# FINANCIAL PROFITABILITY AND RESOURCE USE EFFICIENCY OF TOMATO CULTIVATION IN SOME SELECTED AREAS OF MYMENSINGH DISTRICT IN BANGLADESH

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# CERTIFICATE

This is to certify that the thesis entitled **"FINANCIAL PROFITABILITY AND RESOURCE USE EFFICIENCY OF TOMATO CULTIVATION IN SOME SELECTED AREAS OF MYMENSINGH DISTRICT IN BANGLADESH"** submitted to the Department of Agricultural Economics, Faculty of Agribusiness Management, Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, 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 **MD. RASHIDUL HASAN, Registration No. 19-10060** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

I further certify that the Author duly acknowledges any help or source of information, as has been availed during this investigation.

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Dated:

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**Dedicated to**

**My**

**Beloved Family**

**Members**

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*The Author*

# FINANCIAL PROFITABILITY AND RESOURCE USE EFFICIENCY OF TOMATO CULTIVATION IN SOME SELECTED AREAS OF MYMENSINGH DISTRICT IN BANGLADESH


## ABSTRACT

The study was focused on the profitability of production, the contribution of factors in yield and the socio-economic status of the tomato growers at Mymensingh Sadar and Gauripur Upazilla under the Mymensingh district. Using a simple random sampling technique, 90 tomato cultivators were selected to conduct farm-level surveys with the pre-tested questionnaires. The per acre cost of tomato production was Tk.33751 for all farm categories in the study area. Total cost was highest for the small farms (Tk.35313) followed by the large farm (Tk.33083) and medium farms (Tk.32857). Per acre gross return of tomato cultivation under small, medium and large farms were Tk.61920, Tk.59520 and Tk.59040 respectively, indicating that the per acre gross return of small farms was higher than large and medium farms. Per acre benefit-cost ratio (BCR) of tomato cultivation under small, medium and large farms were 1.75, 1.81 and 1.78 respectively where medium farms gave the best performance. Resource use efficiency indicated that all of the resources were underused except overutilization of human labor, TSP and MoP. In the study area. High wages of labor and insect and disease attacks were significant issues for tomato cultivation.

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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 |
| $^0$C | : Centigrade |
| DAE | : Department of Agricultural Extension |
| Df | : Degrees of Freedom |
| *et al.* | : and others (at elli) |
| etc. | : Etcetera |
| FAO | : Food and Agricultural Organization |
| g. | : Gram |
| GDP | : Gross Domestic Product |
| GNI | : Gross National Income |
| GR | : Gross Return |
| GM | : Geometric Mean |
| HYV | : High Yielding Variety |
| IOC | : Interest on Operating Capital |
| IU | : International Unit |
| K. cal. | : Kilocalorie |
| Kg | : Kilogram |
| Ln | : Natural logarithm |
| MFC | : Marginal Factor Cost |
| mg | : milligram |
| MoF | : Ministry of Finance |
| MoP | : Muriate of Potash |
| MPP | : Marginal Physical Price |
| MS | : Master of Science |
| M. Ton | : Metric Ton |
| MVP | : Marginal Value Product |
| NGO | : Non-Government Organization |
| NR | : Net Return |
| RUE | : Resource Use Efficiency |
| TC | : Total Cost |
| TFC | : Total Fixed Cost |
| Tk. | : Taka |
| TSP | : Triple Super Phosphate |
| TVC | : Total Variable Cost |
| USDA | : United States Department of Agriculture |
| µg | : Microgram |
| $ | : US Dollar |
| ₦ | : Nigerian currency |

# CHAPTER 1
# INTRODUCTION

## 1.1 Background of the Study

Bangladesh has a small economy with numerous benefits in agriculture, such as favorable climatic conditions for producing a wide variety of crops and plants, fertile soils, a vast population to manage agricultural output, abundant water for irrigation and fish cultivation and so on. Although the contributions of agricultural percentage share in national GDP is declining, the total national value is increasing in the economy of Bangladesh in the last few years. In an agro-based country like Bangladesh, the crop sector contributes the largest part to the whole agricultural production. From the agricultural sector, the gross domestic product (GDP) at market price is 4106614 crore Tk. in FY 2020-21 which was 3804464 crore Tk. in FY 2019-20 (base year 2015-16) and the crop sector contributes 1996305 crores Tk. in FY 2020-21 which was 1861159 crore Tk. in FY 2019-20 (Bangladesh Economic Review 2021).

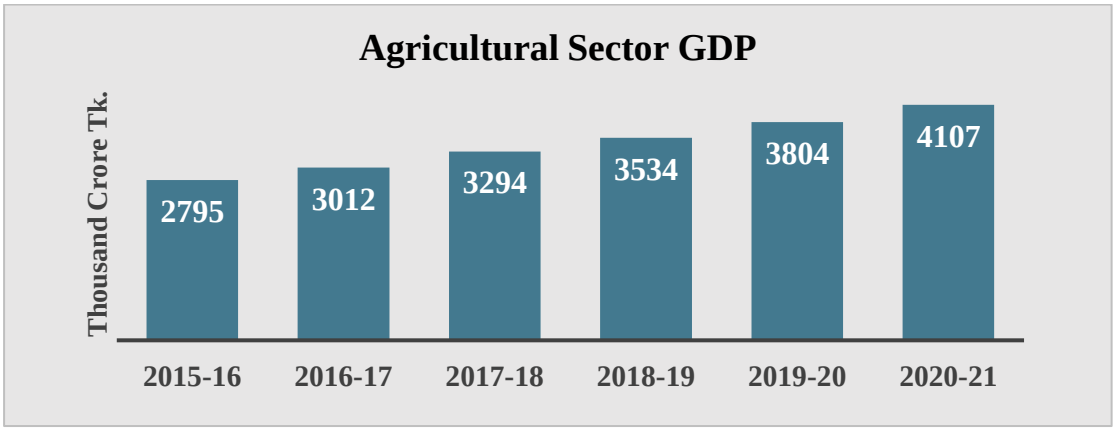


**Figure 1.1: GDP Contribution of the Agriculture Sector at the Current Market Price (**Source: BER 2021)

Bangladesh is an agricultural country blessed with highly fertile land. Bangladesh has produced 16 million tons (1 crore 60 lakh) of vegetables annually and holds the third position after China and India in terms of producing vegetables (FAO 2019). Presently 16.2 million (1 crore 62 lakh) farmer families are involved in the production of 60 types of vegetables in our country. Among the different vegetables, tomato is one of the most important vegetables in terms of acreage, production, yield and vitamins.

Tomato cultivated area and production is increasing day by day. The area of tomato cultivation during 2016-17 was about 68366 acres with a total production of 388725 M. Ton where the Yield was 5686 kg/acre and during 2020-2021 was about 72878.64 acres with a total production of 447815.49 M. Ton (BBS 2021). The land used for tomato cultivation is increased by about 6% and the total production is increased by about 15% in the last five years. The demand for domestic and foreign markets in all seasons has increased manifold, and many new potential varieties are also available. It also plays a good role in the food processing sector and its nutritional values are not negligible.

### 1.2 Origin and Nutritional Status of Tomato

Tomato is a type of fruit mostly used as a vegetable in our country. Tomato is known as *Solanum lycopersicum* which is an edible red berry plant that originated in western South America and Central America. Its use as a cultivated food may have originated with the indigenous peoples of Mexico. The Spanish encountered the tomato for the first time after their contact with the Aztecs and they brought the plant to Europe. From there, the tomato was introduced to other parts of the European-colonized world during the 16th century.

Tomato is a nutritious food that offers a wide range of benefits to our body systems. But two hundred years ago in the USA, it was believed to be poisonous as the plant is a member of the toxic nightshade family. Tomato provides vitamin A, C, calcium, phosphorus, potassium, fiber etc. It also contains various nutrients and antioxidants like alpha-lipoic acid, lycopene, choline, folic acid, beta-carotene, lutein etc. It can be eaten as fresh or cooked and used as an ingredient for salad, soup, pickle, chutney, ketchup, sauce, curry etc. Its nutritional element supports fair skin and protects from cancer.

The presence of fiber, potassium, vitamin C, folate and choline in tomato supports heart health. Lycopene, lutein, beta-carotene etc. powerful antioxidants of tomato to protect eyes from light-induced damage and age-related macular degeneration. It provides low sodium and high potassium which helps to maintain healthy blood pressure. Tomato is a laxative fruit with high water content and fiber which helps reduce constipation and support bowel movements. It is also helpful for maintaining blood glucose levels.

**Table 1.1: Nutrient Combination of Tomato (Nutrition Values Per 100 g.)**

| 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 | 0.17g |
| **b. Niacin** | 0.594 mg | **Phyto-nutrient** | |
| **c. Pyridoxine** | 0.08 mg | a. Carotene - β | 449µg |
| **d. Thiamin** | 0.037 mg | b. Carotene - α | 101µg |
| **e. Vitamin A** | 833 IU | C. Lutein-zeaxanthin | 123µg |
| **f. Vitamin C** | 13 mg | d. Lycopene | 2573µg |
| **g. Vitamin E** | 0.54mg | | |
| **h. Vitamin K** | 7.9 µg | | |
| **Electrolytes** | | | |
| **a. Sodium** | 5 mg | | |
| **b. Potassium** | 237 mg | | |

(Source: USDA, 2019)

### 1.3 Significance of Tomato within the Economy of Bangladesh

Bangladesh is an agriculturally oriented country that thrives on crop cultivation. Bangladesh has a subtropical monsoon climate. Bangladesh is well-known for producing a wide range of tropical crops including rice, wheat, maize, potato, jute, legumes, oilseeds, tomato, sugarcane, and so on. The population of Bangladesh has risen to an astounding figure with most of them living in rural regions. Rural residents earn barely enough to maintain their families and are frequently impoverished. Seasonal dryness, monsoon rains, and winter waves make it a harsh reality of existence that is based on inadequate infrastructure and centralized communication networks. High population expansion cancels out increasing agricultural productivity, exacerbating food insecurity and destitution.

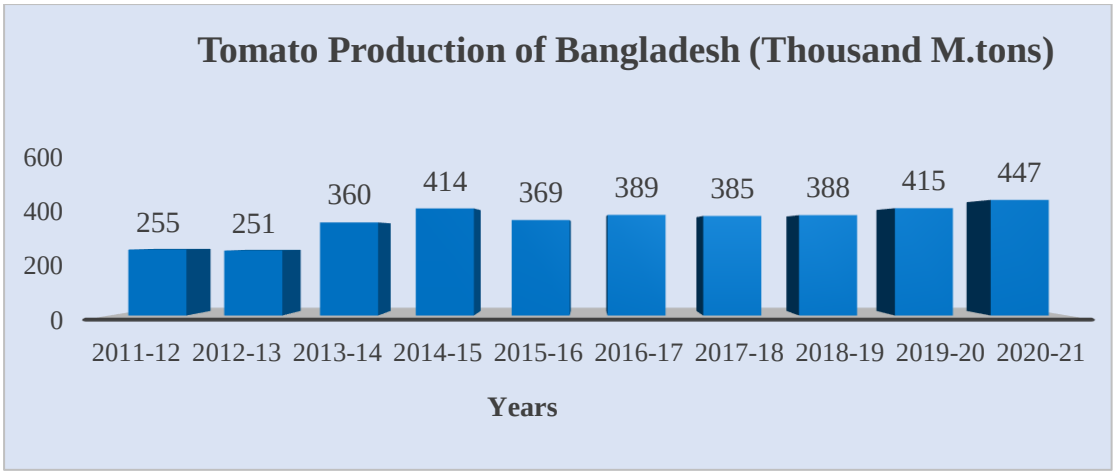


**Figure 1.2: Tomato Production of Bangladesh in Last Ten Years** (Source: BBS 2021)

Tomato is a high-value crop, which needs intensive cultivation practices and the financial and labor inputs involved are therefore greater than those needed for most staple crops. The demand for this fresh vegetable is not only increasing but also it is largely used for the food processing industry in our domestic market. The information from the Figure 1.3 shows that the production of tomato was 255 thousand M. tons in 2011-2012 and after ten years, 447 thousand M. tons in 2020-2021. So, the production of tomato is enhancing rapidly in recent years.

### 1.4 Tomato Cultivation Areas and Production of Bangladesh

There are around ten thousand varieties of tomato existing now around the world. Oxheart, Marglobe, Sunmargino, Roma VF, Pusa Rubi are some popular tomato varieties in our country. Recently BARI developed some varieties of tomato namely, Ratan, Manik, BARI Tomato-3, BARI Tomato-4, BARI Tomato-5, Chaiti, Apurba, Shila, Lalima and Anupama. BARI Tomato-4, BARI Tomato-5, Chaiti, Lalima and Anupama (hybrid) can also be grown in the summer season. Tomato plants are of two types: determinate and indeterminate. Indeterminate type terminates in a vegetative bud, whereas determinate type terminates in a flower bud. Seedlings of 25-30 days are usually planted in November-December and tomatoes are ready for harvest in 80-90 days.

**Table 1.2 Annual Cultivation of Tomato in 2017-18 to 2019-20**

| DIVISION | 2017-2018 | | 2018-2019 | | 2019-2020 | |
|---|---|---|---|---|---|---|
| | Area (Acres) | Production (M. Tones) | Area (Acres) | Production (M. Tones) | Area (Acres) | Production (M. Tones) |
| **Dhaka** | 10789 | 52544 | 10260 | 49250 | 9935 | 59321 |
| **Chattagram** | 14986 | 60208 | 15192 | 62515 | 15541 | 73754 |
| **Khulna** | 7599 | 33195 | 7670 | 32640 | 7747 | 33285 |
| **Mymensingh** | 5331 | 37403 | 5331 | 37403 | 6150 | 32761 |
| **Rajshahi** | 13718 | 90094 | 14242 | 94205 | 14528 | 92897 |
| **Rangpur** | 9084 | 75163 | 9124 | 76195 | 9051 | 86555 |
| **Sylhet** | 5138 | 28051 | 4964 | 288224 | 4568 | 29946 |
| **Barishal** | 2864 | 8380 | 2914 | 7221 | 2942 | 6975 |
| **Bangladesh** | 69509 | 385038 | 69697 | 387653 | 70460 | 415494 |

(Source: BBS, 2020)

Table 1.2 represents the annual production of tomatoes in 2015-16 to 2017-18 in the different divisions of Bangladesh. The production of tomato cultivation was highest in the Rajshahi, Rangpur and Chattagram divisions. and the land area used for the production was highest in Chattagram, Rajshahi and Dhaka. Table 1.2 shows the rate of cultivation of tomato is increasing day by day except for the Mymensingh and Barishal divisions. This study helps to find out the obstacles and opportunities of tomato cultivation practices through profitability, resource use efficiency and problem regarding cultivation practices in a small range of scale at the area of Mymensingh Sadar Upazilla and Gauripur Upazilla.

### 1.5 Justification of the Study

Bangladesh Agriculture is mainly dominated by the cereal crops like rice, wheat, maize etc. But vegetable like tomato production helps solve some important issues like unemployment, poverty, hunger, malnutrition, food scarcity. On the other hand, most farmers want to optimize their resources like land, labor, capital, water and other inputs to maximize their income. Some farmers may increase yield by using extra inputs, some may degrade soil fertility and ignore the environmental issues. As a result, cultivation costs may increase. This study provides an analysis of resource use efficiency and

profitability of tomato cultivation in the selected areas of Mymensingh district. Agriculture can create a great opportunity for economic growth and employment for a vast population.

### 1.6 Objectives of the Study

1. To find out the socio-economic features of tomato growers in the study location;
2. To estimate the costs and returns of tomato cultivation in the selected areas;
3. To evaluate the resource use efficiency of tomato cultivation and
4. To assess the factors that influence the profitability of tomato cultivation.

