FINANCIAL PROFITABILITY AND RESOURCE USE EFFICIENCY OF BRINJAL CULTIVATION IN SOME SELECTED AREA OF GAZIPUR DISTRICT

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CERTIFICATE

This is to certify that thesis entitled, **"FINANCIAL PROFITABILITY AND RESOURCE USE EFFICIENCY OF BRINJAL CULTIVATION IN SOME SELECTED AREA IN GAZIPUR DISTRICT"** submitted to the **Department of Agricultural Economics**, Faculty of Agribusiness Management, Sher-e-Bangla Agricultural University, Dhaka-1207, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE** IN **AGRICULTURAL ECONOMICS,** embodies the result of a piece of bona fide research work carried by **MOHAMMAD SHAHADAT HOSSEN** bearing Registration No. **12-04873** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

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

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Dedicated to
My
Beloved Parents

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FINANCIAL PROFITABILITY AND RESOURCE USE EFFICIENCY OF BRINJAL CULTIVATION IN SOME SELECTED AREA OF GAZIPUR DISTRICT

ABSTRACT

The present study was designed to determine the financial profitability and resource use efficiency of brinjal *(Solanum melongena L.)* cultivation in some selected area of Gazipur district. A total of 90 brinjal farmers from three upazila namely Sreepur (30), Kapasia (30), and Kaliakair (30) were selected. Tabular technique and statistical technique such as Cobb douglas production function was used to achieve the major objectives of the study. The major findings of the study revealed that brinjal production was highly profitable. The total cost of production was estimated Tk. 265617, Tk. 262652 and Tk. 252640 per hectare for Sreepur, Kapasia and Kaliakair upazila respectively. The average total cost was Tk. 260303. Total yield per hectare were 268890 kg, 29905 kg and 26812 kg for Sreepur, Kapasia and Kaliakair respectively. The average per unit brinjal price was Tk. 15 for all areas. Gross return for Sreepur, Kapasia and Kaliakair upazila were Tk. 430240, Tk. 418670 and Tk. 402180 respectively. Net return per hectare was Tk. 164623, Tk. 156018 and Tk. 149540 respectively. The average net return was Tk. 157732 per hectare. BCR on full and variable cost were 1.62 and 2.02, 1.60 and 1.98, 1.59 and 2.08 for Sreepur, Kapasia and Kaliakair upazila respectively. The average BCR on full and variable cost were 1.60 and 2.03 which implies that one taka investment generated 0.60 Tk. and 1.03 Tk. respectively. The regression coefficient of hired labor, land preparation, chemical fertilizers, irrigation and pesticide showed positive and significant effect and seedling, manure showed insignificant effect. The coefficient of multiple determinations, R^2 and F-value were 79% and 43.48 which indicated good fit of a model. The ratio of MVP and MFC of hired labor, seedling, land preparation, manure, chemical fertilizers, irrigation and pesticide was 0.54, 4.25, 3.32, -0.06, 2.03, 2.71 and 4.22 respectively. It indicated that farmers in the study areas were over utilizing hired labor, and manure. On the other hand seedling, land preparation, chemical fertilizers, irrigation, and pesticide were underutilized. Farmers faced many problems in the study area during brinjal production. Among them inset infection, higher price of pesticides, lack of quality seedling, high wage rate of labor, lack of human labor were major problems of brinjal cultivation. Supply of inputs and improvement of market facilities can play an important role in increasing brinjal production.

LIST OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATION AND ACRONYMS

AEZ	Agro-Ecological Zone
BARI	Bangladesh Agriculture Research Institute
BARC	Bangladesh Rural Advancement Committee
BAU	Bangladesh Agricultural University
BBS	Bangladesh Bureau of Statistics
BCR	Benefit Cost Ratio
BER	Bangladesh Economic Review
^{0}C	Centigrade
DAE	Department Agricultural Extension
DAP	Di Ammonium Phosphate
et al.	And Others
FAO	Food and Agriculture Organization
FAOSTAT	Food and Agricultural Organization Statistics
GR	Gross Return
GM	Gross Margin
GM	Geometric Mean
Gm	Gram
HYV	High Yielding Varieties
ha	Hectare
IOC	Interest on Operating Capital
Kg	Kilogram
ln	Natural Log
MS	Master of Science
MT	Metric Ton
MOP	Muriate of Potash
NR	Net Return
Tk.	Taka
%	Percentage

SAU	Sher-e- Bangladesh Agricultural University
REG	Registration
Rs	Rupee
t ha^{-1}	Ton per hectare
t	Tons
TSP	Triple Super Phosphate
TVC	Total Variable Cost
TC	Total Cost
US	United State of America
USDA	United States Department of Agriculture
UK	United Kingdom

CHAPTER 1

INTRODUCTION

1.1 General Background of the Study

Agriculture is the largest employment sector in Bangladesh. Agriculture plays an important role in overall economic development of Bangladesh. The performance of this sector has an impact on macroeconomic objectives like employment generation, poverty alleviation and food security. A plurality of Bangladesh earns their living from agriculture. It contributes about 13.60% in national GDP (BER, 2019). Due to gradual transformation of the economy from agriculture to industry and service sectors, this sector decreases gradually around 50% in 1970 to 13.60% in 2019. Despite increase in the shares of fisheries, livestock and forestry, crop sub-sector alone accounts for 52.81% share of agricultural GDP in FY 2018-19 (BER, 2109).

Brinjal is an important and popular vegetable in Bangladesh which is consumed throughout the year. Brinjals are classified into two categories in respect of their production period. These are Rabibrinjal and Kharifbrinjal. Though it is more or less available throughout the year, its peak supply comes during December to April (Mollika, 2015). Brinjal is a good source of vitamins and minerals. Plenty of brinjal are produced in Bangladesh and in 2011-2012; the total production of brinjal was 354 thousand metric tons (BBS, 2012).

The present study is essential for brinjal production in Bangladesh. The study not only emphasizes on the profitability of brinjal production but also establish the relationship between socioeconomic characteristics and problems faced by the brinjal growers. It also identifies crucial problems of brinjal production and ranks those problems which make this research identical. The results of the study will be helpful to the policy maker to formulate future policy considering farmers production problem and the researcher for further study about brinjal. Table 1.1 presents the percentage contribution of agricultural subsectors at total GDP of agriculture.

Table 1.1 Percentage contribution of agricultural subsectors at GDP

Agricultural Subsectors	% contribution of GDP
Crops & Vegetables	**7.05**
Livestock	**1.47**
Fisheries	**3.50**
Forestry	**1.58**
Total	**13.60**

Source: BER, (2019)

1.2 Vegetables Production in Bangladesh

In Bangladesh, more than 60 different types of vegetables of indigenous and exotic origin are grown. At present total vegetables growing area in the country is about 2,25,153 hectares (2.47 acre is equal to a hectare), of which 65% are cultivated during winter (DAE, 2016).People of south Asian country like Bangladesh cannot think of food without adding vegetable. Vegetable have a great demand in Bangladesh. The major crops grown and consumed in Bangladesh are rice, wheat, maize, potato, tomato and brinjal etc. In FY 2016-17, total area under vegetable is 2.67 lac hectares with the total production 1.89 lac metric tons (DAE, 2018) in our country. The production of vegetable can meet up the domestic demand.

Table 1.2 Area and production of vegetables in Bangladesh

Year	Area (Lac ha)	Production (Lac MT)
2009-10	1.73	**1.51**
2010-11	1.87	**1.61**
2011-12	1.98	**1.58**
2012-13	1.96	**1.64**
2013-14	2.13	**1.60**
2014-15	2.19	**1.64**
2015-16	2.25	**1.76**
2016-17	**2.67**	**1.89**

Source: DAE, (2018).

In FY 2016-17, total area under vegetable cultivation and total production of vegetable has increased. Nowadays they are valuable trade crops in the world. Due to huge population demand for cereals, land area under vegetables is also increasing that creating fill up gap between demand and supply of vegetables.

