, the Cobb-Douglas production function model's overall outcome for tomato output was adequate. The model's projected values support the finding that the chosen factors significantly impacted the total revenue from tomato production.

CHAPTER 8
PROBLEM OF TOMATO PRODUCTION

8.1 Introduction

One of the most significant vegetable crops gaining a lot of attention from researchers throughout the world is the tomato. The management of the production and financial risks faced by tomato farmers is largely influenced by their attitudes about risk. So, the goal of this study is to determine Bangladeshi tomato growers' risk tolerance and financial success.

8.2 Problem Related to Production

8.2.1 Severe Pest and Disease Attack

The onslaught of pests and disease is the next issue that the growers of summer and winter tomatoes have raised. They said that due to pest attacks, tomato production had significantly decreased and that they were unable to use pesticides effectively due to the greater cost of insecticides. This problem has affected approximately 88percent of growers of summer and 88percent of growers of winter tomatoes.

8.2.2 High Price of Human Labour

The cost of labor was a considerable component of the tomato farmer's expenses. About 92 percent of growers of summer tomatoes and 88 percent of growers of winter tomatoes have brought up this problem. If the price could be reduced to a extent then the net earnings of the farmers could be increase.

8.2.3 High Price of Insecticide

The cost of insecticide was a considerable component of the tomato farmer's expenses. About 92 percent of growers of summer tomatoes and 75 percent of growers of winter tomatoes have brought up this problem. Pest attack was devastating so a large amount of insecticide has to use to control them. But the price of insecticide was very high. If the price could be reduced to a extent then the net earnings of the farmers could be increase.

8.2.4. Low yield due to plant disease

Less production due to plant disease is one of the biggest problems for tomato grower farmers. Table 8.1 shows that 75 percent of growers of winter tomatoes and 85percent

Table 8.1: Problem faced by summer and winter tomato farmers

	Summer Tomato		Winter Tomato		
Problems	**No of respondents**	**Percentage**	**No of respondents**	**Percentage**	
Relating to Production					**Rank**
Severe pest and diseases attack	43	95	36	100	1st
High price of human labor	41	92	32	88	2nd
High Price of insecticides	41	92	27	75	3rd
Low yield due to plant related disease	38	85	27	75	4th
High price of quality seedling	34	76	27	75	5th
Scarcity of labor	32	70	22	60	6th
Poor harvest due to natural disasters	25	55	18	50	7th
Relating to marketing					**Rank**
High Market Subscription	45	100	36	100	1st
Selling problems	41	92	34	92	2nd
Lack of cold storage	38	85	34	92	3rd
Seasonal demand	38	85	29	81	4th
Lack of Technological Knowledge	38	85	29	81	5th
Price fluctuation	38	85	27	75	6th
Transportation and communication	33	73	18	50	7th
Other Problems					**Rank**
High Price of Tunnel material cost	41	92	34	94	1st
Spoilage	38	85	27	75	2nd
Lack of capital	30	65	22	60	3rd
Inadequate extension service	24	53	18	50	4th

Source: Field Survey, 2023

of growers of summer tomatoes, respectively, had to suffer from pest attack and had a big amount of production loss.

8.2.5 High price of seedling

More labor days are required to cultivate one hectare of tomatoes in a single season. About 76 percent of summer tomato farmers and 75 percent of winter farmers reported this problem. According to the respondents, the biggest economic problem is that farmers must spend a lot of money on buying good quality of seedling. (Table 8.1)

8.2.6 Scarcity of Labor

Production of tomatoes requires the use of adequate labor, both in terms of quantity and quality. In the research area, there was a serious lack of hired labor during the harvest season. Table 8.1 shows that a staggering 70 percent of summer tomato growers voiced discontent with the labor shortage at a time when just 60 percent of winter tomato growers had brought up this issue.