### 1.7 Organization of the Thesis

This thesis includes nine chapters or sections. Chapter I discusses the introduction including the background, global production, justification and objectives of the study. Later, a review of related literature is presented in Chapter II. Chapter III explains the research methodology of the study. The results and the discussion of the study are revealed in Chapters IV, V, VI, VII and VIII. Finally, Chapter IX shows the summary, conclusions and policy recommendations of the study.

# CHAPTER 2
# REVIEW OF LITERATURE

This section presents the literature review on detailed resource use efficiency and profitability measurement analysis for tomato production using different financial analyses. The main purpose of this chapter is to review some related studies connected with the present study. Although several studies have been found related to tomato production in Bangladesh, only a few studies have so far been done related to financial profitability and resource use efficiency. Again, some of these studies may not be entirely relevant to the present study, but their findings, methodology of analysis and suggestions have a positive influence on the present study.

**Zaman *et al.* (2006)** conducted a study where they made an experiment return of summer tomato cultivation by using the data collected from the experimental plot in Regional Agricultural Research Station, Jamalpur. BARI released variety BARI Tomato-10 (Anupama) showed best with a per hectare yield of 28240 kg. To cultivate summer tomato in one hectare of land, the total variable cost involved BDT 292936 and the total cost of production were BDT 297936. The gross margin was BDT 695464, net return or profit was BDT 690464 and benefit-cost ratio (BCR) was 3.32 and they concluded that cultivation of summer tomato is profitable for the Jamalpur region.

**Mohiuddin *et al.* (2007)** conducted a study in Patiya and Satkania Upazila of Chittagong district in 2005-2006 to assess the adoption status, agronomic practices and profitability of improved tomato variety among the farmers. All the improved varieties that are cultivated in the study area Surokka (Indian variety) are ranked first followed by Ratan (BARI variety) and Ruma VF (Indian variety). Farmers' consciousness about improved tomato cultivation was found increasing where the gross margin was Tk 101566/ha and Tk. 140015/ha based on variable cost and cash cost respectively. Per hectare net return from tomato cultivation was Tk. 100338. Based on a variable cost, returns to labor and returns to irrigation were found Tk. 483 and Tk. 13.33 respectively. Major reasons in case of improved tomato cultivation were higher yields, thick fruit skin, large size, long durability and high price due to attractive color and size. The farmers of improved tomato adopters face problems like non-availability of quality

seed, unfavorable weather, good quality fertilizer and insecticide for tomato cultivation among which high price of inputs was recorded as one of the major problems to the tomato farmers.

**Agele *et al.* (2008)** conducted their study about responses of some cultivars of tomato to weather events of the cropping seasons in terms of growth, fruit yield, and nitrogen use efficiency when grown under the application of inorganic and organic manures. The tomato varieties were selected for evaluation of both early and dry season crops in the humid rainforest zone of Nigeria. The cultivars were characterized by strong genotype by environment interactions and seasonal and/or genotype-specific N use efficiency and in the case of both cropping seasons, the tomato cultivars differed in their ability to take up and accumulate N in the shoot and fruit tissues from the organic and mineral fertilizers. Higher values of fresh and dry weights of root and shoot biomass were produced by tomato plants grown in plots in which NPK and poultry manure were applied over unmanured plots. Delayed planting did not considerably decrease N uptake, but decreased final crop dry matter yields.

**Karim *et al.* (2009)** conducted an experiment on the Profitability of Summer BARI Hybrid Tomato Cultivation in Jessore District of Bangladesh at Bagherpara thana under Jessore district to assess the profitability, contribution of factors to production and changes in the socio-economic status of the farmers. About 42 percent and 21 percent of total variable costs were allotted for tunnel preparation and using human labor, respectively. The average yield of BARI hybrid tomato was found 32.78 t/ha where the average return per hectare over variable cost is observed to be Tk. 11, 44,387 on a full cost basis and Tk. 12, 07,481 on a cash cost basis. On average benefit-cost ratio was resulted to be 4.19 on a full cost basis and 5.09 on a cash cost basis. The cost per kilogram of hybrid tomato cultivation was Tk. 10.94 but the return from one kilogram of tomato production was Tk. 45.83. The functional analysis gives the result that MP and TSP had a positive significant contribution to yield while human labor, hormone, irrigation and seed had a negative significant impact on the yield of hybrid tomato. As a whole, the overall socio-economic status of the sample farmers was found to increase by 20.33 percent. The high price of tunnel materials, timely non-availability of hormone, insect and diseases attack were the major problems for tomato production.

**Tijani *et al.* (2010)** studied the Profitability of tomato (*Lycopersicon esculentum* Mill.) production and constraints for which data were collected from 80 respondents in local government areas in Ogun State, Nigeria, and analyzed using descriptive statistics and enterprise budgetary analysis. The gross margin was found ₦ 43,350.29 (₦, Nigerian currency) and net profit was found ₦ 36,382.68, indicating that tomato production was profitable. Other calculations of the ratio of net returns to total expenses (27%), operating expense ratio (72%), and net farm income ratio (21%) indicated that there is room for incensement in tomato production. Major constraints were found lack of access to credit facilities, price fluctuations, and high cost of inputs. Credit accessibility from formal and informal sources, agricultural price support programs for fair pricing of output, provision of subsidies on inputs, and formation of farmer cooperatives are suggested as essential to improving productivity and profitability of tomato production under tropical conditions.

**Begum *et al*. (2011)** conducted a study to estimate the costs and returns from the cultivation of selected crops in different locations. He found the benefit-cost ratios over total costs were 1.61, 1.72, 1.62, 3.55, 1.90, 2.17, 3.72, 1.94 and 2.64 for the cultivation of maize, groundnut, mung bean, sweet potato, cabbage, cauliflower, tomato, cucumber and okra respectively. High costs of fertilizers and insecticides were the major problems to higher production for most of the crops as mentioned by the sample farmers.

**Saleh *et al* (2014)** conducted a study on yield Performance of local and exotic hybrid tomato varieties in Bangladesh where thirteen local and exotic hybrid tomato varieties viz. BARI F1 Tomato-4, BARI F1 Tomato-5, BARI F1 Tomato-6, BARI F1 Tomato-7, BARI F1 Tomato-8, Lali, Abhilash, Nayak, Moon, Delta, Mintoo super, Mintoo, and success were evaluated to see their performances during the winter season of 2012-2013. RCBD (Randomized Complete Block Design) was used having three replications. Yellow leaf curl virus infection was maximum in the variety Lali (10.41%) and minimum (2.08%) in BARI F1 tomato-5 and Mintoo and no virus infections were found in the rest varieties. The maximum yield was performed from BARI F1 tomato-4 while minimum yield was obtained from Delta. Considering the results, it can be concluded that most of the local varieties showed greater performance compared to the exotic varieties.

**Ibitoye *et al.* (2015)** conducted a field survey on resource use efficiency among tomato farmers in Kogi State, Nigeria. The data were collected from 240 respondents through purposive sampling in 2014. The questionnaire design was the main instrument used for data collection. Data collected were examined through the use of simple descriptive statistics, OLS regression analysis and efficiency ratio. Farmers' educational status, farming experience, contact with extension workers, and farm size were positively related and were found significant at 1 percent in influencing the output of tomato produced in the State. Resources such as pesticide, labor, years spent in school, the quantity of seed and farm size were positively and significantly related to tomato yield in Kogi State. Quantity of pesticide, seed and fertilizer were found over-utilized while labor and farm size were found underutilized.

**Ali *et al.* (2016)** conducted a study on resource use efficiency and return to scale in off-season tomato production in Punjab province of Pakistan. Simple random sampling requiring 70 off-season tomato growing farmers was used for collecting primary data. Cobb-Douglas function was used to check the production elasticity of different inputs and the overall goodness of the model was revealed ($R^2$) (0.693) and statistics (11.888). The elasticity of production showed a positive significant effect in case of age, education, experience, polythene sheet, tractor use, irrigation, labor-man days and contact with extension agents. Underutilization of resources was found for polythene sheet, tractor hours and irrigation followed by overutilization of input resources was observed for NPK, seed quantity, chemical sprays and labor-man days. There is decreasing return to scale but its value would be increased after efficient use of all inputs.

**Samshunnahar *et al.* (2016)** conducted a field survey to analyze the profitability, contribution of factors in yield and socioeconomic condition of small-scale tomato-producing farmers in some selected areas in Bangladesh. The main variables of production like seeds, human labor, tillage, fertilizer, irrigation and insecticides were considered to calculate the impacts on tomato production. Amongst 3 farm size groups, small tomato farmers earned the highest profit. Gross returns per acre of small, medium and large farms were recorded Tk. 104180, 95000 and 82600 and their corresponding net returns were recorded Tk. 46978, 45356 and 5354, respectively. Moreover, the

undiscounted benefit-cost ratio was the highest for medium farmers (1.91) than small farmers (1.82), while it was the lowest for large farmers (1.74). The coefficient of determinations ($R^2$) was about 0.694. The result showed that human labor and tillage were significantly positive. It was finally observed that a considerable development took place to increase the household income of the studied farmers and to improve the financial conditions with the introduction of small-scale commercial tomato production.

**Farooq *et al*. (2017)** conducted a field survey on the impact of Tomato Spotted Wilt Virus (TSWV) on root depth, fresh root weight, dry root weight plant and yield of twenty tomato varieties namely BARI Tomato-1, BARI Tomato-2, BARI Tomato-3, BARI Tomato-4, BARI Tomato-5, BARI Tomato-6, BARI Tomato-7, BARI Tomato-8, BARI Tomato-9, BARI Tomato-10, BARI Tomato-11, BARI Tomato-12, BARI Tomato-13, BARI Tomato-14, Roma VF T-311, Unnayan F1, Udayan F1, Rio Grande, Tidy and Diganta. The study was done at Amtoli Upazilla in Barguna district under the AEZ 18 in Bangladesh during the winter season of 2008-09. BARI-T2 gifted the highest reduction of root depth and the lowest reduction in Digonta; reduction of fresh root weight was found to be highest in BARI-T1 and lowest in the Rio Grande and reduction of the dry root was found to be lowest in BARI-T11 and highest in Roma. The fruit yield reduction was noticed higher due to early infection followed by mid and late infection stages in all the varieties. The highest fruit yield reduction was collected in BARI-T2, while the lowest was in BARI-T12 due to TSWV infection.

**Islam *et al*. (2017)** conducted a field experiment at the Horticulture Department, Sylhet Agricultural University, Sylhet, Bangladesh to find out the suitability of tomato production during the summer season of May to October 2014. Five tomato hybrids viz., BARI hybrid tomato-3, BARI hybrid tomato-4, NHC-1, NHC-2 and NHC-3 were conducted for tomato production during the summer season under Sylhet condition. Among the hybrids, a maximum of 5.3% total soluble solid was found in BARI hybrid tomato-3. The hybrid, BARI hybrid tomato-4 gave the highest fruit yield followed by NHC-1. The benefit-cost ratio showed that one can earn more than four thousand taka/decimal by growing tomatoes during the summer season in the Sylhet region. This study indicated that there is bright scope of tomato production during summer in the Sylhet region.

**Parvin (2017)** conducted a study based on the cost of production and profitability of Tomato producers at Rangpur district. Data was gathered from 100 farmers by using a simple random sampling method. The Tomato farmers answered their opinion in their socio-economic characteristics and the unconditional majority of them belonged to the young age category (20-35 years) having the medium family size, primary education level, small farm size (0.01- 0.33 acre). The study denominates that the small farmers were almost more profitable than others. The main difficulty reported by the Tomato farmers was the lower price of Tomato during the harvesting period, lack of good quality seed, the higher price of inputs and lack of government intervention etc. The findings ultimately will be supportive to the planners and policymakers in formulating micro or macro-level policies for the improvement of Tomato production in the country.

**Saha *et al.* (2017)** recently experimented ARS, BARI, Satkhira on three types of organic fertilizer (OF) like OF from Co-compost (Faecal Sludge and Municipal Solid Waste), earthworm compost (Vermicompost) and cow dung whereas chemical fertilizer was used as control treatment. Now a day's farmers are cultivating tomatoes in saline areas where they do not use any compost fertilizers as organic fertilizers. This experiment was conducted in RCBD design with three dispersed replications in the winter season 2016-17 at ARS, Satkhira with four fertilizer doses viz., T1 = 100% Chemical Fertilizer, T2 = Co-compost with 50 percent RDF, T3 = Vermicompost with 50 percent RDF, T4= Cow dung; were set as the treatments. Tomato (BARI Tomato-14) was planted on 15 November 2016 and from the economic study, higher income was obtained from using co-compost along with chemical fertilizer followed by T3, T1 and T4. Now, it is clear that 2-ton compost with 50 percent inorganic fertilizer from Recommended Dose of Fertilizer (RDF) provides the highest yield with economic benefit.

**Mukherjee *et al.* (2018)** conducted a field study where the tomato was grown during November–March, 2003–2005 below the following irrigation regimes: rain-fed or irrigation when cumulative pan evaporation (CPE) reached 50 mm ($CPE_{50}$) or 25 mm ($CPE_{25}$) and the following mulch treatments: none, rice straw, and white or black polyethene. Fruit yield increased with higher irrigation frequency. Mulch enhanced fruit yield by 23%–58% than no mulch. The cost-benefit (CB) ratio increased with an improvement in irrigation frequency. Rice straw, which is less costly and easily

available, gave the highest CB ratio (1:3.1) in all moisture conditions, followed by black polyethene (1:2.9). The use of black polyethene when water is scarce (rain-fed, $CPE_{50}$) influences to increase income compared to plants in bare soil when water is plentiful.

**Mitra and Sharmin (2019)** conducted a field study to determine the risk attitude and profitability of tomato farmers in Bangladesh. Sixty sample respondents of tomato farmers were selected from the Mymensingh district while the obit regression model was utilized to calculate the factors affecting risk attitudes of tomato farmers. In addition, financial profitability was examined and results found that only 18 percent of farmers were risking preferring than 42 percent of farmers were risk-averse. Training and education help to understand the significance of receiving newly introduced technology, timely application of seed, irrigation and fertilizer. Education assists to admit from diversified sources that make them risk preferred. The benefit-cost ratio (BCR) of tomato farming was 2.31 indicating that tomato farming is perfectly profitable. Productivity and profitability of tomato farmers can be developed if farmers can manage different risks and uncertainty associated with production practices.

The above-mentioned discussion and review indicate that most of the studies consulted with cost, return, profitability and productivity of tomato. Moreover, this study was conducted using updated data to get recent information regarding production. Maximum studies examined indicators, which influence production. Limited studies were conducted on the productivity and resource use efficiency of tomato farming in Bangladesh. The review of the literature was congenial to re-design methodological aspects to overcome the limitations of previous studies which would help the policymakers and researcher for further investigations.

# CHAPTER 3
# METHODOLOGY

## 3.1 Introduction

The proper result of survey research depends, to a great extent, on the appropriate methodology used in the research. The proper methodology is determined by the nature, condition and objectives of the study. It also depends on the bound of necessary funds, materials and time. The present study was based on primary data that were collected from the field survey and reliable sources. In this study, the random survey method was chosen because it is less expensive, requires less time and after all, it is a simple and easy technique. But the main shortcoming is that the investigator has to depend upon the memory of the respondents. To overcome the shortcoming, repeated visits were made to collect data in the study area and the questions were asked so that the respondents could answer from memory. The survey for the present study involved some necessary steps.