1.3 Origin and Status of Brinjal

Brinjal is a member of the Solanaceae or nightshade family, which includes tomatoes, potatoes, and peppers. Its origin is considered to be india where it continues to grow wild. This spiny, bitter, orange, pea-sized fruit has been cultivated throughout india and china for more than 1500 years (Wikipidia, 2018). Brinjal is one of the earliest cultivated crops because they were less perishable than other foods of the time. Eggplant (US, Australia), aubergine (UK), brinjal (South Asia and South Africa) is a plant species in the nightshade family solanaceae. Solanum melongena is grown worldwide for its edible fruit.

Brinjal is used as a vegetable in most parts of the world. It is commonly used for curry and other savory dishes. There are many different varieties of brinjal. Each one has unique flavor and taste. Among dark purple, brownish purple, black, magenta and black brinjal have more Sulfur compounds.

The total production of brinjal is 5,23,09,119 metric tons up by 2.2% from 5,11,92,811 metric tons in 2016 (FAOSTAT, 2019). China was by far the largest producer of brinjals, according for over 62% of global production. And India was contributed second high production of global world.

Table 1.3 Total productions (MT) of brinjal producing country in 2016-17

Country	2016	2017
China	32883567	**31855430**
India	12510000	**12515000**
Egypt	1307793	**1300265**
Turkey	888917	**854049**
Iran	654149	**671399**
Indonesia	535436	**509749**
Japan	307800	**306000**
Italy	286473	**317585**
Philippines	241901	**235626**
Spain	**225912**	**242643**

Source: FAOSTAT, (2018)

In Bangladesh, brinjal is cultivated in all the years round. But basically brinjal cultivated in winter season. BARI has released many varieties which can be grown in Robibrinjal in winter season and Kharifbrinjal in summer season (Haque, 2015). It is grown more or less in every district of Bangladesh. But brinjal is commercially cultivated in Jamalpur, Narsingdi, Gazipur, Tangial, Khulna, Rajshashi and Dhaka (BBS, 2016). In Gazipur district cultivate three varieties such as kajla, nayantara and uttara. Table 1.4 represent total area and Production of Brinjal by Regions from 2014-15 to 2016-17 in Bangladesh in different regions.

Table 1.4 Area and production of brinjal by regions from 2014-15 to 2016-17

Region	2014-15		2015-16		2016-17	
	Area (ha)	Prod. (MT)	Area (ha)	Prod. (MT)	Area (ha)	Prod. (MT)
Gazipur	1078	1330	1102	1343	1111	1313
Sylhet	731	2794	786	2836	704	2471
Rangpur	6913	19355	6898	20122	6955	21012
Barishal	797	895	733	760	768	892
Chittagang	3884	12428	3886	12412	4008	12761
Dhaka	8655	19240	8504	19841	8128	16758
Khulna	11956	35691	12159	55005	12128	52589
Rajshahi	9482	40291	9918	44128	9727	43834
Bangladesh	**45644**	**139792**	**46068**	**164667**	**45665**	**159891**

Source: BBS, (2018)

The yield of brinjal is 45.58 ton/ha which is very low compared to the other brinjal producing countries (BBS, 2018). A large number of farmers in the study area are engaged in brinjal cultivation because it is profitable compare to other vegetable crops. Total area, production and yield are shown in the following table 1.5.

Table 1.5 Area and production of brinjal in gazipur district

Year	Area (ha)	Production (MT)	Yield(Ton/ha)
2013-14	1011	1289	40.45
2014-15	1078	1330	42.54
2015-16	1102	1343	43.98
2016-17	1111	1313	45.23
2017-18	1178	1413	49.47

Source: BBS, (2014) & (2018)

1.4 Nutritive and Medicinal Value of Brinjal

Brinjal are root vegetable with a variety of benefits. Brinjal also known as aubergines, belong to the nightshade family of plants and are used in many different dishes around the world. Although often considered a vegetable, they are technically a fruit, as they grow from flowering plant and contain seeds. There are many varieties that range in size and color. And while brinjal with a deep purple skin are most common, they can be red, green or even black. The main nutrients in 100 grams of raw onions are given below.

Table 1.6 Nutrients Values and weights of Brinjal (100 gm)

Nutrients	Quantities
Water	**92.30 gm**
Energy	**2kcal**
Protein	**0.98 gm**
Total lipid (fat)	**0.18 gm**
carbohydrate	**5.88 gm**
Fiber	**3.00 gm**
Sugar	**3.53 gm**
Calcium, Ca	**0.009 gm**
Potassium, K	**0.229 gm**
Iron, Fe	**0.00023 gm**
Vitamin C	**0.0022 gm**
Vitamin B6	**0.000084 gm**
Vitamin E	**0.00030 gm**

Source: USDA, (2019)

1.5 Objectives of the Study

The overall objective of the study is to determine profitability and resource use efficiency of brinjal cultivation in some selected area of gazipur district. The objectives of the study are as follows:

I. To identify the socio-demographic profile of the sample farmers;

II. To estimate the cost and returns of brinjal production;

III. To determine the factors affecting the economic return of brinjal cultivation;

IV. To estimate resource use efficiency of selected inputs of brinjal farms;

V. To examine the impact of brinjal cultivation of farmers socio-economic status and

VI. To identify the major problems associated with brinjal cultivation.

1.6 Justification of the Study

Eggplant, known as brinjal in Bangladesh, is a high-value crop that is widely grown and consumed throughout the country. About 150,000 farmers grow brinjal in Bangladesh and it ranks third after patato and rice among crops in the country in terms of quantity consumed (BBS, 2018). It is a critical piece of Bangladesh's food security puzzle. As most of the people in our country are dependent on agriculture, it is essential to diversify crops for the increasing production.

Among the vegetable crops, brinjal plays an important role in the economy of Bangladesh. The climate of Bangladesh is also suitable for brinjal cultivation. There are various reasons for the poor yield rate brinjal in Bangladesh. Most of the brinjal farmers are afraid of investing in brinjal cultivation due to insufficient information on brinjal farming, credit facilities and marketing techniques. While making production decision, they consider cost of production against the yield of the crop.

1.7 Statement of the problems

Bangladesh is an agricultural country. Most of the population of Bangladesh is directly or indirectly dependent on the agricultural sectors and most of the

employment sectors are circled in agricultural base. So we should give more emphasis to the agricultural sector. In our country many kinds of product is cultivated some are directly used for food; some are used industrial sector and so many kinds. I prefer to ananlize the cost of inputs of the different agriculture product, and how the corresponding cost of the production can be economic model. When an innovation is introduced to the farmer, it may be readily accepted, partly accepted, completely or partly rejected or sometimes, it may so happen that the adoption of innovation is discontinued or totally stopped. These happening are certainly due to a number of factors.

- To what extent of brinjal production has been adopted by the brinjal growers?
- What are the characteristics of brinjal growers?
- What are the relationships of the adoption of brinjal production technologies with some selected characteristics of the brinjal growers?

1.8 Limitations of the Study

There were some limitations during the survey conducting period. The researcher had to face the following problems in collecting data from the field.

I. Farmers did not keep any records of their farming. So, most of the answers were from their memory.
II. Sometimes respondents could not answer to questions accurately.
III. Farmers provided data in local units of measures in response to questions.
IV. Sometimes respondents did not cooperate willingly to provide information. So researcher had to put extra effort during the interview.
V. Most of the farmers did not have any knowledge about research study. Therefore, it was difficult to explain.
VI. Most of the brinjal farmers, in the study areas were middle aged group and they got primary level of education.

CHAPTER 2

REVIEW OF LITERATURE

The review of literature in any research is necessary because it provides knowledge and information relevant to the proposed study. By reviewing past research paper, it gives a guideline on how to design the future research paper properly. Some of the studies may not entirely relevant to the present study, but their findings, methodology of analysis and suggestions have a great impact on the present study. Review of some research works relevant to the present study, have been discussed below.