8.2.6 Poor Harvest due to Natural Disasters

Farmers have a lot of difficulty harvesting tomatoes from the field during the hot and wet seasons due to a lack of infrastructure and appropriate technologies. About 55percent of growers of summer tomatoes and 50percent of winter tomato growers have brought up this issue.

8.3 Problems Related to Marketing

8.3.1 High Market Subscription

Table 8.1 shows that 100 percent of summer tomato producers and about the same percentage of winter tomato growers reported experiencing issues with the high market subscription. They have mentioned a very severe issue, which is this.

8.3.2 Selling Problems

The selling challenge was the most significant of all the marketing problems. According to research area table 8.1, 92 percent of farmers in the summer tomato industry and 92 percent of farmers in the winter tomato industry stated that they did not sell their goods flexibly because owner and other middlemen complexity was introduced into the market.

8.3.3 Storage Problems

For large farmers, following the harvest, the storage issue ranked second in terms of importance when it came to marketing issues. Table 8.1 shows that 85 percent of

summer tomato farmers and 92 percent of winter tomato growers in the study area said that they lacked suitable storage facilities.

8.3.4 Seasonal Demand

Farmers are experiencing output challenges because of the progressively increasing temperature in recent years. Table 8.1 shows that 85 percent of summer tomato farmers and 81 percent of winter tomato farmers reported encountering this problem in the study area.

8.3.4 Lack of Technological Knowledge

Around 85percent of summer tomato farmers and 85percent of winter tomato farmers have cited this issue. They don't have access to the latest technology. If they have proper knowledge and proper access to the technology, they can boost up their production.

8.3.5 Price Fluctuation

According to Table 8.1 of the research area, 85 percent of summer tomato farmers and 75 percent of winter tomato farmers reported issues that. Ignorance of new technologies came in fourth place in this case among all the technical problems.

8.3.6 Transportation and Communication

Unexpected seasonal fluctuations present a severe challenge to the agriculture sector. Table 8.1 shows that 73 percent of summer tomato farmers and 50 percent of winter tomato growers acknowledged this problem. Around 62.5 percent of farmers mentioned this problem, making it one of the most important problems that need to be resolved.

8.4 Other Problems

8.4.1 High Price of Tunnel material Cost

The tomato farmer spent a substantial amount on supplies to prepare the tunnel. Tomato production in the study area has been impacted by the recent rise in tunnel material prices. Table 8.1 shows that a combined 92 percent of growers of summer tomatoes and 94 percent of winter tomatoes acknowledged this problem.

8.4.2 Spoilage:

Roughly 85 percent of growers of summer tomatoes and 75 percent of growers of winter tomatoes have brought up these difficulties. The use of suitable cold storage facilities has resulted in a significant number of tomatoes going bad.

8.4.3 Lack of Capital

About 65 percent of growers of summer tomatoes and 60 percent of growers of winter tomatoes have brought up the lack of financing issue. If they had adequate funding, they claimed, they could deploy appropriate infrastructure and technology.

8.4.4 Inadequate extension Service

Farmers in the study area complained that their local agricultural assistance was insufficient and that their block supervisor did not support them. 53 percent of summer tomato growers and 50 percent of winter tomato growers said that Bangladesh Secretary did not respond to their requests for assistance quickly. The block supervisor's lack of cooperation consequently came in second place among all technical concerns in the research field.

8.5 Solutions

8.5.1 Production Solutions:

The majority of tomato producers, who grow both summer and winter tomatoes, believe that the cost of fertilizer and insecticide should be reduced. Also, the government ought to increase subsidies in the pesticide business. Since pest infestation is widespread, if the cost of insecticide is reduced, framers' net returns will rise.

8.5.2 Marketing Solutions

All of the respondents believed that market tax was very detrimental to their net profits and that the government should deduct the market tax as low as possible. Again, 92 percent of respondents indicated that it is very crucial to appoint government people as middleman or intermediaries so that farmers have no issue to sell the tomatoes or easily can transport the products to the cities at a low cost. They have also suggested that price monitoring should be done at least a week so that price can’t be fluctuated frequently. Furthermore, they have told that proper technological knowledge and proper training will be very useful for production. They have also cited that transportation and communication problems need to be improved.