## 3.2 Selection of the Study area

Farm management research usually involves the selection of one or more areas that are particularly suitable enough for fulfilling the objectives according to the study requirement. For the present study, the Mymensingh Sadar Upazilla and Gauripur Upazilla area of the Mymensingh district was selected randomly. Primary data was collected from Konapara and Kolapara villages from the Mymensingh Sadar Upazilla and Tanguripara and Baliapara villages from the Gauripur Upazilla based on farm size. Having 0.05 to 2.49 acres cultivated land under small size farm, 2.50 to 7.49 acres cultivated land under medium size farm and more than 7.50 acres cultivated land under large size farm was considered (BBS 2020). The major reasons for selecting the study area were as follows:

i. Availability of tomato cultivating farmers in the study area.
ii. Good communication & cooperation from the farmers.
iii. Previously no such type of study was conducted in this location.
iv. These villages had some identical characteristics like homogeneous soil and climatic situation for producing tomato.

### 3.3 Selection of the Samples

The selection of the respondents was made randomly and 90 tomato farmers from Mymensingh Sadar and Gauripur Upazilla were selected as samples. Among the 90 farms, 60 were in small size, 25 were in medium size and 5 were in large size farms.

### 3.4 Sources of Data

Data necessary enough for the present study were collected from primary and secondary sources. Primary data were collected from farmers and secondary data from various published sources. Secondary sources included the Bangladesh Bureau of Statistics (BBS), Bangladesh Economic Review (MoF), FAO and other related agencies in Bangladesh.

### 3.5 Preparation of the Survey Schedule

Firstly, a survey schedule was designed to record the desired information with the study's objectives. 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. General information of the respondents.
ii. Present the socio-economic situation of the farmers.
iii. Cost of using resources and other additional activities.
iv. Return from the yield of Tomato.
v. Problems faced by the farmers at the time of production.
vi. Opinions of the respondents.

### 3.6 Method of Data Collection

Farm Management data can be collected by different methods of which survey, cost accounting, financial accounting methods etc. are mostly used. The reason why the survey method was used in the present study is realistic, less costly, less time-consuming and easier to collect.

### 3.7 Period of Data Collection

The whole survey was conducted by the researcher himself from April to June 2020. Data was collected through several visits by the researcher to the location.

### 3.8 Collection of Data

The collection of accurate and reliable data from the field is not an easy task. The reliability of data highly depends on the method of data collection. To ensure accuracy and reliability, data were collected from the sample respondents by direct interview with designed schedules for the study. During the interview, each respondent was given a summary of the nature and purpose of the study for quick and free response. To capture the accuracy and reliability of data, care and caution were taken at the time of the data collection. Attention was paid based on the mode of the respondent and a congenial relationship was maintained between the respondent and the researcher.

### 3.9 Problems Faced in Collecting Data

In collecting primary data, the following outcomes were faced by the researcher:

i. Most attentive problem was the time limitation for collecting primary data.
ii. Most of the farmers in the selected areas did not want to give actual information about their income sources because it has no direct benefit for them.
iii. For collecting data, the researcher had to rely totally on the memory of the respondents because they did not keep any written record.
iv. Most of the respondents in the study areas did not have any solid knowledge about the study and it was time-consuming and laborious to explain the purpose of this research to convince them.
v. Sometimes respondents were not available at home and in such cases the researcher had to give more effort and time to collect the information.

### 3.10 Processing and Tabulation of Data

The processing of data is important based on the objectives of the study. The responses were checked to calculate errors involved in them. After collection of data from the field data for the study were then coded, tabulated, summarized and processed for analysis. The data had been transformed into an Excel sheet from the interview schedules with MS Excel.

### 3.11 Analytical Technique

Data were analyzed on account of achieving the objectives of the study. For this study, the following techniques were used:

a) Tabular technique and b) Statistical analysis.

### 3.11.1 Tabular Technique

The tabular technique was applied to verify data to get meaningful findings by using simple statistical measures like means, percentages and ratios.

### 3.11.2 Statistical Analysis

This component included in the financial analysis was designed to study the factors affecting tomato cultivation and resource use efficiency. For this, a production function analysis was carried out to explore the necessity and productivity of the individual inputs. The data for this analysis was ordered on a per-acre basis.

## 3.12 Financial Profitability Analysis

The primary and major goal of a farm is profit maximization. Cost and return analysis is the most commonly used method of determining and comparing the profitability of different farm households. In the present study, the profitability of tomato cultivation is calculated in the following way-

### 3.12.1 Gross Return

Per acre Gross Return (GR) or Total Return (TR) was calculated by multiplying the total amount of product by their respective per-unit prices.

GR = Quantity of the Product × Average Price of the Product

### 3.12.2 Gross Margin

Gross Margin (GM) is defined as the difference between Gross Return and variable costs. Generally, farmers want maximum return over the variable cost of production. The Gross Margin was calculated on Total Variable Cost (TVC) basis. Per acre Gross margin was obtained by subtracting variable costs from Gross Return. That is,

Gross Margin = GR – TVC

### 3.12.3 Net Return

Net Return (NR) or profit was calculated by deducting the Total Production Cost or Total Cost (TC) from the Total Return or Gross Return. That is,

Profit = GR – TC

### 3.12.4 Benefit-Cost Ratio

The benefit-cost ratio was calculated by the following formula

$$BCR = \frac{TR}{TC}$$

### 3.13 Functional Analysis

To calculate the production function, one requires improvement of its properties leading to the specification of an explicit functional form. One of the most specifically used production functions for empirical estimation is the Cobb Douglas Production Function which was originally used by C.W. Cobb and P.H. Douglas in the twenties to calculate the marginal productivities of labor and capital in American manufacturing industries. Their main purpose was to estimate the portion of labor and capital in the total product; hence they used this function with the assumption that the sum of elasticities or regression coefficients should total one. Cobb and Douglas finally fixed the function to time series in the 1930s and 1940s; the same equation was used for a cross-section of industries. The popularity of this function is just because of the following characteristics of the function:

- It provides the elasticities of production with accustomed to inputs;
- It permits more degrees of freedom than other algebraic forms (like a quadratic function) which allow increasing or decreasing marginal productivities, and
- It facilitates the calculations by reducing the number of regressions to be handled in regression analysis.

The original form of Cobb and Douglas Production Function was

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

This forces some elasticities to be equal to one. Their later modification was

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

Where, $\alpha+\beta$ need not 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

$$Y= a\ X_1^{b_1}\ X_2^{b_2}\ X_3^{b_3}\ X_4^{b_4}\ X_5^{b_5}\ X_6^{b_6}\ X_7^{b_7}\ X_8^{b_8}\ X_9^{b_9}\ e^{U_i}$$

The input-output relationship in tomato production was analyzed with the help of the following:

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

Where, Y = Gross Return (Tk./acre)

a = Intercept Value

$X_1$ = Cost of Human Labor (Tk./acre)

$X_2$ = Cost of Land Preparation (Tk./acre);

$X_3$ = Cost of Seed (Tk./acre);

$X_4$ = Cost of Urea (Tk./acre);

$X_5$ = Cost of TSP (Tk./acre);

$X_6$ = Cost of MoP (Tk./acre)

$X_7$ = Cost of Manure (Tk./acre)

$X_8$ = Cost Irrigation (Tk./acre)

$X_9$= Cost of Pesticide (Tk./acre)

$U_i$ = Error term;

i = 1, 2, 3, …….9;

$b_1$, $b_2$, $b_3$, $b_4$, $b_5$, $b_6$, $b_7$, $b_8$ $b_9$ = Co-efficient of respective variance

In a log-linear regression model involving any number of variables, the coefficient of each of the X variables calculates the (partial) elasticity of the dependent variable Y concerning that variable. If output and all inputs changes in unique proportion, it is known as constant returns to scale, if changes in output are less than changes in all inputs, it is known as decreasing returns to scale and if changes in output are greater than changes in all inputs, it is known as increasing returns to scale.

### 3.14 Measurement of Resource Use Efficiency

Farmers can get maximum profit up to the point where the value of the added product is greater than the cost of the added resources in producing it. When the marginal physical product is measured in monetary terms (MPP* product price), it is called marginal value product. Marginal factor cost (MFC) is the price of one unit of output. To test the efficiency of resource allocation, the ratio of MVP to MFC for each input is considered to be 1 which can be written by following:

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

When Resource-use efficiency,

RUE =1, resources were optimally utilized,

RUE < 1, resources were over-utilized, and

RUE > 1, resources were underutilized.

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

$$\text{MVP } (X_i) = b_i \times \frac{Y\ (GM)}{X_i\ (GM)}$$

Where, $b_i$= regression coefficient per resource

$Y_i$ = Mean value (GM) of Gross Return

$X_i$ = Mean value (GM) of inputs

### 3.15 Cost Items

The cost of inputs is an important factor that plays a significant role in financial decision making for performing income-generating activities. Respondents in the study area used purchased inputs as well as home circulated inputs. The cost of purchased inputs and home circulated inputs were not calculated separately. The cost items of Tomato cultivation are given below.

1. Cost of seed
2. Human labor cost
3. Fertilizer cost
4. Land preparation cost

5. Irrigation cost
6. Manure cost
7. Insecticide and pesticide cost
8. Interest on operating capital
9. Land use cost

### 3.15.1 Cost of Seed

Seed cost is estimated based on home-preserved and purchased seed. Home-preserved seeds were estimated based on prevailing market prices and cost of purchased seed were calculated at the actual market prices.

### 3.15.2 Fertilizer & Manure Cost

It is very important for cultivation to use the recommended dose of fertilizer and manure in the field. The cost of fertilizer involved Urea (for Nitrogen), TSP (for Phosphorus), MoP (for Potash), Gypsum (for Calcium and Sulfur). Fertilizer and manure costs were calculated at the prevailing local market rates and estimated according to the cash price paid by the farmers per kg. The price of Urea, TSP and MOP were Tk. 16, 22, 16 per kg respectively.

### 3.15.3 Insecticide & Pesticide Cost

Farmers used Dithane M-45, Redomilgold, Flora, Anne, Thiovit 80wp and Rovral 50wp for tomato cultivation. These costs are estimated based on the price paid by the farmers.

### 3.15.4 Human Labor Cost

Human labor cost was the largest and most valuable input in the cultivation of Tomato which was found Tk. 500 per day. Labor cost involves family and hired labor. Family labor includes the cultivator himself, the adult male and female as well as children of a farmer's family. To determine the costs of unpaid family labor, the opportunity cost concept was used and the opportunity cost of family labor was assumed to be the market wage rate. Eight adult male hours were equivalent to one man-day and the opportunity

cost principle was formulated to estimate the wage rate of labor. In producing tomato human labor were used for the following operations:

- Land preparation, plowing and laddering
- Transplanting seed and seedling
- Application of fertilizer and manure
- Weeding and irrigation
- Pest control and
- Harvesting, storing and marketing

### 3.15.5 Land Preparation and Irrigation Cost

The costs of Machinery services were calculated by taking into account the actual costs paid by the Tomato farmers. In the study area, almost all the respondent farmers used power tillers, tractors and other machinery for land preparation. They mainly used hired tractors. A power tiller owner supplied fuel and the driver for land preparation. So, the service charge was also included in the machinery cost. The cost of irrigation was calculated by adding the rental charge of the machine and the cost of fuel. Some farmers collect only water from the shallow tube well by paying a charge.

### 3.15.6 Land Use Cost

The cost of land use was different for various points, according to the location, topography and fertility of the soil. The land was used for four months for cultivating tomato starting from land preparation to harvesting. In the present study, the cost for use of land was estimated by taking the cash rental value of land and the other choice to account for the cost of land use.

### 3.15.7 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)

$$IOC = AI.\ I.t$$

Where, IOC = Interest on operating capital

I = Rate of interest

$$AI = \frac{\text{Total Investment}}{2}$$

t = Total time period of a cycle

### 3.16 Procedure for Evaluation of Returns

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

# CHAPTER 4
# DESCRIPTION OF THE STUDY AREA

## 4.1 Introduction

A brief description of the selected study area is presented in this chapter. The knowledge of the study area is essential to understand and explain the findings of the study. The description of the study area includes location, physical features and topography, climate, temperature and rainfall, population, agriculture, transportation of the study area.

## 4.2 Location

The study area covers four villages from Mymensingh Sadar Upazilla & Gauripur Upazilla of Mymensingh District. The area of Mymensingh District is 4363.48 sq km, located in between 24°15' and 25°12' north latitudes and in between 90°04' and 90°49' east longitudes. Mymensingh District is located on Mymensingh Division and on the bank of Brahmaputra River, about 120 km (75 miles) north of Dhaka. It is bordered on the north by Meghalaya, a state of India and Garo Hills, on the south by Gazipur District, on the east by the districts of Netrokona and Kishoreganj and on the west by the districts of Sherpur, Jamalpur and Tangail (Wikipedia 2021).

The location of the study was Kolapara and Konapara villages located at Sirta Union in Mymensingh Sadar Upazilla as well as Tanguripara and Baliapara villages located at Sidhla Union in Gauripur Upazilla. The locations of the District, Upazilla and Unions are presented in the following Map (figure 4.1, 4.2 and 4.3).

## 4.3 Physical Features and Topography

The study area is covered by both high and low land where the soil texture varied from silt loam to silty clay and soil pH from 5.2 to 7.8. The land surface of the study area is plain and fertile and the soil structures of these areas are almost similar. The favorable water level, flat topography and loamy soil have encouraged the expansion of groundwater irrigation facilities. (Banglapedia 2021)