Chowdhury (2011) concluded that commercial vegetable growers of Gazipur district earned the highest profit than small scale vegetable growers. He showed that per hectare BCR of brinjal, bitter gourd, and teasle gourd production in small scale were 1.91, 1.46, and 1.63 respectively where BCR in commercial scale production were 2.35, 1.73, and 1.95 respectively. Cobb Douglas production function model revealed that small scale growers allocated their resource in the zone of decreasing returns and commercial growers in the zone of increasing returns.

Habib et al. (2015) carried out an experiment on technical efficiency and profitability of brinjal production in some selected areas of Bangladesh. The net return was Tk. 16459.7 and per hectare yield was 30704 kg. The coefficients of human labor, seeds, irrigation water were positive which had positive effect on brinjal production. In technical inefficient model experiment, farm size, training had negative coefficients which help in reducing technical inefficiency.

Hasan *et al.* (2014) examined the profitability of important summer vegetables namely bottle gourd, brinjal, and cucumber in Keranigonj upazilla. The study found that the benefit cost ratios (BCR) considering variable cost were 2.83, 4.88 and 4.57 for bottle gourd, brinjal and cucumber respectively. The highest BCR was for brinjal (3.72) and the lowest for bottle gourd (2.40) on the basis of total cost. Major problems identified by the study were lack of capital, low price of output, high price of input, price fluctuation, and lack of storage facilities etc.

Hasan (2010) conducted an economic study on brinjal production in selected areas of Bangladesh. Per hectare yields of brinjal were 26217 kg, 28202 kg and 30637 kg for small, medium and large farmers. In technical inefficient model farm size was significant but showed negative sign which means that larger farm holdings were technically efficient.

Islam (2000) carried out a study on economic analysis of winter vegetables like brinjal, cabbage, radish and tomato in three villages of Sadar thana under Mymensingh district. However he showed that for producing these winter vegetables, per hectare cost was the highest for cabbage followed by brinal, radish and tomato. On the other hand per hectare yield was the highest for brinjal followed by cabbage, tomato and radish which were Tk. 80240.00, Tk. 60540.00, Tk. 45353.00. and Tk. 44751.90 respectively.

Islam *et al.* (2000) analyzed the productivity and resource use efficiency of potato production using TPS technology in the farmer's field in district of Bogra and Jessore of Bangladesh. The TPS technology found to have a higher benefit-cost ratio (BCR) than the traditional technology. It was revealed from the efficiency analysis that the potato growers using TPS technology allocated their resources in rational stage of production. However, there existed inefficiency in the uses of human labor, seed, manure and fertilizers in TPS technology and had a potentiality to increase potato output by 20 percent with efficient organization of these resources.

Kamal et al. (2017) attempted to estimate the profitability, domestic resource cost and problems of brinjal production. They study revealed that total costs of brinjal production per hectare were about Tk. 240097 and Tk. 216831 in Pabna and Jhenaidah district respectively. BCR was 2.02 and 1.83 which indicated profitable brinjal production. Domestic resource cost was 0.47 and 0.52 in Pabna and Jhenaidah. This showed that Bangladesh has comparative advantages in brinjal production.

Khandoker (2013) conducted a study to assess the profitability, resource use efficiency, and factors affecting the production of brinjal, bean, and radish. The benefit cost ratio on full cost basis for brinjal, country bean and radish were 1.86,

1.42 and 1.50 respectively. Human labor, land preparation, seed, TSP, experience in farming, and training had positive and significant effect on country bean, brinjal, and radish production research was conducted on bottle gourd production and all of them were analyzed the profitability combined with other vegetables. Moreover there is no research which conducted only on bottle gourd production and covered all aspects. Therefore, this study has attempts to analyze the profitability, input output relationship, and resource use efficiency of bottle gourd production in a wider aspect.

M.A. Rashid (2018) A study was conducted in 35 districts of Bangladesh during 2016-17 winter season for assessing the farm level performance of *Bt* eggplant in reducing pesticide use, cultivation cost and increase farm income. Five hundred five *Bt* eggplant farmers were selected purposively and 350 non-*Bt* eggplant farmers were selected randomly for the study. Net returns per hectare were Tk. 179,602/ha for *Bt* eggplant as compared to Tk. 29,841/ha for non-*Bt* eggplant. Pesticides were applied 11 times to *Bt* eggplant where as it was 41 times to non-*Bt* eggplant for controlling sucking pests. The *Bt* eggplant farmers saved 61 percent of the pesticide cost compared to non-*Bt* eggplant farmers, experienced no losses due to fruit and shoot borer, and received higher net returns. All *Bt* and 86% non-*Bt* farmers wanted to cultivate *Bt* eggplant in the next year if they can obtain the seeds/seedlings from the research station. For getting higher yield and economic benefits, in the course of technology dissemination, the importance of good production practices must be emphasized.

Matare and Suhasuni (2014) the present study on "Economic analysis of production and marketing of brinjal in South Gujarat Johansen test used for examine the integration of wholesale prices of brinjal among the major markets of South Gujarat (Surat, Navsari and Vyara) and out of South Gujarat (Ahmadabad and Vadodara) The major findings of the study revealed that there was cost of cultivation per hectare and cost of production per quintal of brinjal was 92867 and 251.83, respectively. The overall net income per hectare was 211212. The return per rupee of investment was 3.28. Following three marketing channel were identified in the study area for marketing of brinjal. Channel I: Producer –Wholesaler cum commission agent - Retailer – Consumer, channel II: Producer – Wholesaler – Consumer and Channel III:

Producer- village merchant- Commission agent cum wholesaler- Retailer – Consumer. The channel II was more efficient than the because producer share in consumer rupee was more (71.33%) in channel II, than channel I (58.95%) in Navsari market. In Surat market producer share in consumer rupee was maximum (56.27%) in channel I than the channel III (51.27%) and in Tapi market channel producer share in consumer rupee is highest in channel II than (71.17%) channel I (61.90%).

Millika (2015) The present study was designed to analyze the production, cost, return and profitability of three winter vegetables (brinjal, country bean and cabbage) production of three villages ofNarshingdi District in Bangladesh. To achieve the objectives, data were collected from 60 farmers. The sample farmers were selected through purposive sampling technique.The major findings of the study were: among the winter vegetables, cabbage production was more profitable. Per hectare profitability of growing vegetables from the viewpoints of individual farmers was measured in terms of gross return, gross margin and value addition. Per hectare gross costs of brinjal, country bean and cabbage production were Tk. 241277, Tk. 162337 and Tk. 204152 respectively, and per hectare average yields of brinjal, country bean and cabbage were estimated at 24175 kg/ha 15774 kg/ha, and 24707 kg/ha, respectively. Per hectare gross returns of brinjal, country bean and cabbage were Tk. 483500, Tk. 347028 and Tk. 494140, respectively. Per hectare net returns of brinjal, country bean and cabbage were Tk. 242223, Tk. 184691, and Tk. 289988, respectively. It shows that cost of production per hectare was higher for brinjal than for cabbage and country bean. The study also shows that per hectare yield, gross returns, gross margin, net return and benefit cost ratio of cabbage were higher than those of country bean and brinjal. Therefore, it is clear that cabbage production was most profitable among the three crops.

Rahman et al. (2016) the objectives of this research study are to identify and measure the impact of the factors on brinjal production and to calculate the profit of brinjal production. Primary data collection was carried out at three villages of Islampur Upazila under Jamalpur district. Cobb-Douglas production function was applied to determine the effects of inputs on brinjal production. Human labor, seed cost, MP cost and pesticides have significant impact on brinjal production. The most

important factor for variation in costs as identified was human labor and chemical fertilizers cost. Net return and cash margin of brinjal production were BDT 303,358 and BDT 345,415 per ha, respectively while the profit per Kg was BDT 6.63.Thus, Brinjal is a highly profitable enterprise. This study also identified some problems faced by farmers for producing brinjal like insects affect, lack of capital, lack of quality seed, lack of storage facilities, marketing problems. Thus more research and extension service can be adopted to solve the problems in order to increase production and ensure the nutritional food value in Bangladesh.