8.5.3 Other Solutions:

The most important issue of other problem is the price of tunnel material cost. Bamboo, thin rope and other things are very necessary for tomato plant. If the price can be dropped in these items, a large amount of cost can be reduced. Government

should take some necessary steps to reduce this cost and proper cold storage systems should be established so that a large amount of tomatoes cannot be wasted.

8.6 Conclusion

According to the discussion above, the majority of farmers claimed that the price of insecticide and fertilizer was the biggest barrier to their tomato production. And this problem is ranked first in terms of ranking order. Yet, I think the reply is being contradictory. I believe that winter fog and tomato diseases were the two main barriers to tomato output. The yield might be significantly increased and the farmers could profit if the proper insecticide and direct tunnel material access were offered at the right time.

CHAPTER 9
SUMMARY, CONCLUSION AND POLICY RECOMMENDATION

9.1 Introduction

This chapter concentrates on the summary in light of the arguments presented in the earlier chapters. On the basis of empirical facts, conclusions are reached. To enhance the ineffectiveness of Bangladesh's tomato production, policy recommendations have been developed.

9.2 Summary

In Bangladesh, tomatoes are more extensively consumed, grown, and available. They also have a better nutritional value. Bangladesh’s growing population is driving up tomato consumption on a daily basis. Expanding the use of High Yielding Varieties (HYV) and hybrid seed varieties, improving management, and delivering inputs on schedule are crucial for advancing the tomato industry. The latter has a considerable impact on the pace of adoption of contemporary technologies and the sustainability of tomato production. For agricultural output to rise, resources must be used effectively.

Because they mature so quickly, tomatoes can potentially grow alongside other crops. Bangladesh has only ever produced tomatoes on a very small scale up until now. In the villages of Rarirchar, Borogovindapur, and Madhaya in the Comilla District, field research was conducted between February and March 2023 to ascertain the profitability and resource use efficacy of tomato production. A simple random sampling technique was used to gather data and information from 81 farmers who cultivate different tomato varieties, notably those released by BARI. The complete data set was painstakingly evaluated and summarized in order to remove any lingering inaccuracies. To achieve the objectives of the study, descriptive statistics like average, percent, and others were utilized to analyze the majority of the data, which were given in tabular form. Functional analysis was used to get the desired outcomes. The parameters impacting tomato yield were also estimated using a Cobb-Douglas production function.

Of the 45 summer tomato farmers, Figure 5.1 reveals that 34 percent had completed primary level (Class I to IX) schooling, 46percent had completed SSC, 8 percent had completed HSC, 3 percent had completed an honors degree, 6 percent could only write their names, and 3 percent were illiterate. The average education level among 36 winter tomato growers was 62 percent (Classes I through IX), 13 percent (SSC), and 13 percent could only write their names or were illiterate. In the experimental area, the total variable expenses fluctuated from year to year.

The estimation showed that the overall variable cost for summer tomatoes was Tk. 427576 per hectare, which represented 65.91 percent of the whole cost, and the total variable cost for winter tomatoes was Tk. 409279 per hectare, which represented 65.95 percent of the total cost.

Estimates show that the total fixed cost per hectare for year-round summer tomato production in the study region was Tk. 221141 per hectare which was 34.09 percent of total cost, and the total fixed cost per hectare for year-round winter tomato production was Tk. 211175 per hectare which was 34.05 percent. The complete cost was subtracted from the gross return to arrive at the net return. And the net return for the winter tomatoes was Tk. 204984 per hectare, while the net profit for the summer tomatoes was Tk. 557838 per hectare.