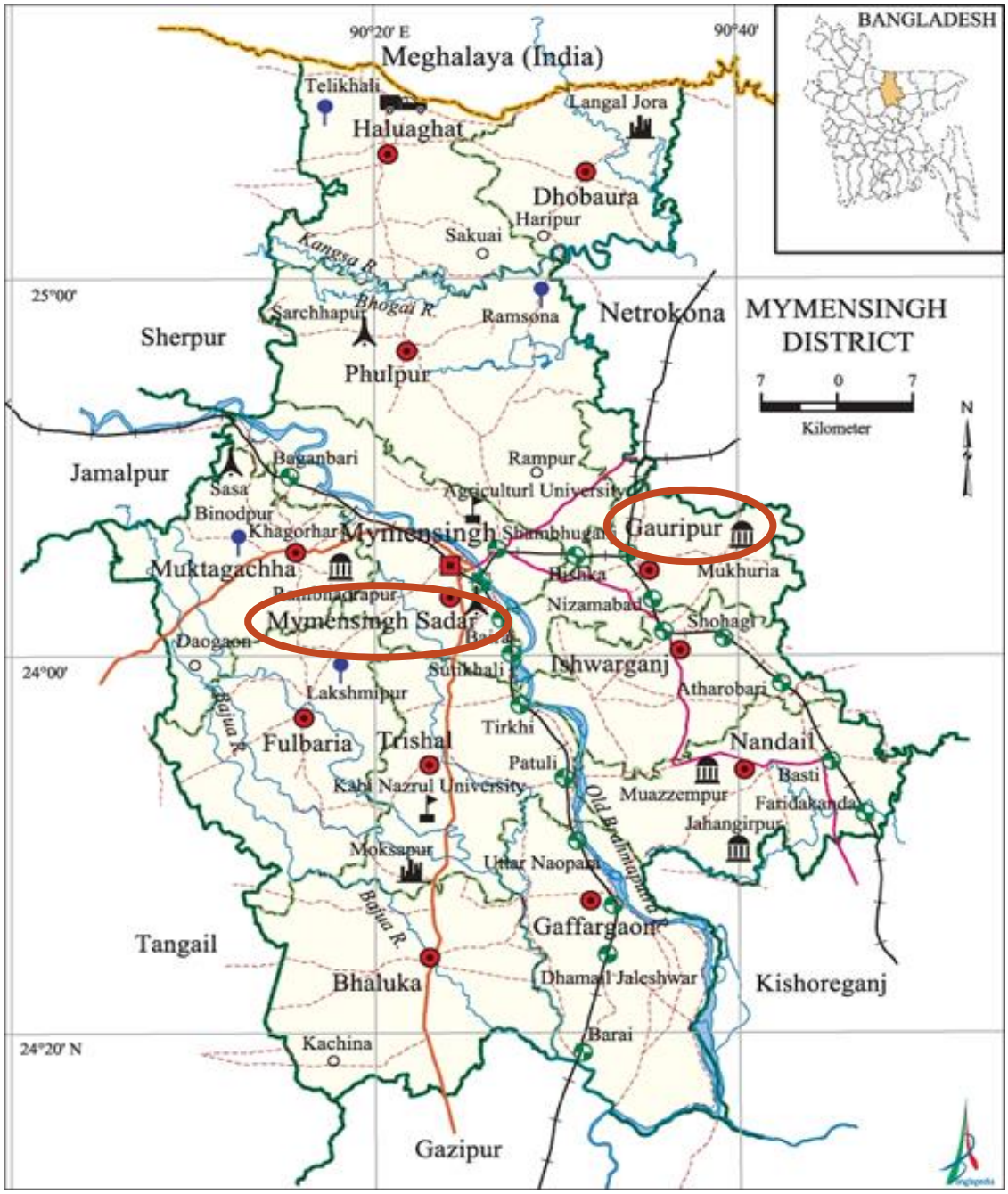


**Figure 4.1: Map of Mymensingh District Showing Mymensingh Sadar Upazilla and Gauripur Upazilla**


**Figure 4.2: Map of Mymensingh Sadar Upazilla showing study area**

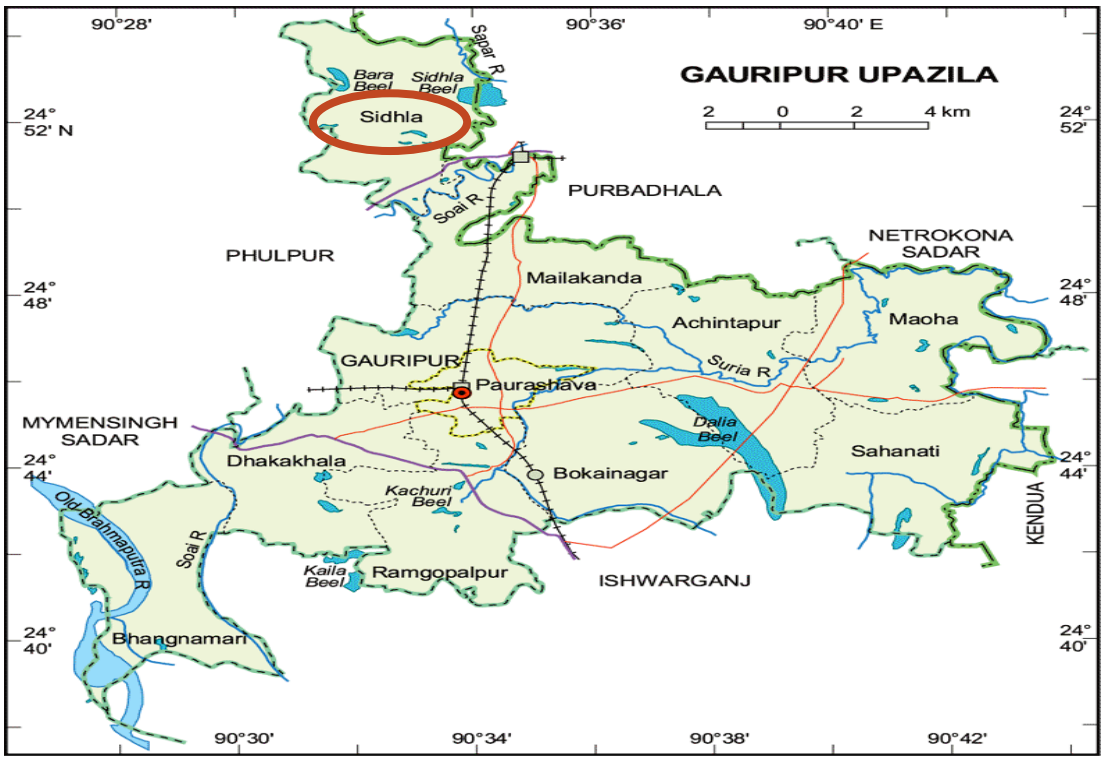


**Figure 4.3: Map of Gauripur Upazilla showing study area**

### 4.4 Administrative Area

Mymensingh district has a city corporation, ten municipalities and twelve Upazilla. The twelve Upazilla are Bhaluka, Dhubaura, Fulbaria, Gaffargaon, Gauripur, Haluaghat, Ishwarganj, Mymensingh Sadar, Muktagachha, Nandail, Phulpur and Trishal. The whole area includes 146 unions, 2709 villages, 102 wards and 217 mahallas.

**Table 4.1: Area, Union, Municipalities, Ward and Villages of Mymensingh Sadar and Gauripur Upazilla**

| Upazilla | Total Area (acres) | No. of Municipalities | No. of Union | No. of Ward | No. of Villages |
|---|---|---|---|---|---|
| **Mymensingh Sadar** | 380.72 | 1 | 13 | 21 | 175 |
| **Gauripur** | 276.74 | 1 | 10 | 9 | 289 |

(Source: BBS, 2020)

### 4.5 Population

As of the 2021 Bangladesh census, Mymensingh Sadar Upazilla has total population of 776 thousand. Males constitute 391 thousand and females 385 thousand.

**Table 4.2: Area, Population, Number of Household, Male-Female Ratio and the Literacy rate of Mymensingh Sadar & Gauripur Upazilla**

| Name of the Area | Number of Household | Population Density Per sq.Km | Population (000) | | | Male-Female Ratio |
|---|---|---|---|---|---|---|
| | | | Male | Female | Total | |
| Mymensingh Sadar | 167472 | 2037 | 391 | 385 | 776 | 1.02 |
| Gauripur | 72047 | 1167 | 160 | 163 | 323 | 0.98 |

(Source: BBS, 2020)

Mymensingh Sadar has 167472 households in total; Gauripur Upazilla has a population of 323 thousand and 72047 households. Males constitute 160 thousand and females 163 thousand (Table 4.2).

### 4.6 Climate, Temperature and Rainfall

The climate of Mymensingh is a little cooler than Dhaka, as it is closer to the Himalayas, and sufficient to be a monsoon-influenced humid subtropical climate instead of a tropical wet and dry climate or tropical monsoon climate as found further south in Bangladesh. The monsoon starts in May or June and continues till August. It rains heavily and sometimes for days and weeks. During the monsoon, the temperature varies between 25 and 31 °C (77.0 and 87.8 °F). The temperature falls below 15 °C (59 °F) in winter which is spread over December and January and may well include November and February. The highest temperature is felt during April–May period, when it may reach as high as 40 °C (104 °F).

**Table 4.3: Monthly Average High Temperature, Average Low Temperature, Average Temperature and Rainfall of the Study Area in 2020.**

| Month | Average High Temperature (°C) | Average Low Temperature (°C) | Average Temperature (°C) | Rainfall (mm) |
|---|---|---|---|---|
| **January** | 24.0 | 11.0 | 17.5 | 12 |
| **February** | 27.7 | 13.8 | 20.7 | 17 |
| **March** | 31.8 | 18.4 | 25.1 | 46 |
| **April** | 33.4 | 22.3 | 27.8 | 110 |
| **May** | 32.1 | 23.7 | 27.9 | 286 |
| **June** | 31.0 | 25.0 | 28.0 | 469 |
| **July** | 31.2 | 25.8 | 28.6 | 401 |
| **August** | 31.2 | 25.8 | 28.5 | 398 |
| **September** | 31.1 | 25.5 | 28.4 | 311 |
| **October** | 30.8 | 23.6 | 27.2 | 179 |
| **November** | 28.7 | 18.2 | 23.4 | 18 |
| **December** | 25.8 | 13.5 | 19.6 | 2 |
| **Year** | 29.8 | 20.6 | 25.2 | 187.41 |

(Source: Bangladesh Meteorological Department, 2020)

High humidity causes heavy sweating during this period. Table 4.3 shows that maximum and minimum temperatures in the study area ranged from 34.4°C to 11°C.

The average maximum temperature was the highest in April which was 34.2°C and the average minimum temperature was found in January which was 11°C. The maximum average rainfall is about 469 mm in June and the lowest is 2 mm in December. (Bangladesh Meteorological Department,2020).

### 4.7 Non- government Organizations (NGOs)

A good number of non-government organizations (NGOs) like BRAC, ASA, Grameen Bank, SSS (Society for Social Service) etc. are engaged in various types of rural development programs in the study area. In recent years, NGOs are providing technical and financial support in livestock, poultry, fisheries, homestead gardening, handicrafts etc. Not only they are also engaged in educational programs but also, they provide loans in small amounts (microcredit) to poor women and landless farmers.

### 4.8 Use of Modern Technology

Agriculture is the biggest field of employment facilities of the people in the study area. In Mymensingh Sadar & Gauripur Upazilla, the principal agricultural crop is rice which is cultivated in three seasons such as Aus, Aman and Boro. The winter crops such as wheat, potato, mustard, and vegetables like brinjal, cucumber, bottle gourd, bean, tomato, pumpkin and some other plant type vegetables are also grown in the study area. Modern technology like deep and shallow tube wells, power tillers, HYV seeds, chemical fertilizers, insecticides are widely used in the study area.

### 4.9 Roads, Communication and Marketing Facilities

Transport and marketing facilities are the main agricultural infrastructure and play an important role in the agricultural and economic development of a country. Without a well-developed transport system, it becomes impossible for the village people to utilize the facilities of modem technology. Buses, bicycles, rickshaws, auto rickshaws and van services are the main transportation mean in the study area. The marketing systems in these Upazilla headquarters are moderately well where there are many markets in the study area. Generally, farmers purchase daily requirements including agricultural inputs and sell their products to the village markets and the middlemen like Paikers, Beparies, Aratdars etc. The villagers sometimes receive fair prices for their products.

### 4.10 Conclusion

The above description gives an overview of the physical, topographical, demographic and socioeconomic situation of the Mymensingh district in general and for the study of Upazilla in particular. Mymensingh district has potential for tomato cultivation and its contribution to the national economy. The accurate management and use of the available natural resources are also compulsory to enhance the productivity of tomato cultivation.

# CHAPTER 5
# SOCIO-ECONOMIC CHARACTERISTICS OF THE TOMATO GROWERS

## 5.1 Introduction

This section of the study deals with selected demographic characteristics of the respondent growers which often influence their production decision. The decision-making behavior of an individual is determined by the demographic characteristics. Some important characteristics were considered in this study such as family size and composition, experience, occupation, ownership pattern, educational status etc. A brief description of these cases is presented in the following sections.

## 5.2 Age Distribution

The age of farmers influences the production of the farming system. Some researchers think that older farmers are more experienced and more efficient in using resources. Other researchers comment that younger farmers want to adopt improved technology than older ones.

**Table 5.1 Age Distribution of the Respondents**

| Age Category (Years) | Mymensingh Sadar | | Gauripur | | | All |
|---|---|---|---|---|---|---|
| | Number | Percent | Number | Percent | Number | Percent |
| **Young (20-35)** | 13 | 28.89 | 10 | 22.22 | 23 | 25.56 |
| **Middle Aged (36-50)** | 20 | 44.44 | 25 | 55.56 | 45 | 50 |
| **Old (Above 50)** | 12 | 26.66 | 10 | 22.22 | 22 | 24.44 |
| **Total** | 45 | 100 | 45 | 100 | 90 | 100 |

(Source: Field Survey, 2020)

It is clear from figure 5.1 that farmers between 20-35 years of age stood for 25.56 percent of the total sampled tomato farmers while farmers between 36-50 years constituted 50 percent. There are 24.44 percent of sample farmers whose ages were 51

years and above. Figure 5.1 revealed tomato farmers were of the mostly middle-aged group.

### 5.3 Educational Status

Education is generally regarded as a crucial factor of the social improvement of a community since it plays a critically important role in reducing poverty and inequality, improving health and enabling the use of knowledge. Education means efficiency which helps farmers to increase skill and productivity.

**Table 5.2 Educational Status of the Respondents**

| Level of Education | Mymensingh Sadar | | Gauripur | | All farmers | |
|---|---|---|---|---|---|---|
| | No. | Percent | No. | Percent | No. | Percent |
| **Illiterate** | 5 | 11.11 | 3 | 6.67 | 8 | 8.88 |
| **Sign only** | 3 | 6.67 | 7 | 15.56 | 10 | 11.11 |
| **Primary (class 1-5)** | 6 | 13.33 | 12 | 26.67 | 18 | 20 |
| **Secondary (class 6-10)** | 26 | 57.78 | 21 | 46.66 | 47 | 52.24 |
| **Above Secondary** | 5 | 11.11 | 2 | 4.44 | 7 | 7.77 |
| **Total** | 45 | 100 | 45 | 100 | 90 | 100 |

(Source: Field survey, 2020)

It is evident from table 5.2 that out of 90 sample farmers, in total, 8.88 percent of farmers did not receive any education, 11.11 percent of farmers can only write some letters, 20 percent of farmers had completed primary level education. Most of the farmers (52.24%) among the respondents had received high school-level education. About 7.77 percent of farmers had completed their higher secondary education or above.

### 5.4 Occupational Status

Occupation is one of the major attributes of socio-economic characteristics. In Bangladesh, rural people's occupations are being diversified. They try to seek farm (agriculture) and non-farm (business and service) income-earning opportunities. On the

basis of their occupation, the respondents were classified into three categories namely, agriculture, business and service. The scale used for computing the occupation score of

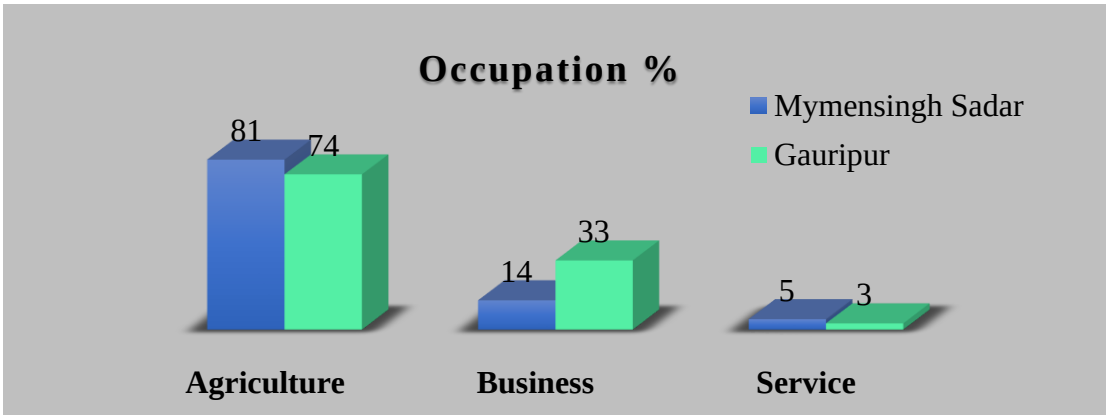


**Figure 5.1: Distribution of the farmers according to their occupation**

(Source: Field Survey, 2020)

a respondent is given Figure 5.1. Figure 5.1 indicated that the highest proportion of the respondents in Mymensingh Sadar and Gauripur involved in only agriculture which was 81% and 74% respectively. The lowest participation of respondents was service sector which was 5% in Mymensingh Sadar and 3% in Gauripur Upazilla.