M.R. Hasan (2016) this paper analyzed the profitability of brinjal cultivation in three districts namely Mymensingh, Rajshahi and Comilla of Bangladesh. Primary data were collected from brinjal farmers using pretested interview schedule during May-July, 2014. Farmer‟s production efficiency was analyzed through netfarm income and benefit cost ratio (BCR) considering variable cost and total cost of production. The results showed that total cost of brinjal was the highest in Mymensingh (Tk. 309,732/ha) compared to Rajshahi (Tk.285464/ha) and Comilla (Tk.301436/ha), while total revenue from brinjal cultivation was the highest in Comilla (Tk. 407,580/ha) compared to other districts. Again, net farm income was found highest in Comilla (Tk. 106,144/ha) district than other districts. Problem Confrontation Index (PCI) revealed that low prices of vegetables was the first ranked order problem and lack of capital ranked second in the study areas. Correlation analysis indicated that farmer‟s education, total family member, homestead area, vegetable cultivation area, no. of agricultural training, no. of extension contact, and farming experience were significantly and negatively correlated with problem confrontation. Department of Agricultural Extension (DAE) should provide hand-on training on diseases, insects and pests management for increasing production.

Noyon (2014) conducted a production and marking profitability of pesticide free vegetables (brinjal, wax, sponge gourd, cucumber and bitter gourd) initiated by PKSF in Dhaka. Per hectare yields of brinjal, wax, sponge gourd, cucumber and bitter gourd were 28880 kg, 35240 kg, 39124 kg, 36763 kg and 43414 kg respectively. Per hectare BCR of brinjal, wax, sponge gourd, cucumber and bitter gourd were 2.20, 1.86, 1.87, 1.85 and 1.95 respectively.

Rebeka et al. (2018) conducted in the upazila namly keraniganj of Dhaka, during 2015 to assess the profitability, resource use efficiency and factor affecting eggplant cultivation. Net return and cash margin of eggplant production were USDA 4780.9 and USDA 4968.8 per hetare respectively, while rate of return was 2.60. Thus, eggplant cultivation is highly profitable enterprise. In all cases, resources are underutilized, so there is more scope to utilize the resources more efficiently in case of eggplant production.

S. Khandoker et al. (2016) conducted in three vegetables growing districts namely Comilla, Jessore and Narshingdi during 2013-2014 to assess the profitability, resource use efficiency, factors affecting and problems of vegetables production. Based on area, production and market priority, three winter vegetables such as radish, country bean and brinjal were selected of the study. Total cost of brinjal, country bean and radish production per hectare were Tk. 208101, Tk. 167757 and Tk. 130267, respectively. Per hectare average yield of brinjal, country bean and radish were 29.84 tonne, 16.96 tonne and 31.30 tonne, respectively. The net return of brinjal, country bean and radish were Tk. 179780, Tk. 69683 and Tk. 63944 per hectare, respectiv ely. The benefit cost ratio on full cost basis for brinjal, country bean and radish were 1.86, 1.42 and 1.50 respectively.

The above reviews indicate that a few studies have been conducted on financial profitability of brinjal cultivation. The present study aims to collect information on profitability of brinjal production. The result of present study would help researchers, respected farmers and policy makers in taking necessary steps for increasing brinjal production. Ultimately that will help increasing total production.

CHAPTER 3

METHODOLOGY

3.1 Introduction

Importance of the methods and procedure in conducting any research can hardly be over emphasized. Methodology enables the researcher to collect valid and reliable information and to analyze the same properly to arrive at correct decisions. Keeping this in view, the researcher took utmost care in using proper methods in all the aspects of this investigation. The methods and procedures followed in this study have been described in this chapter.

3.2 Selection of the Study Area

The study area was selected on the basis of objectives of the research. Gazipur district was selected for the present study. Primary data were collected from three upazila namely Sreepur upazila, Kapasia upazila and Kaliakair upazila. The main reasons for selecting the study area were as follows:

I. Availability of large number of brinjal farmers in the study area.
II. Easy accessibility and good communication facilities in those area.
III. This type of study was not done previously in the study area.
IV. The areas are easily accessible.
V. All the mentioned areas fall in the same agro ecological zone.

3.3 Preparation of Survey Schedule

The survey schedule was designed in accordance with the objectives of the study. The draft was made which included various questions that should be asked. Before taking actual interview draft schedule was pre-tested by interviewing some brinjal farmers. Improvement and modification were done based on the experience of pretesting interview. This will help the researcher to get more information regarding brinjal farmers. For this study, survey method is followed to collect data. It is very important in any survey to prepare a survey schedule. Keeping in mind the objective of the survey, preliminary survey schedule are designed for collection of data from the

selected brinjal producers. After preparing a draft schedule, one type of survey schedules is used for producers. The pretest is conducted for the following methods:

I. To test suitability of the survey schedule;
II. To test and verify coverage of items of the schedule;
III. To identify the questions which respondents formed efficient to answer;

3.4 Selection of Sample and Sampling Technique

Due to limitation of time and funds, it is impossible to make a survey covering whole area. For this reason, sampling was done to minimize the cost and time. A total of 90 farmers had been selected purposivly from three upazila. Each upazila represents 30 respondents for this study. Data were collected by the researcher herself using a prepared interview schedule. Face to face interview was done to collect information from farmers.

3.5 Data Collection Period

The study was mainly based on primary data collected through face to face interview during the month of June to August 2019. Data was collected through interview by using questionnaire. Data was collected field level cross-sectional data using pre-tested interview schedule. Necessary inform action regarding this study was collected based on input costs, price, yields etc.

3.6 Method of Data Collection

There are different methods of collecting information from the respondents. In the present study, face to face interview was designed because this type of interview is more appropriate than others. Before taking actual interviews the whole purpose of the study was explained to the sample farmers. During the interview if farmers did not get any questions, researcher explained the question in an easier way. In order to reduce the error, data were collected in local unit but later those units were converted into standard international units.

3.7 Analytical Technique

The collected data were analyzed with the purpose of achieving the objectives of the study. The following two techniques of analysis were used.

1) Tabular analysis
2) Functional analysis

3.7.1 Tabular Analysis

Tabular technique is generally used to find out the variation between variables. It was applied to classify data in order to get meaningful result by using statistical measures like sum, means, percentage etc. Different costs, gross margin and net profit were calculated in tabular form. In this study data were mostly presented in tabular form because of its simple and convenient characteristics.

Profitability Analysis

Eight variables such as cost of hired labor, cost of seedling, cost of land preparation, cost of manure, cost of chemical fertilizers, cost of irrigation, cost of pesticide and cost of others (Bamboo stick) in producing brinjal was considered for profitability analysis as well as Cobb-Douglas production function. Profit function of the following algebraic from was used in this study,

$$Profit(\pi) = \sum_{i=1}^{n}(P_{yi}\ .\ Y_i) - \sum_{i=1}^{n}(P_{xi.}\ X_i) - TFC$$

Where,

Π = Net Return

P_{yi}= Price per unit of the ith produce

Y_i = Quantity of the ith produce

P_{xi}= Price per unit of the ith inputs

X_i = Quantity of the ith inputs

TFC= Total Fixed Cost

3.7.2 Functional Analysis

To learn more about the relationship between output and input, Cobb-Douglas production function was used. It is chosen to estimate the effects of key variables on production process of brinjal. In this study seven independent variables were hypothesized to explain the production of brinjal. On the other hand, gross rueturn hectare was considered as the dependent variable.

The specification of the Cobb-Douglas production function model was as follows:

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

The empirical production function was the following:

$$\mathbf{lnY = ln\ a + b_1\ lnX_1 + b_2\ lnX_2 + b_3\ lnX_3 + b_4\ lnX_4 + b_5\ lnX_5 + b_6\ lnX_6 + b_7\ lnX_7 + \ + u_i}$$

Where,

Y = Gross return

X_1= Hired labor cost (Tk./ha)

X_2= Seedling cost (Tk./ha)

X_3= Land preparation cost (Tk./ha)

X_4= Manure cost (Tk./ha)

X_5= Chemical fertilizer cost (Tk./ha)

X_6= Irrigation cost (Tk./ha)

X_7= Pesticide cost (Tk./ha)

a = Intercept

b_1, b_2, b_3……b_7 = Coefficients of the respective input

u_i= Error term

3.8 Procedure of Estimating Indicators

The average wage of family labor was taken as the opportunity cost of the human labor. In the study areas, the cost of human labor were estimated by multiplying wage rate with recorded man-day/ha.