Benefit cost ratios were calculated for both summer and winter tomato production, with the benefit cost ratio for summer tomato production being 1.86 and the benefit cost ratio for winter tomato production being 1.33, respectively, meaning that investing 1 taka in tomato production would yield a return of 1.86 taka for summer tomato and for winter tomato it was 1.33 taka.

In contrast to costs associated with land preparation, seedlings, insecticides, and irrigation, the results of a production function analysis revealed that costs associated with insecticide, fertilizer, and irrigation had a positive and significant impact on both summer and winter tomato yield. The adjusted (R^2) value was discovered to be 0.68 for summer tomatoes indicating that the factors included in the models could account for 68 percent of the entire variation in tomato yield. On the other hand, for winter tomatoes the adjusted (R^2) was found 0.671 that means models could account for 67 percent of the entire variation in winter tomato yield. As a result, the model's explanatory variables all played a crucial role in illuminating the variation in tomato

production.

Table 7.2 demonstrated that the ratios of MVP and MFC of Seed (4.18), Land preparation (3.42), Fertilizer (22.62) and Manure (1.86) for summer tomatoes and Winter tomato (2.17), Fertilizer (1.54) and Manure (1.98) for winter tomatoes were both positive and more than one suggested that these tomato production inputs were underutilized in the study area. In order to reach this degree of efficiency, farmers should employ these inputs more frequently. The hired labor (.77) and irrigation (.88) ratios of MVP and MFC were both less than 1, indicating overuse of these variables. Once more, the ratios of Hired Labor (0.98), MVP and MFC of Seedling (0.242), and Irrigation (0.32) for winter tomatoes were found to be less than 1, indicating that these variables were overused. Therefore, in order to achieve significantly higher efficiency in tomato production, farmers need reduce their utilization of this independent input.

Tomato cultivation presented a number of challenges for farmers in the research area. Tomato farmers generally confront three types of constraints: those related to production, those related to marketing, and others. The high cost of pesticide, high cost of human labor, high price of tunnel variable cost and high market tax are the most important problems with the economy. All farmers agreed that market taxes are an exploitation of them. They repeated their claim that the market tax on a kilogram of tomatoes is 3 takas, which is excessive. It was given priority over all other economic matters.

The provision of credit with convenient terms, the provision of inputs and machinery, the improvement of transportation infrastructure, the formation of farmers' organizations, and the improvement of market facilities were some of the solutions that tomato growers suggested when they identified their own problems.

9.3 Conclusion

The study's main finding is that, based on the statistics, tomato growing is more productive and profitable in the Comilla district. Each and every one of the following elements—seed cost, labor cost, fertilizer cost, pesticide cost, manure cost, plowing cost, irrigation cost, etc.—is essential for the production of tomatoes.

It is crucial to teach farmers about resource efficiency even though they were unaware of the right input doses that could, in some cases, increase the return on

output. Had the present inputs and production processes been made available in time, the yield and output of tomatoes would have increased, along with income, better livelihoods, and a change in the health of rural people. It is therefore recommended that steps be done to improve the socioeconomic, financial, and employment possibilities for tomato growers, including the provision of irrigation infrastructure, effective policy, and efficient extension services. Also, it is suggested to grow tomatoes on more nearby land in the research regions. Due to the increasing domestic consumption of tomatoes as human food, a well-planned tomato production program at the national and international levels is required to create the current and future potential market.

9.5 Recommendations

Based on the study's findings, it may be possible to make the following specific recommendation for the expansion of tomato production:

• Given the profitability of the tomato industry, as summer tomato ensures more profit the government and pertinent institutions should support more and arrange appropriate extension programs for summer tomato farmers, such as training and advertising, to expand production and geographic reach.

• An extension campaign could persuade for summer tomato farmers to employ more underutilized inputs which were seedling, land preparation, fertilizer and manure that greatly boost tomato growing yield. For winter tomato farmers extension campaign could persuade to employ more underutilized inputs such as fertilizer, land preparation and manure. Often used inputs should be limited while being used.