### 5.5 Family Size

The family member includes wife, sons and daughters-in-law, unmarried daughter, father, mother and brother. The family size of the farmers ranged from 2 to 12 members.

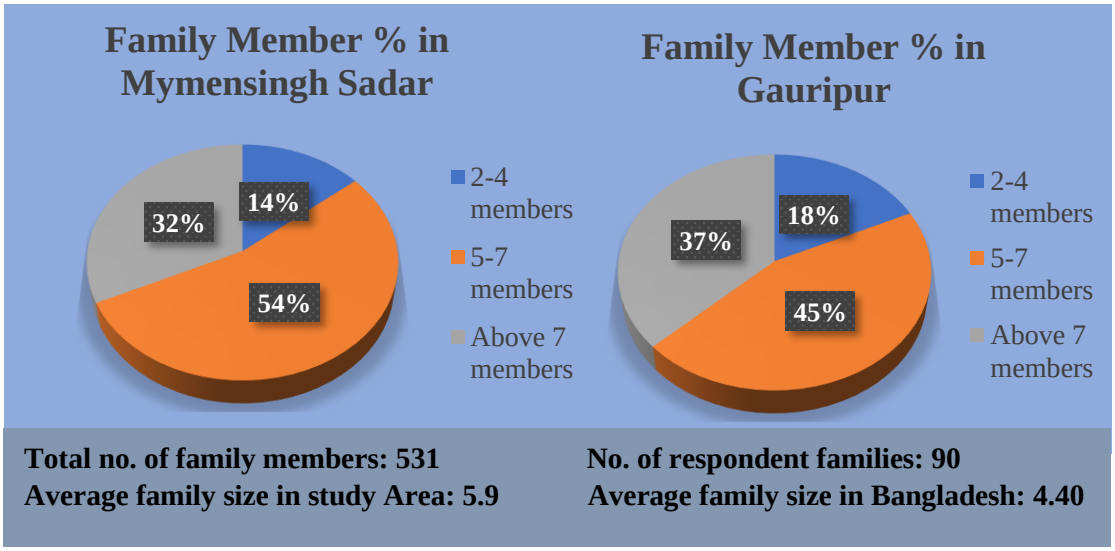


**Figure 5.2: Distribution of Farmers According to Their Family Size**

(Source: Field Survey, 2020)

On the basis of their family size, the farmers were classified into the following three categories: "small family" (2-4), "medium family" (5-7) and "large family" (above 7). In Mymensingh Sadar and Gauripur Upazilla, the majority of respondents had medium size family which were 54% and 45% respectively (Figure 5.2). The proportion of small size family was comparatively low in Mymensingh Sadar (14%) and Gauripur Upazilla (18%). Out of 90 respondents' families, the average family size was found 5.9 in the study area where the national level is 4.40.

### 5.6 Experiences in Agriculture

Experience in t agricultural cultivation of the farmers ranged from 1 to 50 years. On the basis of experience, the farmers were classified into three categories: 1-10 years, 11-25 years and above 25 years. The distribution of the farmers according to their experience is shown in Figure 5.3.

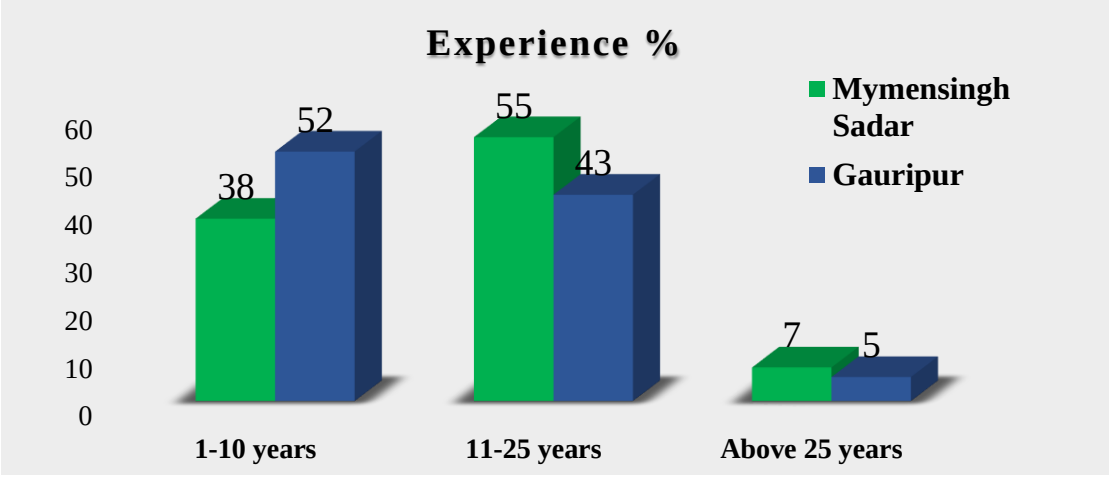


**Figure 5.3: Experience Level of the Farmers in Mymensingh Sadar and Gauripur**
(Source: Field Survey, 2020)

Experience is an important factor as it gives the farmer perception about the consequences and solution to any unexpected occurrence. The data which was presented above was not only the experience of tomato cultivation but also the experience of other crops or vegetable cultivation. From the above Figure 5.3, the experience level from 1-10 years was found 38, 52 and 45 percent; from 11-25 years was found 55, 43 and 49 percent; from and from above 25 years was found 7,5 and 6 percent for Mymensingh Sadar, Gauripur Upazilla and all farmers respectively.

### 5.7 Annual Family Income

Annual family incomes of tomato farmers come from vegetable farming, business, agriculture, service, and others. In the present study, the incomes of tomato farmers were categorized into four categories namely, (less than 150,000), (from 150,000 to 200,000), (from 200,000 to 250,000) and (above 250,000). The scale used for computing the income score of the respondents is given below.

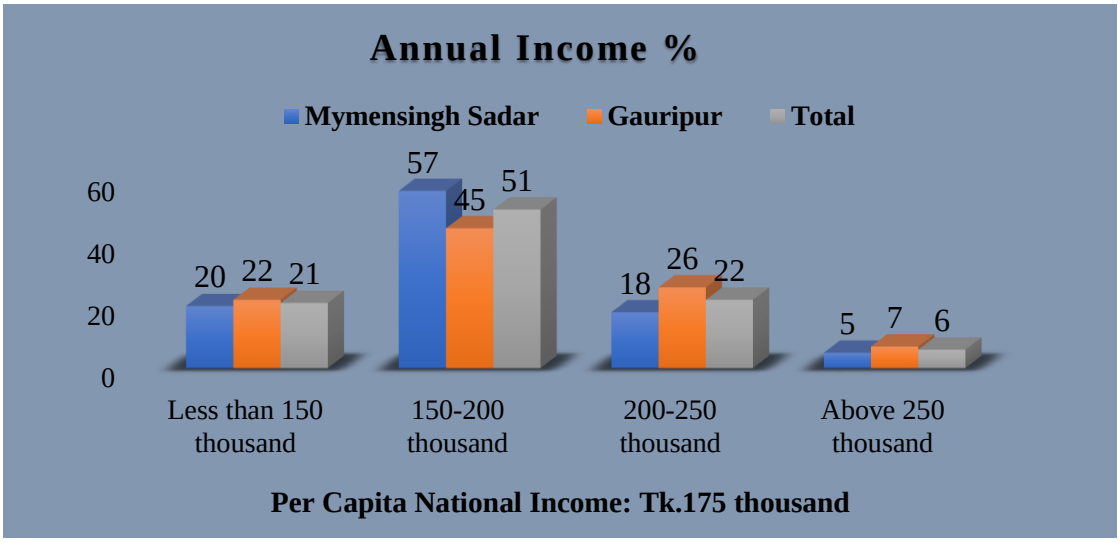


**Figure 5.4: Annual Family Income of the Respondents in Mymensingh Sadar and Gauripur** (Source: Field Survey, 2020)

Data contained in Figure 5.4 indicated that the highest proportion of the respondents had 150-200 thousand income level which was 57% in Mymensingh Sadar and 45% in Gauripur Upazilla where per capita gross national income (GNI) was Tk.195976 or US $2064 (BBS, 2020). The respondents who had less than 150 thousand income per year were found 20% in Mymensingh Sadar and 22% in Gauripur Upazilla. The respondents who had 200-250 thousand income levels per year were found 18% in Mymensingh Sadar and 26% in Gauripur Upazilla. The respondents who had more than 250 thousand income per year were found 5% in Mymensingh Sadar and 7% in Gauripur Upazilla.

### 5.8 Source of Fund

Credit received of the farmers were two groups such as own funded and credit received. It is evident that about 38.8 percent of the tomato farmers had credit received and the rest of 61.2 percent was own funded.

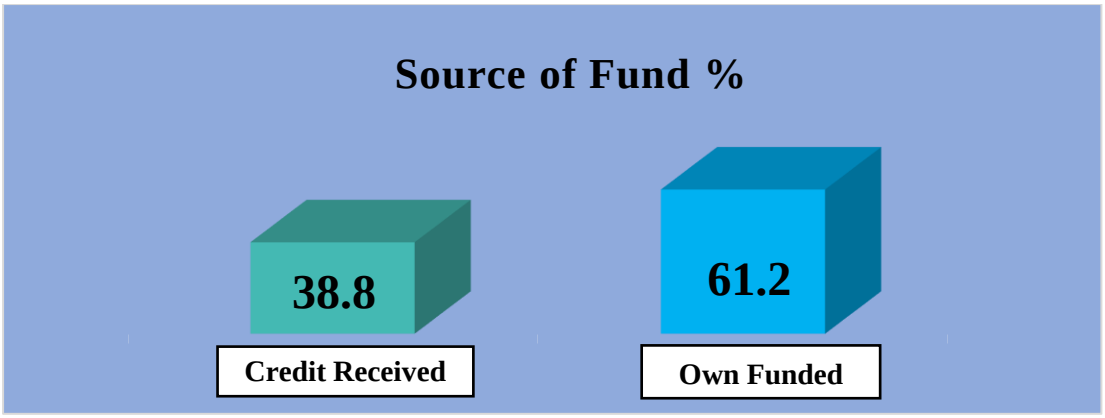


**Figure 5.5: Distribution of the farmers according to their source of fund**
(Source: Field Survey, 2020)

Credit receivers were classified into three categories namely, banks, NGOs, and others like raising funds from friends, relatives etc. The scale used for computing the credit received sector score of the respondents is given below (Figure 5.5).

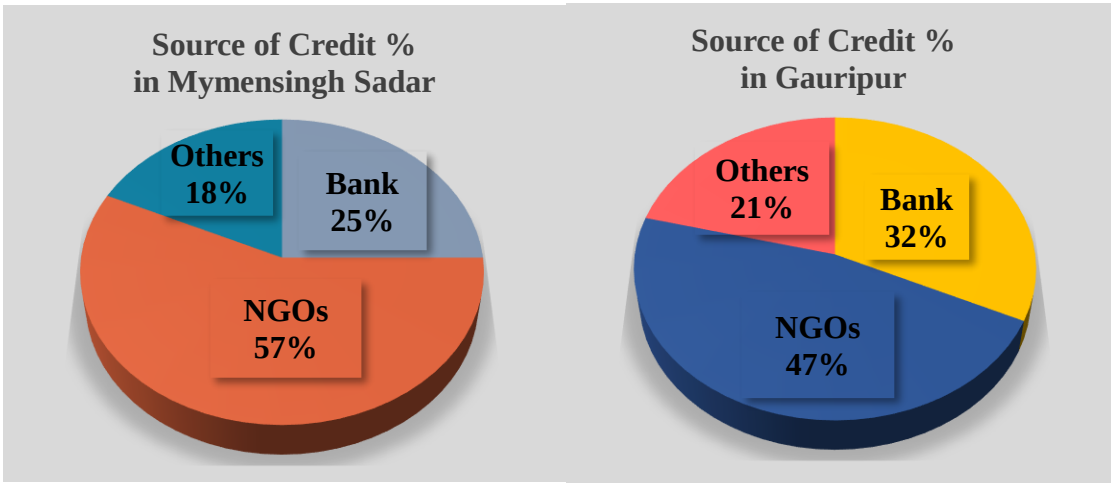


**Figure 5.6: Distribution of the farmers according to their source of credit in Mymensingh Sadar and Gauripur** (Source: Field Survey, 2020)

Data contained in Figure 5.5 indicated that the highest proportion was credit received from NGOs which was 57% in Mymensingh Sadar and 47% in Gauripur Upazilla. In Mymensingh Sadar Upazilla, the rest of the respondents depended on banks (25%) and other sources (18%). However, in Gauripur Upazilla, 32% depended on the bank and 21% depended on other sources.

## 5.9 Conclusion

This chapter analyzed the socio-economic attributes of the respondent farmers. The findings of the study indicate that most of the farmers are not well educated and their annual income is not high but most of the farmers are involved in agriculture with long experience of cultivation.

# CHAPTER 6
# PROFITABILITY OF TOMATO CULTIVATION

## 6.1 Introduction

The identity of this chapter is to estimate the costs, returns and profitability of cultivating tomato and to focus on the main factors affecting the return of tomato production. The items of costs include fertilizer, manure, insecticide and pesticide, irrigation, seed, labor cost, land preparation cost, land use cost and cost on operating capital at four percent in six months. All the calculations were performed by acres and gross margin, net return; returns per taka invested on total cost were estimated. The costs and returns of tomato cultivation are discussed below.

## 6.2 Cost of Tomato Cultivation

The cost means the total amount of funds used in cultivation. In the present study Table 6.1 represents the total costs of tomato production. The average total variable cost, total fixed cost and total cost were Tk.21504, Tk.12247 and Tk.33751 respectively. Thus, the costs of tomato cultivation under different farm sizes are discussed below.

### 6.2.1 Land Preparation Cost

In recent years, the use of animal power is diminishing with the introduction of machine power, but in the study area, animal power was also used for land preparation and mainly used for laddering, threshing and carrying. The owner charged a fixed amount of money as a service charge for using a power tiller which was Tk.250 per bigha (local unit) land preparation for one tillage. From Table 6.1, it was found that the total cost of machinery and animal power for cultivation under small, medium and large farms was Tk.2480, Tk.2234 and Tk.2244 respectively (Table 6.4).

### 6.2.2 Cost of Seed

Farmers prefer to use seeds stored from their previous production for saving the input cost. But some new farmers like to purchase them as the productivity performance of purchased seed is good. In the Mymensingh Sadar Upazilla, most of the farmers purchase seed but in Gauripur Upazilla most of the farmers use stored seed The cost of home supplied seed was calculated on the basis of actual price paid by the farmers for purchased seed. It was found that per acre cost of seed for tomato production under

small, medium and large farm were Tk.1428, Tk.1467 and Tk.1405 respectively (Table 6.4).