3.8.1 Cost of Human Labor

Human labor is an important input in producing agricultural product. In this study human labor was measured in terms of man-days and eight hours of work were equivalent to one man-day.

1 adult man = 1.4 adult woman

The average wage of family labor was taken as the opportunity cost of the human labor. In the study areas, the cost of human labor were estimated by multiplying wage rate with recorded man-day/ha.

3.8.2 Cost of Land Preparation

Land preparation is one of the most important components in agricultural production process. Land preparation for brinjal requires ploughing, laddering to make soil suitable for planting seedling. The number of ploughing varies from plot to plot. In the study areas, most of the time they ploughed land for 4 times.

3.8.3 Cost of Seedling

In the study area, most of the farmers used purchased seedling for brinjal production. Some of the farmers used home supplied seedling as well. Cost of seedling varied depending on its quality and availability. The cost of purchased seedling was calculated based on the actual price paid by the farmers. The cost of home supplied seedling was estimated at the prevailing market price.

3.8.4 Cost of Manure

For the higher production, most of the farmers used manure. They used these kinds of fertilizer for higher yield. The cost of manure was estimated at present market prices during the survey.

3.8.5 Cost of Chemical Fertilizers

For the higher growth rate of brinjal production, most of the farmers used different kinds of chemical fertilizers. These chemical fertilizers are Urea, TSP, Mop, Gypsum

and Boron etc. The cost of these chemical fertilizers was estimated at present market prices during the survey.

3.8.6 Cost of Irrigation

Irrigation is the most important input for brinjal production. In the study area, shallow tube- well, river, ponds etc. were used as sources of irrigation. Cost of irrigation varies from farmers to farmers. It was calculated based on how many times irrigation needed per hectare and how was its cost.

3.8.7 Cost of Pesticides

Farmers used many types of pesticides for 2-3 times in a month to keep their crop free from pests and diseases. Cost of pesticides was calculated based on the market price which was applied in the field per hectare.

3.8.8 Cost of Others (Bamboo Stick)

Farmers need the bamboo stick for brinjal production. Cost of these bamboo stick was calculated by using market price during the survey.

3.8.9 Interest on Operating Capital

Interest on operating capital was determined on the basis of opportunity cost principles. It was calculated by taking all the cost incurred throughout the production period at the rate of 5.5% per annum for six months. Following formula was used:

$$IOC = AIit$$

Where,

IOC = Interest on operating capital

AI = Total investment/2

i = Interest rate

t = Total time period of a cycle

3.8.10 Cost of Land Use

In the study area the cost of land was different to plots depending on location, topography and fertility of the lands. It also varies from one season to another i.e., from kharif to robi season and from crop to crop. Land use cost was estimated on the basis of opportunity cost of the use of land per hectare for six months during the production period. That's why cash rental value of land had been used for estimating cost of land use. Land use cost may be calculated by using one of the following concepts:

- Interest on the value of land
- Rental value of land
- Forgoing income from the alternative use

3.8.11 Gross Return

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

Gross Return = Quantity of the product* average price of the product

3.8.12 Gross Margin

Gross margin is the difference between gross return and variable costs. Generally gross margin was calculated on total variable cost (TVC) basis. Per hectare gross margin was obtained by subtracting variable cost from gross return. That is,

Gross Margin = Gross Return – Total Variable Cost

3.8.13 Net Return

Net return was estimated by deducting the total fixed cost from the total return.

Net Return = Gross Return – Total Fixed Cost

3.8.14 Benefit Cost Ratio (BCR)

BCR is used to compare benefit per unit of cost. The BCR (undiscounted) is the ratio of gross return to total cost. The BCR (undiscounted) was calculated by using following formula:

$$BCR = \frac{Gross\ Return}{Total\ Cost}$$

3.8.15 Measurement of Resources Use Efficiency

Farmers can get maximum profit up to the point where value of added product is greater than the cost of the added resources in producing it. When 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. In order to test the efficiency of resource allocation, the ratio of MVP to MFC for each input is considered to 1 which can be written by following:

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

The resources are considered to be efficiently used when the ratio of MVP to MFC is one. If the ratio is greater than 1, yield can be increased by using more resources and if the ratio is less than 1, the resources are overused which will minimize the profit.

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

Where,

b_i = Regression coefficient per resources

Y = Mean value (GM) of gross return

X_i = Mean value (GM) of inputs

CHAPTER 4

DESCRIPTION OF THE STUDY AREA

4.1 Introduction

This chapter presents a brief description of the salient feature of the study areas. To know the overall features of the study area, a short description has been presented in this chapter. It is necessary to know the agricultural activities, possible development opportunities and potentials of the study area. This will help the agricultural organization to make appropriate decision regarding various agro- related activities. Location, population and households, physical features, topography, literacy rate, educational facilities, cropping pattern, climate, temperature etc. are discussed below.

4.2 Location

The selected farmers in the present study are from Gazipur district. Area of Gazipur district is 1741.53 sq km, located in between 23°53' and 24°21' north latitudes and in between 90°09' and 92°39' east longitudes. Three upazila namely Sreepur, Kapasia and Kaliakair are selected for this study. The area of the above upazilas is 465.24 sq km, 356.98 sq km and 314.14 sq km respectively. These upazilas are mostly bounded by each other.

Gazipur district is bounded by Mymensingh and Kishorganj districts on the north, Dhaka, Narayanganj and Narsingdi districts on the south, Narsingdi district on the east, Dhaka and Tangail distruicts on the west. The locations of the upazilas are presented in the following Map region.

Figure 4.1: Map of gazipur zila

Source: Banglapedia, (2019)

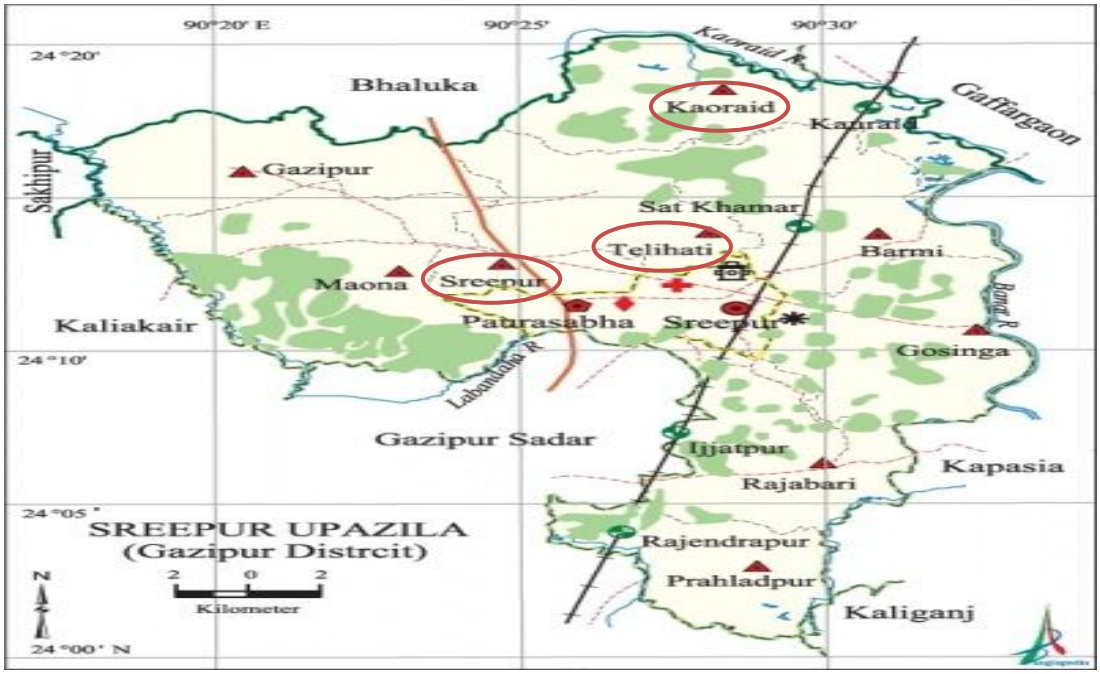

Figure 4.2: Map of sreepur upazila

Source: Banglapedia, (2019)