• To lower the cost of inputs that have a positive impact on production but aren't being utilized to their fullest potential, the government should take the necessary actions, such as offering monitoring facilities and subsidies and also the market tax. As a result, tomato farmers will gain more as a net benefit.

• Government should take care of huge spoilage of tomato and should bring up cold storage facilities as soon as possible

• Tomato producers should obtain proper training on a variety of topics, including the use of high-quality seed, intercultural operations, required fertilizer doses,

pesticides, hormones, and water management techniques, in order to increase productivity and technical efficiency.

9.6 Limitations of the Study

While the study evaluated the nation's farmers using interview schedules, it had a number of drawbacks.

• The information was mostly acquired based on the frequently erroneous recollections of farmers;

• When farmers were interviewed for the majority of the data, there was a possibility that some of them did not get along with the interviewer.

• Due to time and resource constraints, thorough and in-depth study was partially hindered and aggravated.

• Tomatoes are occasionally produced incorrectly, causing growers to neglect to keep track of costs or earnings.

Due to a lack of data sources and further investigation, the relative advantage of tomatoes over other vegetables could not be established.

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APPENDIX I

Department of Agricultural Economics

Sher-e-Bangla Agricultural University, Dhaka-1207

An Interview Schedule for the Study Entitled

Productivity and Technical Efficiency Analysis of Early and Late Verities of Tomato Production in Some Selected Areas of Comilla District in Bangladesh

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

Respondent's Name:
.....

Address: Village: ……..……..…… Upazilla: ……..……..

District: ……..…….. Mobile: ……..……

B. Socio-demographic information

Tomato Cultivation Related Information

Particulars	Area(Unit area=…….. decimal)
Winter Tomato	
Summer Tomato	

Module 1: Detailed Information of Household Members

Sl. No.	Name of the Household member	Relation with HH (Code)	Sex (M=1, F=2)	Age in complete Years	Marital Status (10 yrs.+) (Code)	Occupation (Code)		Education (5 yrs.+) (Year of schooling)	Whether any member include in a NGO? Code)
						Main	Subsidiary		
1	2	3	4	5	6	7	8	9	10
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									

Module 2: Land ownership and farm category (in decimal)

Category of land	Tenure Status							Total land size	Farm category
	Own land	Rented in	Mortgaged in	Leased in	Rented Out	Mortgaged out	Leased Out		
	1	2	3	4	5	6	7	8=(1+2+3+4-5-6-7)	9
1.Crop land									
2.Orchard									
3.Homestead									
4.Ponds									
5.Others									
6.Total									

If total land size is 50 to 100 decimal=marginal farm, 101 to 250 decimal= small farm and 251 to above = medium and large farm

9. Farm category code- Marginal farm=1. Small farm= 2 and Medium and large farm=3

Module 3: Production related information

Production Related Timetable

Particulars	Land Preparation	Seed Sowing	Harvesting
Winter Tomato			
Summer Tomato			

Cost of Production

(a)Human labor use

Crop			Winter Tomato		Summer Tomato	
Variety						
Plot size (in decimal)						
Activities		Gender	Man-days/ Unit area	Wage rate (Tk/day)	Man-days/ Unit area	Wage rate (Tk/day)
			1	2	3	4
1.Land Preparation	a. Family	M				
		F				
	b. Hired	M				
		F				
2.Seedling/ Transplantation	a. Family	M				
		F				
	b. Hired	M				
		F				
3.Weeding	a. Family	M				
		F				
	b. Hired	M				
		F				
4.Applying fertilizer	a. Family	M				
		F				
	b. Hired	M				
		F				
5. Applying irrigation water	a. Family	M				
		F				
	b. Hired	M				
		F				
	a. Family	M				
		F				