**Table 6.1: Per Acre Cost of Tomato Cultivation for Small Farms in the Study Area**

| Cost Items | Unit | Quantity | Rate (Tk./unit) | Cost (Tk./unit) |
|---|---|---|---|---|
| **Land Preparation** | **-** | **-** | **-** | **2480** |
| **Seed** | **gm** | **24** | **60** | **1428** |
| **Manure** | **Kg** | **790** | **0.5** | **395** |
| **Cost of Fertilizer** | **-** | **-** | **-** | **4395** |
| **a) Cost of Urea** | **Kg** | **122** | **16** | **1956** |
| **b) Cost of TSP** | **Kg** | **66** | **22** | **1455** |
| **c) Cost of MoP** | **Kg** | **61.5** | **16** | **984** |
| **Hired Labor Cost** | **Man-days** | **12** | **500** | **6000** |
| **Pesticide and Insecticide** | **-** | **-** | **-** | **1105** |
| **Irrigation** | **-** | **-** | **-** | **686** |
| **Tunnel Material Cost** | **-** | **-** | **-** | **816** |
| **Interest on Operating Capital at 9%** | **-** | **-** | **-** | **699** |
| **Family Labor Cost** | **Man-days** | **5** | **500** | **2500** |
| **Land Use Cost** | **-** | **-** | **-** | **10414** |

### 6.2.3 Cost of Fertilizer

In the study area, farmers mainly used three types of chemical fertilizer namely Urea, Triple super Phosphate (TSP) and Muriate of potash (MoP). In case of tomato cultivation under small, medium and large farm total cost of fertilizer were Tk.4395, Tk.3871 and Tk.4019 respectively (Table 6.4). From the Table 6.1 it may be concluded that total cost of fertilizer for small farm was higher.

### 6.2.4 Cost of Manure

Farmers used manure to keep their land fertile. The average cost of manure for tomato production under small, medium and large farm was found to be Tk.395, Tk.358 and

Tk.372 per acre respectively (Table 6.4). The average cost of manure for tomato production was Tk.375.

**Table 6.2: Per Acre Cost of Tomato Cultivation for Medium Farms in the Study Area**

| Cost Items | Unit | Quantity | Rate (Tk./unit) | Cost (Tk./unit) |
|---|---|---|---|---|
| **Land Preparation** | **-** | **-** | **-** | **2234** |
| **Seed** | **gm** | **25** | **60** | **1467** |
| **Manure** | **Kg** | **716** | **0.5** | **358** |
| **Cost of Fertilizer** | **-** | **-** | **-** | **3871** |
| **a) Cost of Urea** | **Kg** | **133** | **16** | **1810** |
| **b) Cost of TSP** | **Kg** | **56** | **22** | **1235** |
| **c) Cost of MoP** | **Kg** | **51.5** | **16** | **826** |
| **Hired Labor Cost** | **Man-days** | **12** | **500** | **6000** |
| **Pesticide and Insecticide** | **-** | **-** | **-** | **1030** |
| **Irrigation** | **-** | **-** | **-** | **642** |
| **Tunnel Material Cost** | **-** | **-** | **-** | **810** |
| **Interest on Operating Capital at 9%** | **-** | **-** | **-** | **660** |
| **Family Labor Cost** | **Man-days** | **3** | **500** | **1500** |
| **Land Use Cost** | **-** | **-** | **-** | **10414** |

### 6.2.5 Hired Labor Cost

Human labor is required for major activities and management of the selected farms such as land preparation, sowing, weeding, applying fertilizer, mulching, harvesting etc. Human labor is classified into hired labor and family labor categories. The labor of women and children was converted into man-equivalent days by presenting a ratio of 2 children days =1.5 women days =1 man equivalent day. Labor wage rate varies concerning different regions and conditions. In the study area, the computed average rate was Tk. 500 per man-days for tomato production. The wage rate was fixed for different types of activities. The cost of hired labor is presented in Table 6.4 where the hired labor cost per acre was Tk.6000 for all farm categories.

**Table 6.3: Per Acre Cost of Tomato Cultivation for Large Farms in the Study Area**

| Cost Items | Unit | Quantity | Rate (Tk./unit) | Cost (Tk./unit) |
|---|---|---|---|---|
| **Land Preparation** | **-** | **-** | **-** | **2244** |
| **Seed** | **gm** | **24** | **60** | **1433** |
| **Manure** | **Kg** | **750** | **0.5** | **372** |
| **Cost of Fertilizer** | **-** | **-** | **-** | **4019** |
| **a) Cost of Urea** | **Kg** | **116.5** | **16** | **1865** |
| **b) Cost of TSP** | **Kg** | **58** | **22** | **1282** |
| **c) Cost of MoP** | **Kg** | **54.5** | **16** | **872** |
| **Hired Labor Cost** | **Man-days** | **12** | **500** | **6000** |
| **Pesticide and Insecticide** | **-** | **-** | **-** | **1040** |
| **Irrigation** | **-** | **-** | **-** | **605** |
| **Tunnel Material Cost** | **-** | **-** | **-** | **802** |
| **Interest on Operating Capital at 9%** | **-** | **-** | **-** | **663** |
| **Family Labor Cost** | **Man-days** | **3** | **500** | **1500** |
| **Land Use Cost** | **-** | **-** | **-** | **10414** |

### 6.2.6 Insecticide and Pesticide Cost

Farmers of the study area used pesticide computed on the basis of the price actually paid by the farmers. However, many farmers did not have proper knowledge about the exact quantity to be applied and the brands name of the pesticides. It was found that per acre cost of pesticides and insecticides for tomato production under small, medium and large farms were Tk.1105, Tk. 1130, and Tk. 1140 respectively (Table 6.4).

### 6.2.7 Irrigation Cost

Almost all the farmers in the study area used irrigation in their fields. The cost of irrigation water was charged at a fixed rate of the unit of area. It was found that the per acre cost of irrigation for tomato production under small, medium and large farms were Tk.686, Tk.642 and Tk.605 respectively. The cost of the large farm for irrigation was lower than small and medium farms (Table 6.4).

**Table 6.4: Per Acre Cost of Tomato Cultivation in the Study Area**

| Cost Items | Small Farm | Medium Farm | Large Farm | Average |
|---|---|---|---|---|
| Land Preparation | 2480 | 2234 | 2244 | 2319 |
| Seed | 1428 | 1467 | 1405 | 1433 |
| Manure | 395 | 358 | 372 | 375 |
| Cost of Fertilizer | 4395 | 3871 | 4019 | 4095 |
| a) Cost of Urea | 1956 | 1810 | 1865 | 1877 |
| b) Cost of TSP | 1455 | 1235 | 1282 | 1324 |
| c) Cost of MoP | 984 | 826 | 872 | 894 |
| Hired Labor Cost | 6000 | 6000 | 6000 | 6000 |
| Pesticide and Insecticide | 1105 | 1030 | 1040 | 1058 |
| Irrigation | 686 | 642 | 605 | 644 |
| Tunnel Material Cost | 816 | 810 | 802 | 809 |
| Interest on Operating Capital at 9% | 699 | 660 | 663 | 674 |
| **Total Variable Cost** | 22399 | 20943 | 21169 | 21504 |
| Family Labor Cost | 2500 | 1500 | 1500 | 1833 |
| Land Use Cost | 10414 | 10414 | 10414 | 10414 |
| **Total Fixed Cost** | 12914 | 11914 | 11914 | 12247 |
| **Total Cost** | 35313 | 32857 | 33083 | 33751 |

(Source: Field Survey, 2020)

### 6.2.8 Tunnel Material Cost

A part of the expenses of tomato farmers was incurred in purchasing tunnel materials like bamboo, nylon, polythene etc. Cost of staking was also included here. For the small, medium and large farms, the cost of tunnel material was Tk.816, Tk.810, Tk.802 respectively.

### 6.2.9 Interest on Operating Capital

The interest on operating capital was calculated by taking into account all the operating costs incurred during the cultivation period of tomato with 9% interest rate. Interest on

operating capital for tomato cultivation under small, medium and large farms was estimated at Tk.699, Tk.660 and Tk.663 per acre respectively (Table 6.4).

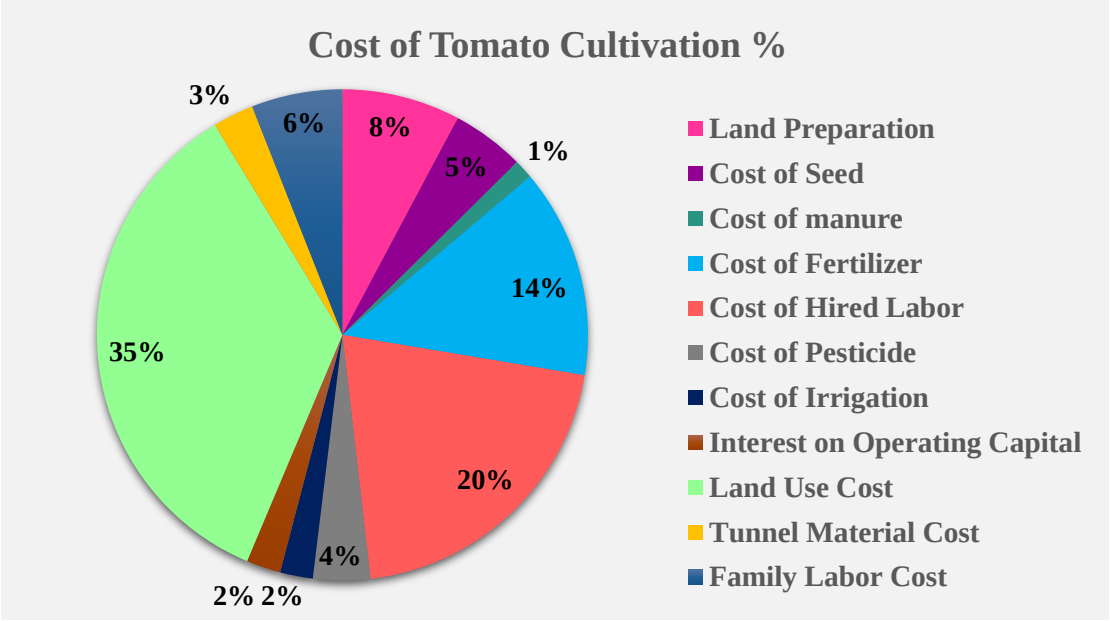


**Figure 6.1: Percentage Share of Different Cost Items in Tomato Cultivation** (Source: Field Survey, 2020)

### 6.2.10 Total Variable Cost

In the experimental area, the total variable costs (TVC) varied from year to year. Total variable cost was estimated adding all the variable costs such as hired labor cost, mechanical power cost, seed cost, cost of chemical fertilizer like Urea, TSP, MoP, cost of pesticides & insecticides, tunnel material cost, cost of irrigation etc. In farm category total variable cost was Tk.22399, Tk.20943 and Tk.21169 per acre for small, medium and large farm tomato cultivation respectively (Table 6.4).

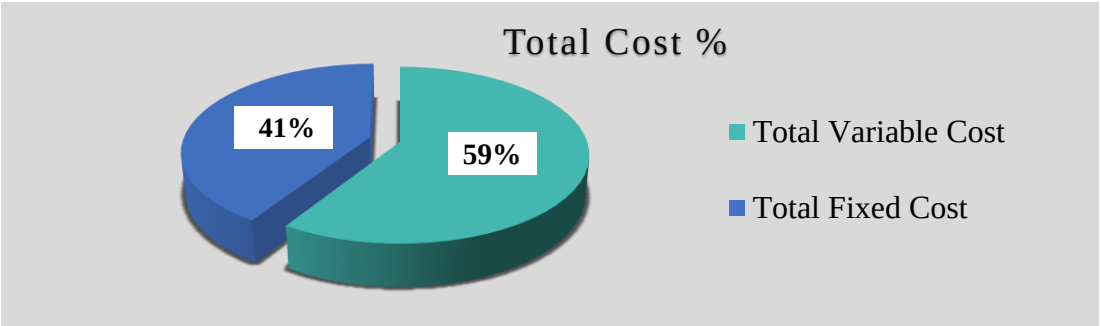


**Figure 6.2: Share of Variable Cost and Fixed Cost to Total Cost of Tomato Cultivation (**Source: Field Survey, 2020)

### 6.2.11 Family Labor Cost

The family labor cost per acre was Tk.1808 for all farm categories. It was highest for the small farm category which was Tk.2500 and the large farm and the medium farm was Tk.1500.

### 6.2.12 Land Use Cost

The price of land was different for different plots depending upon the location and topography of the soil. The cost of land used was estimated by the cash rental value of the land. In computing the rental value of land for the land used cost, it was calculated according to the farmer's statement. Per acre land use cost of tomato cultivation was Tk.10414 under small, medium and large farms (Table 6.1).

### 6.2.13 Total Fixed Cost

Total fixed cost (TFC) was the summation of all fixed costs which was land use cost and family labor cost. In the study area, it was estimated that the small farm incurred the highest amount of fixed cost which was Tk. 12914 and the large farm and the medium farm was Tk.11914 per acre (Table 6.4). The total fixed cost was 59% of the total cost (Figure 6.2).

### 6.2.14 Total Cost of Tomato Cultivation

Total cost (TC) was the summation of total variable cost and total fixed cost. In the study area, per acre cost of tomato production was Tk.33751 for all farm categories. Total cost was highest for small farm (Tk.35313) followed by large farm (Tk.33083) and medium farm (Tk.32857) (Table 6.1). From the Figure 6.2, The average TFC (59% of TC) was higher than the average TVC (41% of TC) in the study area. The Figure 6.1 shows that, among all the cost items, the respondent farmers paid highest for the land use (35%) and the hired labor (20%).

## 6.3 Returns from Tomato Cultivation

The main aim of the **c**ultivation of tomato, like all other businesses is to earn profit by selling fresh tomato. This section aims to estimate the gross return, net return (Profit) and BCR from the tomato **c**ultivation in the study area.

**Table 6.5: Per Acre Profitability and Benefit-Cost Ratio of Tomato Cultivation in the Study Area**

| Item | Small Farm | Medium Farm | Large Farm | Average |
|---|---|---|---|---|
| **Production (kg/acre)** | 3870 | 3720 | 3690 | 3760 |
| **Price (Tk/kg)** | 16 | 16 | 16 | 16 |
| **Gross Return, GR** | 61920 | 59520 | 59040 | 60160 |
| **Total Variable Cost, TVC** | 22399 | 20943 | 21169 | 21504 |
| **Total Fixed Cost, TFC** | 12914 | 11914 | 11914 | 12247 |
| **Total Cost, TC = (TVC+TFC)** | 35313 | 32857 | 33083 | 33751 |
| **Net Return = (GR–TC)** | 26607 | 26663 | 25957 | 26409 |
| **Gross Margin = (GR–TVC)** | 39521 | 38577 | 37871 | 38656 |
| **Benefit-Cost Ratio = (GR/TC)** | 1.75 | 1.81 | 1.78 | 1.78 |

(Source: Field Survey, 2020)

### 6.3.1 Gross Return

Per acre gross return of tomato production under small, medium and large farms are shown in Table 6.5. Gross return per acre consisted of the value of main product. Per acre return was calculated by multiplying the total amount of products by their respective average market price. The average market price of tomato was Tk. 16 per kg. Per acre gross return of tomato cultivation under small, medium and large farms were Tk. 61920, Tk. 59520 and Tk. 59040 respectively which indicates that per acre gross return of small farms were higher than the medium and large farms (Table 6.5).

### 6.3.2 Gross Margin

Per acre gross margin of tomato production under small, medium and large farms are given in Table 6.5. Gross margin was estimated as the difference between gross return and total variable cost. For short run analysis as well as for farm planning, the gross margin analysis is widely used and this analysis is easily understandable to the farmers because of its simplicity. Table 6.5 shows that per acre gross margin of tomato cultivation under small, medium and large farms were Tk.39521, Tk.38577 and

Tk.37871 respectively. It indicates that the gross margin was highest in small farms followed by the medium and large farms.

### 6.3.3 Net return

Net return was measured by substituting the total cost from the gross return. Table 6.5 shows that per acre net return of tomato cultivation under small, medium and large farms were Tk.26607, Tk.26663 and Tk.25957 respectively, which indicates that net return was highest in the medium farms.