Figure 4.3: Map of kapasia upazila

Source: Banglapedia, (2019)

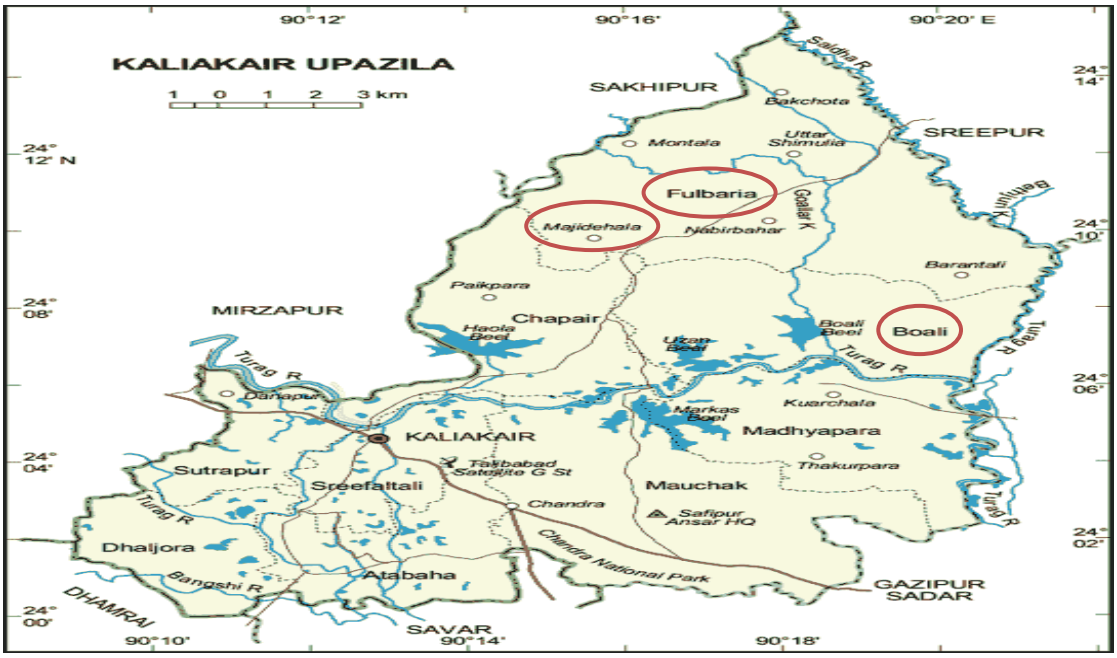

Figure 4.4: Map of Kaliakair Upazila

Source: Banglapedia, (2019)

4.3 Administrative Area

Gazipur Zila consists of five upazilas (Gazipur sadar, Sreepur, Kapasia, Kaliakair and Kaliganj), 3 paurashava, 46 unions, 4 municipility, 710 mouza and 1163 village (BBS 2018). There are also 7 police stations here, which are: Gazipur highway, Joydebpur, Sreepur, Kapasia, Kaliakair, Kaliganj and Tongi.

Table 4.1 Area, Union, Municipality, Village, Mahalla & Mauza of Gazipur District

Area(Sq.km)	No. of union	No of municipality	No fo village	No. of mouza
1741.43	46	4	1163	710

Source: BBS (2018)

4.4 Physical Features, Topography and Soil Conditions

Gazipur district is in Medium Ganges River Floodplain. The region comprises the eastern half of the Ganges River Flood Plain which is low-lying. Soils of the region are silt loams and silty clay loams on the ridges and silty clay loams to heavy clays on lower sites. Organic matter content is low in ridges but moderate in the basins. Soils

are calcareous in nature and general fertility level is medium. Soil of the study area is very fertile as a result various types of crops are cultivated.

Table 4.2 Land Topography in Survey Area

Study Area	Land Type					
	High Land	Medium High Land	Medium Low Land	Low Land	Very Low Land	Total
Gazipur	147886	46089	63481	48800	2905	309161

Source: BBS (2018)

4.5 Population

The Gazipur district has total population of 3,403,912 (BBS 2018) with density of population 2505/Km^2 (5,100/sq mi).Population and density of population of the study areas are presented in table 4.3. Average household size of the district is 4.96, male 52.52 and female 47.48 percent. The number of household in this district is 122140 and density of population is 2505/km^2. Male and female proportion was 1.11 in the respective areas.

Table 4.3 Population, No of household, Male–Female Ratio of Gazipur Upazilla

Population	No of household	Population density/sq.km	Household size	Male (%)	Female (%)	Male female ratio
3403912	255831	2505	4.96	52.52	47.48	1.11

Source: BBS (2018)

4.6 Climate, temperature and Rainfall

Agricultural production depends mostly on the environment of the region. Climate, temperature and rainfall are important factors for any crops production. Maximum temperature of the study area varies from 23.4 to 35.6 ^{0}C and minimum temperature of the study area is from 12.2 to 14.8 ^{0}C. From Table 4.5 we can see that annual rainfall is decreasing over the passage of time.

Table 4.4 Average Maximum and Minimum Temperature (^{0}C) in Selected Station

Name of Station	2015		2016		2017	
	Max.	Min.	Max.	Min.	Max.	Min.
Gazipur	35.6	14.8	35.0	12.8	23.4	12.2

Source: BBS (2018)

Table 4.5 Annual Rainfalls (in Millimeter) in Selected Station

Name of Station	Year			
	2014	2015	2016	2017
Gazipur	2197	1912	1181	1777

Source: BBS (2018)

4.7 Land and Agriculture

Total cultivable land of Gazipur district is 308518 hectares (BBS 2011). Brinjal is mostly grown spices in this study area. Paddy, jute, garlic, oil seed, wheat etc are some major crops in this area. Many different cropping patterns are seen in different region of Gazipur.

Table 4.6 Land Distribution under Different Cropping Pattern

Cropping pattern	**Single crop**	**Double crop**	**Treble crop**	**Net crop**
Percentage of land	58.57	13.72	4.67	76.96

Source: BBS (2011)

4.8 Education

Gazipur district the literacy and educational average literacy is 56.4 percent, male 60.5 percent, female 51.9 percent. Educational institute: university 5, college 45, technical 733, secondary school 276, primary school 733, community school 52, NGO operated school 11 and madrasa 181 (BBS, 2018).

4.9 Occupation

The economy of Gazipur is predominantly agricultural. The major occupation of the present study area is agriculture, non-agricultural laborer, service holder, industrial laborer and others. Average wage rate varies in different areas. Occupational status of different upazilas are presented in Table 4.7.

Table 4.7 Occupational level in the study areas

Name of Upazila	Agriculture	Non-agriculture	Construction	Service	Commerce	Others
Sreepur	57.46	2.65	2.89	15.41	10.85	10.74
Kapasia	58.98	2.80	1.74	14.91	11.49	10.08
Kaliakair	50.79	2.33	2.74	17.68	10.41	11.05

Source: BBS (2018)

4.10 Communication, Transportation and Marketing Facilities

Transportation and communication plays a vital role in overall development of a country. Without good transportation system, it is hardly possible to supply goods and other products in urban and city areas in time. At present day's transportation and communication systems are in good condition in the study areas than before. Most of the roads are concreted and some of them are muddy. Different types of vehicles are also available in those areas. Markets are also available which make farmers receive good prices for their produced.

4.11 Non-Government Organizations

At present a number of non-government organizations (NGOs) such as Grameen Bank, BRAC and ASA etc. are available in the study area. They operate their activities for the betterment of the people and the poor farmers in particular.