6. Applying insecticides/ Others(specify)	b. Hired	M				
		F				
7.Harvesting and Carrying	a. Family	M				
		F				
	b. Hired	M				
		F				
8.Sorting, Grading and Bagging	a. Family	M				
	b. Hired	F				

(b) Machinery Inputs

Crop		Winter Tomato		Summer Tomato	
Purpose of use	Types of ownership	Unit	Cost/unit	Unit	Cost/unit
Land preparation (Power tiller / Tractor)	a. Owned				
	b. Hired				
2. Harvesting	a. Owned				
	b. Hired				
Carrying (Tractor / Power tiller / Van)	a. Owned				
	b. Hired				
4. Others (specify)	a. Owned				
	b. Hired				

(c) Materials Inputs

		Winter Tomato		Summer Tomato	
Inputs (unit)	Types	Quantity	Price/unit	Quantity	Price/unit
1. Seed (Kg)	a. Owned				
	b. Purchased				
3. Manure	a. Owned				
	b. Purchased				
4. Fertilizer (Kg)	Urea				
	TSP				
	MAP				
	DAP				
	MoP				
	Gypsum				
	Zinc sulphate				

	Boric acid				
5. Irrigation					
6. Insecticide (Liter)					
7.Tunnel Material Cost					
8. Others (Specify)					
9. Rental Value of Land (Per Season)					

(d) Return from Tomato cultivation

Crop	Winter Tomato		Summer Tomato	
Output(s)	Quantity (Kg)	Price (TK/Kg)	Quantity (Kg)	Price (TK/Kg)
Tomato				

Module 4: Technical Efficiency Related Information

1. Do you have any training on agriculture? Yes / No

2. Do you have any training on tomato cultivation? Yes / No

3. Tomato Farming Experience: ..... Years

4. Do you have livestock? Yes / No

5. Are you engaged in fish culture? Yes / No

6. Do you have orchard? Yes / No

7. Do you have access to extension service?..... Yes / No

8. Do you have any agricultural credit? Yes...../ No

If yes: Source of Credit? Bank / NGO / Relatives / Others

9. Have you received any remittance last year? Yes/ No

If yes: Have you spend any portion of the remittance in farming?

Yes/ No

10. What is the distance from farm to local market…….

Module 5: Weather events adversely affected the yield of tomato last year

Natural calamities	Put tick mark
Floods	
Drought	
Frequent Rainfall	
Soil / River Erosion	
Cyclone	
Salinity Increase	
Hail	
Lightning	

Module 6: Please mention the problems in Tomato cultivation

Sl. No	Constrains	Degree of Constrains			
		High	Medium	Low	Not at All
1.	High price of quality seed				
2.	Lack of quality seed				
3.	Low price of tomato				
4.	High price of fertilizer				
5.	High price of insecticides				
6.	Lack of availability of inputs				
7.	Lack of irrigation facilities				
8.	Unavailability of human labor				
9.	High price of human labour				
10.	Natural calamities				
11.	Infestation of insects				
12.	Low yield due to plant related disease				
13.	Lack of suitable land				
14.	Inadequate extension service				
15.	Lack of training				
16.	Lack of market				
17.	High marketing cost				
18.	High distance of market				
19.	Lack of capital				
20.	Lack of Tomato storage facility				
21.	Inadequate access to financial market				

Thank you for your nice corporation

APPENDIX II

Table A: Area and Production of Tomato in Bangladesh, 2009-10 to 2020-21

Year	Area '000,(Acre)	Production '000, Mts	Per acre Yield(kg)
2020-21	72878.64	448	6145
2019-20	70460	415	5897
2018-19	69697	387	5562
2017-18	70	385	5539
2016-17	68	389	5686
2015-16	67	368	5451
2014-15	76	414	5471
2013-14	66	360	5454
2012-13	65	251	3862
2011-12	63	255	4035
2010-11	61	232	3798
2009-10	59	190	3220

Source: BBS, 2012,2015,2018 and 2021