### 6.3.4 Benefit-Cost Ratio

Return over per Taka investment or Benefit-cost-ratio (undiscounted) was calculated as a ratio of gross return to total cost. It describes the financial efficiency of the farm. Table 6.5 shows that per acre benefit cost ratio (BCR) of tomato cultivation under small, medium and large farm were 1.75, 1.81 and 1.78 respectively; implying that production of tomato under medium farms was more profitable than the small and large farms. The BCR of cultivation of tomato was 1.78 for all farm categories.

## 6.4 Conclusion

Profitability of a crop cultivation depends on yield, price of the product and cost of inputs as well. Any variation in the above factors will change the profitability. It is changed over time, place and management level. On the basis of above discussion, it could be concluded that the cultivation of tomato is profitable. As, tomato cultivation is a labor-intensive enterprise, farmers have a great potential to use their idle family labor and increase their earnings. However, it can be concluded that the cultivation of tomato would help farmers to earn more household income.

# CHAPTER 7
# RESOURCE USE EFFICIENCY OF TOMATO CULTIVATION

## 7.1 Introduction

This chapter has been created to present a quantitative relationship between some key inputs and the output of tomato cultivation in the framework of functional analysis. To determine the effects of selected inputs on the cultivation of Tomato, Cobb Douglas production function was chosen based on the best fit.

## 7.2 Tomato Production and Relative Factors

Tomato production function refers to the relationship between the inputs of factor services and the output of cultivation of tomato. Cultivation of tomato was considered to be explained by several inputs namely seed cost, land preparation cost, human labor cost, fertilizer cost, manure cost, pesticide cost and irrigation cost.

### 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:

$$Y= a\ X_1^{b_1}\ X_2^{b_2} X_3^{b_3} X_4^{b_4} X_5^{b_5} X_6^{b_6} X_7^{b_7} X_8^{b_8} X_9^{b_9}\ e^{U_i}$$

The function transformed into the following log liner form:

$$\ln Y = Ina+b_1InX_1+b_2InX_2+b_3InX_3+ b_4InX_4+b_5InX_5+b_6InX_6+b_7lnX_7+b_8\ lnX_8+b_9\ ln\ X_9+U_i$$

Where, Y = Gross return (Tk./acre);

a = Constant or intercept value;

$X_1$ = Cost of labor (Tk./acre);

$X_2$ = Cost of land preparation (Tk./acre);

$X_3$ = Cost of seed (Tk./acre)

$X_4$ = Cost of Urea (Tk./acre)

$X_5$ = Cost of TSP (Tk./acre)

$X_6$ = Cost of MoP (Tk./acre)

$X_7$ = Cost of manure (Tk./acre)

$X_8$ = Cost of irrigation (Tk./acre)

$X_9$ = Cost of Pesticide (Tk./acre)

$U_i$ = Error term;

i = 2, 3,.....9;

$b_1$, $b_2$, $b_3$, $b_4$, $b_5$, $b_6$, $b_7$, $b_8$, $b_9$ = Regression co-efficient of respective variables

ln =Natural log.

### 7.3 Interpretation of Results

- F-value was used to measure the goodness of fit for accepted types of inputs.
- The coefficient of multiple determinations ($R^2$) indicates the total variations of dependent variables explained by the independent variables included in the model.
- Coefficients were tested for significance level at 1 percent, 5 percent and 10 percent levels of significance.
- Stage of production was estimated by using returns to scale which was the summation of all the production elasticity of various inputs.

### 7. 3.1 Cost of labor ($X_1$)

The co-efficient for human labor was 0. 056 and was positive and insignificant for tomato cultivation.

### 7.3.2 Cost of land Preparation ($X_2$)

It is evident from Table 7.1 that the coefficient of land preparation cost was 0.248 which was significant at 5 percent level for tomato production. That means, 1 percent in cost of this input keeping other factors constant would result in an increase of gross return by 0.248 percent.

### 7.3.3 Cost of seed ($X_3$)

The estimated co-efficient of seed was 0.195 which was significant at 5 percent level for tomato production. This indicates that an increase of 1 percent in cost of this input keeping other factors constant would result in an increase of gross return by 0.195 percent.

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

| Explanatory variables | Coefficient | Standard error | p-value |
|---|---|---|---|
| **Intercept** | 4.358*** | 0.406 | 0.00 |
| **Cost of human labor ($X_1$)** | 0.056 | 0.069 | 0.446 |
| **Cost of land preparation ($X_2$)** | 0.248** | 0.064 | 0.005 |
| **Cost of seed ($X_3$)** | 0.195** | 0.076 | 0.17 |
| **Cost of urea ($X_4$)** | 0.136 | 0.058 | 0.152 |
| **Cost of TSP ($X_5$)** | 0.171* | 0.052 | 0.024 |
| **Cost of MoP ($X_6$)** | 0.019 | 0.029 | 0.738 |
| **Cost of manure ($X_7$)** | 0.093** | 0.019 | 0.004 |
| **Cost of irrigation ($X_8$)** | 0.162 | 0.109 | 0.208 |
| **Cost of Pesticide ($X_9$)** | 0.157 | 0.118 | 0.287 |
| **$R^2$** | 0.874 | | |
| **Adjusted $R^2$** | 0.871 | | |
| **Return to scale** | 1.26 | | |
| **F- value** | 112.23 | | |

(Source: Field Survey, 2020)

Note: *Significant at 10% level,
**Significant at 5% level,
***Significant at 1% level.

### 7.3.4 Cost of Urea ($X_4$)

The estimated value of the co-efficient of urea fertilizer was 0.136 for tomato production and was insignificant.

### 7.3.5 Cost of TSP ($X_5$)

The estimated value of the co-efficient of TSP fertilizer was 0.171 for tomato cultivation and was significant at 10 percent level. It can be said that 1 percent increase in TSP cost keeping other factors constant, would increase the gross returns by 0.171 percent.

### 7.3.6 Cost of MoP ($X_6$)

The estimated value of the co-efficient of MoP fertilizer was 0.019 for tomato farmer and was insignificant.

### 7.3.7 Cost of manure ($X_7$)

The co-efficient of the variable was 0.093 and significant at 5 percent level. This suggests that an additional spending of 1 percent on manure would enable the farmers to earn 0.093 percent of gross return from tomato cultivation.

### 7.3.8 Cost of irrigation ($X_8$)

The estimated value of the co-efficient of irrigation cost was 0.162 and insignificant.

### 7.3.8 Cost of Pesticide ($X_9$)

The estimated value of the co-efficient of pesticide cost 0.157 and insignificant.

### 7.3.9 The Coefficient of Multiple Determinations ($R^2$)

The co-efficient of multiple determinations, $R^2$ was 0.874 for tomato cultivators which indicates that about 87 percent of the total variation in return of tomato production is explained by the variables included in the model. In other words, the excluded variables accounted for 13 percent of the total variation in return of tomato.

### 7.3.10 Adjusted $R^2$

The term adjusted refers to adjusted for the degrees of freedom. The adjusted $R^2$ for tomato production was found to be 0.87 which indicated that about 87 percent of the variations of the dependent variable were explained by the explanatory variables included in the model (Table 7.1).

### 7. 3.11 Goodness of Fit (F-value)

F value finds out how much the explanatory variable does have a significant influence on the dependent variables. The F-value of tomato production was 112.12 implying that all the included explanatory variables were significant for explaining the variation.

### 7. 3.12 Returns to Scale

It is the situation in which output changes when all inputs are changed proportionally. Returns to the scale of tomato production were computed by adding the coefficient of regression of tomato production. For tomato production in farmers the summation of the coefficients was 1.26. This indicated that the production function showed diminishing returns to scale.

### 7.4 Resource Use Efficiency in Tomato Cultivation

To test the resource use efficiency, the mathematical formula is-

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

To identify the status of resource use efficiency, it was considered that a ratio equal to unity indicated the optimum use of that factor, a ratio more than unity indicated that the yield could be increased by using more of the resources. A value of less than unity indicated the unprofitable level of resource use, which should be decreased to minimize the losses because farmers over used this variable. The negative value of MVP indicates the indiscriminate and inefficient use of resource.

Table 7.2 showed that the ratio of MVP and MFC of human labor (0.14) for tomato cultivation was positive and less than one, which indicated that in the study area human labor for tomato cultivation was over-utilized. So, farmers should decrease the use of human labor to attain efficiency level.

The ratio of MVP and MFC of land preparation cost (5.17) for tomato production was positive and more than one, which indicated that in the study area land preparation was under-utilized (Table 7.2). So, farmers should increase the use of land preparation to attain efficiency considerably.

**Table 7.2: Estimated Resource Use Efficiency in Tomato Production**

| Variables | GM | $\frac{Y(GM)}{X_i(GM)}$ | Co-efficient | MVP ($X_i$) | MFC | $\frac{MVP}{MFC}$ | Comment |
|---|---|---|---|---|---|---|---|
| **Human Labor ($X_1$)** | 7399.55 | 2.56 | 0.054 | 0.142 | 1 | 0.142 | Over-utilized |
| **Land Preparation ($X_2$)** | 804.27 | 23.42 | 0.247 | 5.17 | 1 | 5.17 | Under-utilized |
| **Seed ($X_3$)** | 2378.86 | 7.94 | 0.195 | 1.54 | 1 | 1.54 | Under-utilized |
| **Urea ($X_4$)** | 1327.67 | 14.21 | 0.136 | 1.98 | 1 | 1.98 | Under-utilized |
| **TSP ($X_5$)** | 3239.32 | 5.83 | 0.171 | 0.98 | 1 | 0.98 | Over-utilized |
| **MoP ($X_6$)** | 1120.61 | 16.81 | 0.018 | 0.32 | 1 | 0.32 | Over-utilized |
| **Manure ($X_7$)** | 993.71 | 18.62 | 0.091 | 1.76 | 1 | 1.76 | Under-utilized |
| **Irrigation ($X_8$)** | 1123.95 | 16.78 | 0.163 | 2.71 | 1 | 2.71 | Under-utilized |
| **Pesticide ($X_9$)** | 908.66 | 20.76 | 0.157 | 3.25 | 1 | 3.25 | Under-utilized |
| **Yield (Y)** | 18852.16 | | | | | | |

(Source: Field Survey, 2020)

The ratio of MVP and MFC of seed was found to be 1.54 for tomato cultivation was positive and more than one, which indicated that in the study area use of seed for tomato production was under- utilized (Table 7.2). So, farmers should increase the use of seed for tomato production to attain efficiency considerably

It was evident from the Table 7.2 that the ratio of MVP and MFC of urea (1.98) for tomato cultivation was positive and more than one, which indicated that in the study

area use of urea for tomato cultivation was under-utilized. So, farmers should increase the use of urea to attain efficiency in tomato cultivation.

The ratio of MVP and MFC of TSP (0.98) for tomato cultivation was positive and less than one, which indicated that in the study areas use of TSP for tomato cultivation was over-utilized (Table 7.2). So, farmers should decrease the use of TSP to attain efficiency 44 considerably.

It was evident from the Table 7.2 that the ratio of MVP and MFC of MoP (0.32) for tomato cultivation was positive and less than one, which indicated that in the study area use of MoP for tomato cultivation was over-utilized. So, farmers should decrease the use of MoP to attain efficiency in tomato cultivation.

Farmer should use recommended dose of fertilizer for better result. According to the Soil Resource Institute of Bangladesh in the Mymensingh region for tomato cultivation, Urea should be used 88kg 300 gm per acre land and applied 15 days and 35 days after planting. TSP should be used 7kg 300 gm per acre land and applied during land preparation. MoP should be used 40kg 900 gm per acre land and applied during land preparation.

It was evident from the Table 7.2 that the ratio of MVP and MFC of manure (1.76) for tomato cultivation was positive and more than one, which indicated that in the study area use of manure for tomato cultivation was under-utilized. So, farmers should increase the use of urea to attain efficiency in tomato cultivation.

Table 7.2 revealed that the ratios of MVP and MFC of irrigation used for tomato cultivation was positive and more than one (2.71), which indicated that the application of irrigation was under-utilized. So, farmers should increase the use of irrigation to attain efficiency in tomato cultivation.

It was evident from the Table 7.2 that the ratio of MVP and MFC of pesticide (3.25) for tomato cultivation was positive and more than one, which indicated that in the study area use of pesticide for tomato cultivation was under-utilized. So, farmers should increase the use of pesticide to attain efficiency in tomato cultivation.

## 7.5 Conclusions

It is evident from the Cobb-Douglas production function model that the included key variables had significant and positive effect on tomato production except the positive and insignificant effect of human labor cost, urea cost, MoP cost, irrigation and pesticide cost. Resource use efficiency indicated that all of the resources were under used for tomato production except over utilization of human labor cost, TSP cost and MoP cost. So, there is a positive effect of key factors in the production process of tomato cultivation.

# CHAPTER 8
# PROBLEMS OF TOMATO CULTIVATION

## 8.1 Introduction

Tomato is one of the most important vegetable crops receiving much attention from researchers throughout the world. Tomato farmers are facing production and financial uncertainty where management of these risks is greatly influenced by their attitudes towards risk. So, the objective of this study is to find out the risk attitude and profitability of tomato farmers in Bangladesh.

## 8.2 Economic Problems

### 8.2.1 High Wage of Hired Labor

Tomato production is labor intensive as additional labor days are required to cultivate one acre of vegetables in one season. About 84 percent of Mymensingh Sadar Upazilla and 78 percent of Gauripur Upazilla and a total of about 81 percent of farmers reported this problem. Because of improving labor wage rates and decreasing supply of agricultural laborer, farmers have to pay a huge amount of money for labor. (Table 8.1)

### 8.2.2 High Price of Tunnel Materials

A major part of the expenses of tomato farmers was incurred in purchasing tunnel materials like bamboo, nylon, polythene etc. Recently tunnel material price has gone up and it is disrupted the tomato production in the study area. Table 8.1 shows that a total of 65 percent of farmers reported these problems were 60 percent from Mymensingh Sadar Upazilla and 59 percent from Gauripur Upazilla.

### 8.2.3 Low Price of Output

Table 8.1 shows that 55 percent of farm owners reported this problem among which 51 percent and 60 percent included Mymensingh Sadar Upazilla and respectively Gauripur Upazilla. At the beginning of the season, the sale price became so high but at later it became so low.

**Table 8.1: Problems Faced by the Tomato Farmers**

| Problems | Mymensingh Sadar | | Gauripur | | All | | Rank |
|---|---|---|---|---|---|---|---|
| | No. | Percent | No. | Percent | No. | Percent | |
| **1. Economic Problems** | | | | | | | |
| **a) High wage of hired labor** | 38 | 84.44 | 35 | 77.78 | 73 | 81.11 | 1st |
| **b) High price of tunnel materials** | 27 | 60 | 32 | 71.11 | 59 | 65.56 | 2nd |
| **c) Low price of output** | 23 | 51.11 | 27 | 60 | 50 | 55.56 | 3rd |
| **d)High prices of input** | 19 | 42.22 | 22 | 48.89 | 41 | 45.56 | 4th |
| **2. Technical Problems** | | | | | | | |
| **a) Shortage of labor in peak period** | 33 | 73.33 | 37 | 82.22 | 70 | 77.78 | 1st |
| **b) Lack of cooperation by block supervisor** | 23 | 51.11 | 25 | 55.56 | 48 | 53.33 | 2nd |
| **c) Lack of quality seed** | 15 | 33.33 | 19 | 42.22 | 34 | 37.78 | 3rd |
| **d) Lack of technological knowledge** | 10 | 22.22 | 7 | 15.56 | 17 | 18.89 | 4th |
| **3. Natural Problems** | | | | | | | |
| **a) Non-suitable temperature** | 43 | 95.56 | 39 | 86.67 | 82 | 91.11 | 1st |
| **b) Seasonal change** | 27 | 60 | 24 | 53.33 | 51 | 56.67 | 2nd |
| **c) Attack of insect and disease** | 22 | 48.89 | 23 | 51.11 | 45 | 50 | 3rd |
| **4. Marketing Problems** | | | | | | | |
| **a) Selling problem** | 33 | 73.33 | 36 | 80 | 69 | 76.67 | 1st |
| **b) Storage problem** | 29 | 64.44 | 31 | 68.89 | 60 | 66.67 | 2nd |
| **c) Transportation problem** | 13 | 28.89 | 11 | 24.44 | 24 | 26.67 | 3rd |

(Source: Field Survey,2020)

### 8.2.4 High Prices of Input

Table 8.1 shows that 46 percent of farmers faced the problem of higher input prices. Among different regions of farmers, 42 percent of the farmers from Mymensingh Sadar Upazilla followed by 49 percent of farmers from Gauripur Upazilla faced the problem of high input price during tomato cultivation.