CHAPTER 5

SOCIOECONOMIC CHARACTERISTICS OF THE BRINJAL FARMERS

5.1 Introduction

This chapter provides a brief description of the socio-economic characteristics of brinjal cultivation in the study area. Decision making behavior of an individual is determined to a large extent by his socio-economic characteristics. The socioeconomic ten characteristics considered in the present study were age, education, occupation, farming experience, family type, family size, male female ratio, farm size, sources of family income and family expenditure etc.

5.2 Age Distribution of Brinjal Farmers

Age distribution of farm owners is very important in maintaining profitable operation of a farm business. The selected brinjal farmers were grouped into three categories according to their ages. The different age groups of farm owners are presented in Table 5.1. The age of the selected brinjal farmers was observed to be ranging from a minimum of 25 to a maximum of 60 years.

Table 5.1 Age distribution of brinjal farmers

Age	Percentage of Respondents		
	Sreepur	**Kapasia**	**Kaliakair**
Young(up to 35)	13.33	26.67	16.66
Middle(36-50)	53.34	56.67	56.67
Old(>50)	33.33	16.66	26.67

Source: Field survey, (2019

In the case of age distribution, in sreepur upazila young, middle and old age farmers accounted for 13.33 percent, 53.34 percent and 33.33 percent, in kapasia upazila young middle and old age farmers accounted for 26.67 percent, 56.67 percent and 16.66 percent, in kaliakair upazila young middle and old age farmers accounted for 16.66 percent 56.67 percent and 26.67 percent, respectively (Table 5.1).

5.3 Educational Level of Brinjal Farmers

Education plays an important role for a farm owner and helps a farmer to have day-to-day information about the existing modern techniques together with changes in various management practices. It enables a man capable of managing scare resources and hence to earn maximum profit. To examine the educational level of the brinjal farmers, education were classified into six categories such as illiterate/can sign only, P.S.C,

Table 5.2 Educational level of the owners of brinjal farmers

Educational Level	Percentage of Respondents		
	Sreepur	Kapasia	Kaliakair
Illiterate	13.33	13.33	13.33
P.S.C	33.33	36.67	26.67
J.S.C	16.67	23.33	23.33
S.S.C	16.67	6.67	13.33
H.S.C	16.67	13.33	16.67
Above(>H.S.C)	3.33	6.67	6.67

Source: Field survey, (2019)

S.S.C. H.S.C, and above H.S.C. Figure 5.2 displays the educational level of the respondents. Farmers in sreepur upazila who can sign only, P.S.C, J.S.C, S.S.C, H.S.C and above H.S.C constituted 13.33 percent, 33.33 percent, 16.67 percent, 16.67 percent, 16.67 percent, and 3.33 percent, respectively, farmers in kapasia upazila who can sign only, P.S.C, J.S.C, S.S.C, H.S.C and above H.S.C constituted 13.33 percent, 36.67 percent, 23.33 percent, 6.67 percent, 13.33 percent and 6.67 percent, respectively, farmers in kaliakair upazila who can sign only, P.S.C, J.S.C, S.S.C, H.S.C and above H.S.C constituted 13.33 percent, 26.67 percent, 23.33 percent, 13.33 percent, 16.67 percent and 6.67 percent, respectively (Table 5.2).

5.4 Occupational Status of the Brinjal Farmers

Occupation is one of the important attributes of socio-economic characteristics. The work in which a man is engaged throughout the year is known as his main occupation. In Bangladesh, rural people's occupations are increasingly diversified. About 30% of rural people do not own any land. They seek off-farm and non-farm income earning opportunities. In the selected area, the brinjal farmers were engaged in different occupations along with brinjal farming.

Table 5.3 Occupational status of the brinjal farmers

Categories	Percentage of Respondents		
	Sreepur	**Kapasia**	**Kaliakair**
Agriculture	36.67	40.00	36.67
Agri. And Business	50.00	50.00	43.33
Agri. And Service	13.33	10.00	20.00

Source: Field survey, (2019)

In the case of main occupation, in sreepur upazila agriculture, agriculture and business and agriculture and service accounted for 36.67 percent, 50 percent and 13.33 percent, in kapasia upazila agriculture, agriculture and business and agriculture and service accounted for 40 percent, 50 percent and 10 percent, in kaliakair upazila agriculture, agriculture and business and agriculture and service accounted for 36.67 percent, 43.33 percent and 20 percent, respectively (Table 5.3).

5.5 Farming Experience of the Brinjal Farmers

Farming experience is another socio-economic characteristic. Farming experience of a farmer was defined on the basis of his involvement in farming activities. Low experience was assigned up to 9 years of farming activities, middle experience was assigned 10 to 20 years of farming activities and high experience was assigned above 20 years of farming activities.

Table 5.4 Farming experience of the brinjal farmers

Categories	Percentage of Respondents		
	Sreepur	Kapasia	Kaliakair
Low(up to 9)	16.67	26.67	26.67
Medium(10-20)	30.00	40.00	40.00
High(>20)	53.33	33.33	33.33

Source: Field survey, (2019)

In the case of farming experience, in sreepur upazila low, medium and high experience farmers accounted for 16.67 percent 30 percent and 53.33 percent, in kapasia upazila low, medium and high experience farmers accounted for 26.67 percent, 40 percent and 33.33 percent, in kaliakair upazila low, medium and high experience farmers accounted for 26.67 percent, 40 percent and 33.33 percent, respectively (Table 5.4).

5.6 Family Type of the Brinjal Farmers

Family type is one of the important matters in socio-economic characteristics. Family type was measured by two types of family one is nuclear family another is joint family. Nuclear families are small families consisting of farmer wife and their children. But joint families are large families where farmer wife, mother, father, brothers, sisters and their children.

Table 5.5 Family type of the brinjal farmers

Categories	Percentage of Respondents		
	Sreepur	Kapasia	Kaliakair
Nuclear Family	63.33	70.00	70.00
Joint Family	36.67	30.00	30.00

Source: Field survey, (2019)

In the case of family type, in sreepur upazila nuclear and joint family accounted for 63.33 percent and 36.67 percent, in kapasia upazila nuclear and joint family accounted for 70 percent and 30 percent and in kalialair upazila nuclear and joint family accounted for 70 percent and 30 percent, respectively (Table 5.5).

5.7 Family Size of the Brinjal Farmers

In the study area, family size has been considered as one which has a total number of People living together with the same head of the family. The family member includes wife, sons, unmarried daughter, father, mother and brother. The total numbers of persons of all families were divided into three age categories according to their family size. The different family size of brinjal farmers is presented in Table 5.6.

Table 5.6 Family size of the brinjal farmers

Categories	Percentage of Respondents		
	Sreepur	**Kapasia**	**Kaliakair**
Small(up to 4)	40.00	33.33	33.33
Medium(5-6)	36.67	43.34	53.33
Large(>6)	23.33	23.33	13.34

Source: Field survey, (2019)

Figure 5.1 represent that family size of the brinjal farmers in the study area.

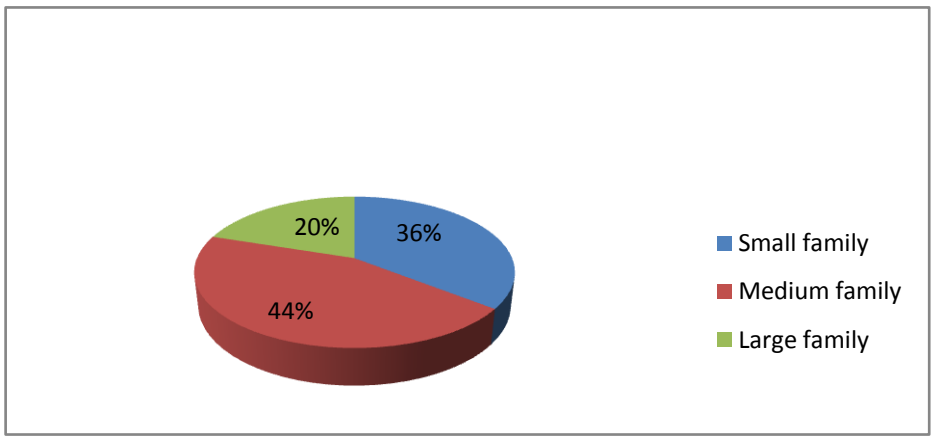

Figure 5.1 Family size of the brinjal farmers

5.8 Male Female Ratio of Brinjal Farmers

The study showed that the total number of family member of brinjal respondents were 471 of whom 250(53 percent) were male and 221(47 percent) were female (Figure 5.2). In the study area, the male-female ratio was found 1.13. The average family size of the farmers was 5.23. The average family at national level was about 4.60(BBS, 2016). The average family size in the study area was found higher than at national level. Figure 4.1 represent ratio of male-female in the study area of gazipur district.