## 8.3 Technical Problems

### 8.3.1 Shortage of Labor in Peak Period

The production of tomato largely depends on the use of adequate skills and quantity of labor. In the study area, the Shortage of hired labor was found high during the harvest season. Table 8.1 shows that about 78 percent of all farmers complained that they did not get an adequate amount of labor during the period of land where were found 73 percent in Mymensingh Sadar Upazilla and 82 percent were found in Gauripur Upazilla.

### 8.3.2 Lack of Cooperation by Block Supervisor

In the study area, farmers complained that they did not get help from the block supervisor and also reported that they did not get proper help from the agricultural assistance from their region. Table 8.1 shows that 51 percent of Mymensingh Sadar Upazilla farmers and 56 percent of Gauripur Upazilla farmers did not get cooperation from the block supervisors. In total, about 53 percent of all farmers reported that they did not get support from BS in proper time. As a result, lack of cooperation by block supervisor ranked 2nd most concerning problem among all technical problems.

### 8.3.3 Lack of Quality Seed

Table 8.1 shows that 33 percent of farmers from Mymensingh Sadar Upazilla and 42 percent of farmers from Gauripur Upazilla reported the problem of lack of quality seed. In the study area all about 38 percent of farmers faced this problem.

### 8.3.4 Lack of Technological Knowledge

In the study area table, 8.1 shows that 22 percent of farmers from Mymensingh Sadar Upazilla and 16 percent of farmers from Gauripur Upazilla reported the problem of lack of knowledge of improved technology. About 19 percent of all farmers faced this problem.

### 8.4 Natural Problems

#### 8.4.1 Non-suitable Temperature

In recent years, the temperature is increasing day by day which is creating problems for farmers during crop production. In the study area, Table 8.1 shows that 95 percent of farmers from Mymensingh Sadar Upazilla and 87 percent of farmers from Gauripur Upazilla reported that they observed this problem. About 91 percent of all farmers reported this problem. This ranked 1st most acute problem among all the natural problems.

#### 8.4.2 Seasonal Change

Unexpected seasonal change is a severe problem for the agricultural sector. Table 8.1 shows that 60 percent of farmers from Mymensingh Sadar Upazilla and 53 percent of farmers from Gauripur Upazilla reported this problem. About 57 percent of all farmers reported this problem.

#### 8.4.3 Attack of Insect and Disease

Table 8.1 shows that 49 percent of farmers from Mymensingh Sadar Upazilla and about 51 percent of farmers from Gauripur Upazilla reported that they observed insect and diseases problems. About 50 percent of all farmers reported this problem.

### 8.5 Marketing Problems

#### 8.5.1 Selling Problem

Selling problem ranked most acute problem among all the marketing problems. According to the study area table, 8.1 shows that 73 percent of farmers from Mymensingh Sadar Upazilla and 80 percent of farmers from Gauripur Upazilla reported that they did not sell their product flexibly because of the intervention of middlemen in the market. All about 77 percent of farmers reported this problem.

#### 8.5.2 Storage Problem

Large number of farmers faced this problem after harvesting period. In the study area, table 8.1 shows that 64 percent of farmers from Mymensingh Sadar Upazilla and 69 percent of farmers from Gauripur Upazilla reported that they did not get a proper storage facility. All about 67 percent of all farmers reported this problem.

### 8.5.3 Transportation Problem

As tomato is a perishable good without timely delivery to consumer the quality of this vegetable decreases. In the study area, transportation problem is a major problem as table 8.1 shows that 29 percent of farmers from Mymensingh Sadar Upazilla and about 24 percent of farmers from Gauripur Upazilla reported that they did not get proper transportation facilities. About 27 percent of all farmers reported this problem.

## 8.6 Solution for the Problems

After studying the mentioned area, the above problems were found and the following possible solutions could be taken according to farmers' opinion.

### 8.6.1 Solution for Economic Problems

Tomato is one of the most potential sub-sectors of vegetables in Bangladesh. Thus, for the national interest, the government should provide financial credit support to the farmers. About 75.56 percent of farmers talked about this as the first solution to economic problems. Again, about 72.22 percent reported that government should fix a price limit for tomato farmers to get rid of the problem of price fluctuation of tomatoes.

### 8.6.2 Solution for Technical Problems

About 81.11 percent of the respondents suggested that government and NGOs should take steps for training on increasing tomato production by dint of using modern equipment where they rank 1$^{st}$ solutions of their technical problems. Again, 58.89 percent think that extension workers should pay immediate attention to this matter for the improvement of the traditional method of tomato production.

### 8.6.3 Minimizing Natural Problem

For solving natural problems, about 91.11 percent of farmers agreed to comply with the prevention strategy that the government has come up with. To overcome disease and irrigation problems, about 51.11 percent suggested teaching the scientific use of chemicals and supplementary supply of artificial irrigation in the dry season by extension workers.

### 8.6.4 Solution for Marketing Problem

About 85.56 percent suggested that government should increase and create the storage facility as it is a rotational crop. Again, about 73.33 percent of respondents suggested that a good processing facility should be encouraged as it has high demand all over the world. Also, about 35.56 percent suggested transportation facilities.

## 8.7 Conclusion

From the above discussion, most of the farmers were reported that high labor price was the main constraint for their tomato production. And this problem occupies the first position according to the ranking position. But there is some inconsistency in the opinion of respondents. Other reports and research journals showed that tomato diseases and cloggy weather in the winter season were the main constraints hampering tomato production. If proper insecticide and availability of tunnel material at the right time can be ensured, then the production can be increased significantly and thus the farmers may be benefited.

# CHAPTER 9
# SUMMARY AND CONCLUSION

## 9.1 Introduction

This chapter illustrates the overview of the discussions made in the earlier chapters. The conclusion is done based on the empirical outcome. Policy recommendations are offered for the progress of the current inefficiency of tomato cultivation in Bangladesh.

## 9.2 Summary

Tomato has become an important vegetable in Bangladesh owing to its higher yield, nutritional value and versatile uses. The demand for tomato in Bangladesh is experiencing day by day due to the increasing population. Higher cultivation of tomato depends on the expansion of High Yielding Varieties (HYV) and hybrid variety of seed, improved management and timely supplying of inputs. The rate of adoption of modern technology and sustainability of tomato production depends largely on its marketing and economic profitability. The efficient use of resources is an important factor in increased production in agriculture. Tomato grows within a short period where intercropping is possible with other crops.

The field study was conducted in the Mymensingh Sadar and Gauripur Upazilla of Mymensingh district during the period from April 2020 to June 2020 to find out the profitability and resource use efficiency of tomato production. A simple random sampling technique was used for data and information from a total of 90 farmers (Kolapara-25, Konapara-20, Tanguripara- 25 and Baliapara-20) who are cultivating different varieties of tomato. The farms were also categorized based on farm sizes which were small, medium and large farms. All the collected data were summarized to eliminate all outstanding errors. Data were presented mostly in the tabular form where descriptive statistics like average, percentage etc. were followed to analyze the data to reach the objectives of the study. Functional analysis was used to achieve the expected findings. A Cobb-Douglas production function was used also to estimate the factors affecting the cultivation of tomato.

The half of the tomato farmers fell in the 36-50 years age, while 24% of them fell in the above 50 years age category and 26% in the 20-35 years age category. The majority

(52%) of the farmers had secondary level of education compared to 20% of them having primary level of education. About 9% of the farmers were illiterate and 8 percent of the farmers were above secondary level of education. The highest proportion 55% of the tomato farmers had 11-25 years' experience in Mymensingh Sadar Upazilla, while 52% of them had 1-10 years' experience in Gauripur Upazilla. The highest proportion (81%) of the respondents only involved in agriculture while in Gauripur Upazilla, it was 74%. The majority of the 54 percent of the tomato farmers in Mymensingh Sadar Upazilla had of 5-7 members compared to 45% farmers in Gauripur Upazilla having more than 7 family members. About 61.2% farmers of the study area was own funded and 38.8% farmers received credit.

Total cost of land preparation for tomato cultivation under small, medium and large farm were Tk.2480, Tk.2234 and Tk.2244 respectively. Per acre cost of seed for tomato under small, medium and large farm were Tk.1428, Tk.1467 and Tk.1405 respectively. The total cost of manure for tomato cultivation was found to be Tk.395, Tk.358 and Tk.372 per acre. Under small, medium and large farm total cost of fertilizer were Tk.4395, Tk.3871 and Tk.4019. From the result it may be concluded that total cost of fertilizer for small farm was higher and followed by large and medium farms. Hired labor cost per acre was Tk.6000 for all farm category. Family labor cost was highest for small farm category which was Tk.2500 and Tk.1500 for large farm and medium farm. It was found that per acre cost of pesticides for tomato production under small, medium and large farm were Tk.1105, Tk.1130, and Tk.1140 respectively. It may be concluded that cost of pesticide for large farm size was higher than the small and medium farms. The irrigation cost for small, medium and large farm were Tk.686, Tk.642 and Tk.605 respectively. Interest on operating capital for tomato production was estimated at Tk.699, Tk.660 and Tk.663 per acre respectively. In farm category total variable cost was Tk.22399, Tk.20943 and Tk.21169 per acre for small, medium and large farm tomato cultivation respectively. Per acre land use cost of tomato cultivation were Tk.10414 under small, medium and large farms. In monetary terms small farm incurred highest amount of fixed cost which was Tk.12914 followed by large farm and medium farm Tk.11914 per acre. Per acre cost of tomato production was Tk. 33751 for all farm categories in the study area. Total cost was_highest for small farm (Tk.35313) followed by large farm (Tk.33083) and medium farm (Tk.32857). The average market price of tomato was Tk. 16 per kg. Per acre gross return of tomato

cultivation under small, medium and large farms were Tk.61920, Tk.59520 and Tk.59040 respectively which indicates that per acre gross return of small farms were higher than large and medium farms. Per acre gross margin of tomato cultivation under small, medium and large farms were Tk.39521, Tk.38577 and Tk.37871 respectively. Per acre net return of tomato cultivation under small, medium and large farms were Tk.26607, Tk.26663 and Tk.25957 respectively, which indicates that net return was highest in medium farms. Per acre benefit cost ratio (BCR) of tomato cultivation under small, medium and large farm were 1.75, 1.81 and 1.78 respectively. So BCR of medium farm was highest.

In this study, Cobb-Douglas production function model was used to determine the effects of key variable inputs. The most important nine explanatory variables were included in the model to explain the gross income or return of tomato cultivation. Most of the variables in the production function were significant in explaining the gross return except the positive and insignificant effect of human labor cost, urea, MP, irrigation and pesticides. The coefficient with expected sign indicates the selected inputs contributed positively to the gross return. The values of the coefficient of multiple determination of tomato cultivation were 0.874 which implied that about 87 percent of the total variation in the gross return could be explained by the included explanatory variables of the model. Production function for tomato cultivation exhibits increasing returns to scale (1.26). This means that, if all the variables specified in the model were increased by 1 percent, gross return would also increase by 1.26 percent. The F-value for the tomato cultivation was 112.23. Resource use efficiency indicated that all of the resources were under used for tomato cultivation except overutilization of human labor, TSP and MoP. So, there was a positive effect of key factors in the production process of tomato cultivation.

In the study area, farmers faced various problems in producing tomatoes. Constrains of tomato growing farmers have been broadly categorized into four: Economic Problems, Technical Problems, Natural Problems and Marketing problems. The high price of labor is the most severe problem among all the economic problems. About 81.11 percent of all farmers reported that they did not get labor support at the proper rate in the proper time. It was ranked 1st among all the economic problems. The highest 77.78 percent of farmers reported the problem of shortage of labor as one of the major

technical problems. Among the social problem temperature fluctuation ranked top and selling problems ranked top in the case of marketing problems.

Tomato farmers who identified their problems also suggested measures for the improvement of the existing tomato production and pricing system of farmers, such as; supply of credit on easy terms, supply of inputs and machinery, improvement of transportation facilities, formation of farmers' organization and improvement of market facilities.

### 9.3 Conclusion

Depending on the findings, the key point of this study is that tomato is more profitable in the middle size farm of Mymensingh district. All of the factors particularly seed cost, labor cost, fertilizer cost, insecticide cost, ploughing cost and irrigation cost etc. are very essential for tomato cultivation. Even though farmers were not careful of the suitable doses of inputs that could improve the return of production to some degree, it is necessary to make the farmers aware of the efficient application of resources. If advanced inputs and production techniques were applied efficiently, yield and cultivation of tomato would have been better as well as income. It can elevate the livelihood and health conditions of people. It is, therefore, proposed that irrigation facilities, effective strategy and efficient extension facilities have to be guaranteed to improve socio-economic, income and employment opportunities of the tomato farmers. It is also suggested to bring more fellow land under tomato cultivation in the study areas. Due to increased domestic consumption of tomatoes as human food, the existing and upcoming potential market should be set up through a well-planned tomato production program at the domestic and global levels.

### 9.4 Recommendations

Based on the findings of the study, the following particular suggestions are given for the improvement of tomato production.

- As tomato is a profitable business, authorities and concerned institutions should facilitate sufficient extension programs like training, advertising to broaden their area and production.

- Producers might be motivated to make use of more inputs in tomato production which are under-used and have a positive substantial influence on yield through extension programs. Over-used inputs should be minimal in case of use.
- Proper training on suggested fertilizer dose, insecticides and pesticides, water management practices, use of the good seed, intercultural operations, etc., should be available for the tomato growers which will promote production as well as resource use efficiency by elevating the technical ability of the farmers.

### 9.5 Limitations of the Study

Truth be told, there are some limitations in the study as the study reviewed the farmers of the country through interview schedules.

- Most of the data were collected through interviews of the farmers and sometimes they were not welcoming with the interviewer.
- The information was collected generally through the memories of the growers which were not consistently correct.
- Tomato is sometimes grown without requiring proper attention & practices so the record of the costs or earnings were not recalled by the farmers.
- In the resource and time constraints, wide-ranging and in-depth studies got affected and hampered to some extent.

Due to a lack of data resources and further study, it was not possible to determine the relative benefits of tomato with other vegetables.

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## APPENDIX

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

| Year | Area '000, (Acre) | Production ('000, M. tons) |
|---|---|---|
| **2020-2021** | 72 | 448 |
| **2019-2020** | 70 | 416 |
| **2018-2019** | 70 | 388 |
| **2017-2018** | 70 | 385 |
| **2016-2017** | 68 | 389 |
| **2015-2016** | 67 | 368 |
| **2014-2015** | 76 | 414 |
| **2013-2014** | 66 | 360 |
| **2012-2013** | 65 | 251 |
| **2011-2012** | 63 | 255 |