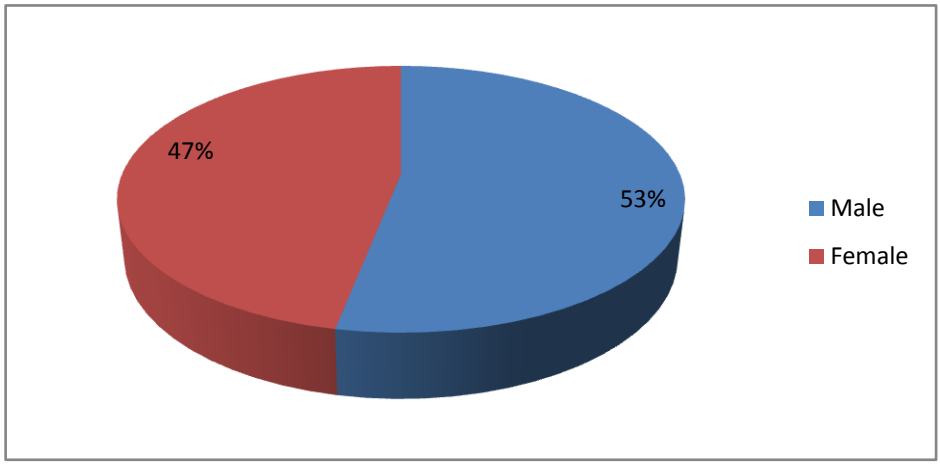

Figure 5.2 Male female ratio of brinjal farmers

Source: Field survey, (2019)

5.9 Farm Size of the Brinjal Farmers

Farm size was estimated on the bas is of the cultivated area either owned by a farmer or cultivated on share cropping, the area being estimated in terms of full benefit to the respondents.

Table 5.7 Farm Size of the brinjal farmers

Categories	Percentage of Respondents		
	Sreepur	**Kapasia**	**Kaliakair**
Marginal(0.51 to 1.0 acres)	13.33	10.00	10.00
Small(1.01 to 2.5 acres)	36.67	43.33	50.00
Medium(>2.5 acres)	50.00	46.67	40.00

Source: Field survey, (2019)

In the case of farm size, in sreepur upazila marginal, small and medium farmers accounted for 13.33 percent, 36.67 percent and 50 percent, in kapasia upazila marginal, small and medium farmers accounted for 10 percent, 43.33 percent and 46.67 percent, in kaliakair upazila marginal, small and medium farmers accounted for 10 percent, 50 percent and 40 percent, respectively (Table 5.7). Figure 5.3 represent that farm size of the brinjal farmers in the study areas.

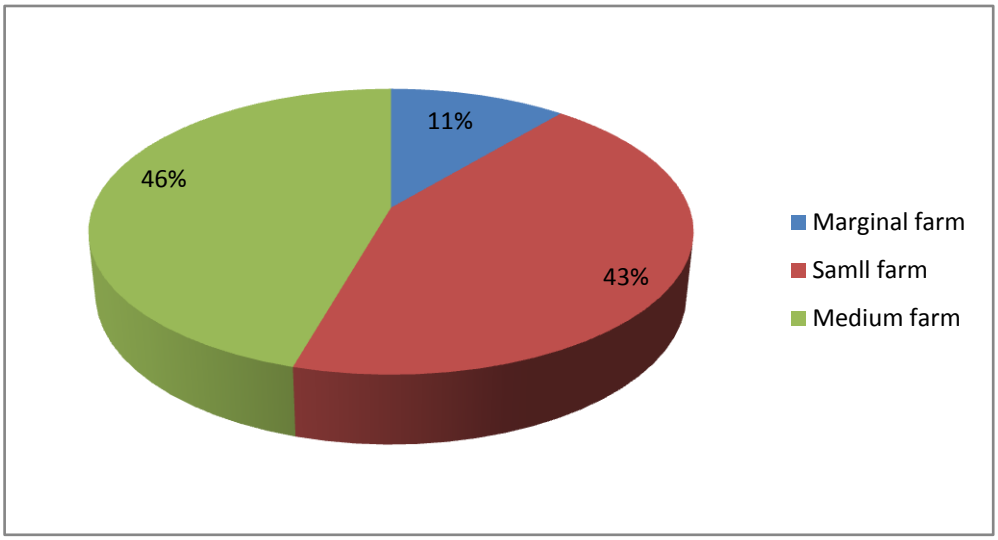

Figure 5.3 Farm size of the brinjal farmers

5.10 Income Level and Other Sources of Income

Family income of the farmers comprises different sources. Annual family incomes of farmers come from agricultural sources and non-agricultural sources are shown in Figure 5.4 and 5.5. The figure indicates that the family income derived from agricultural income was lower than others Sources.

5.10.1 Agricultural Income of Brinjal Farmers

The annual income of a farmer is an important indicator of how much he can invest in his farming business. Annual income means the total earning in taka by the respondents himself and the members of his family from agriculture, and other sources during a year. It was expressed in taka. The value of all the agriculture products encompassing rice, jute, maize, potato, mustard, pulse crops, brinjal, tomato, vegetables, fruits, cow, goat, sheep, fish resources and poultry etc, were taken into

consideration for calculating annual income. Figure 5.4 represent that agricultural income of the brinjal farmers in the study areas.

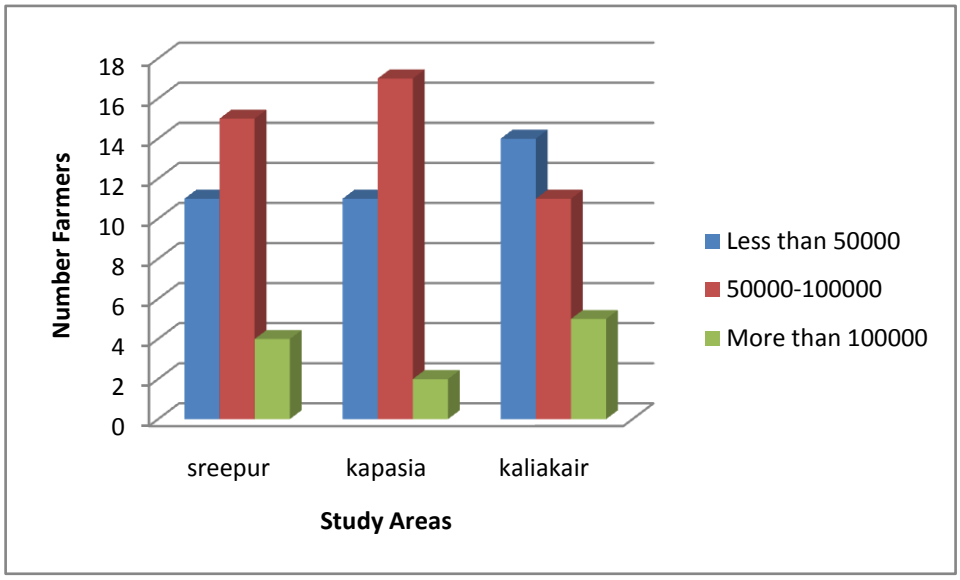

Figure 5.4 Agricultural incomes of brinjal farmers

Source: Field survey, (2019)

5.10.2 Non-Agricultural Income of Brinjal Farmers

Earning from each respondent and other member of his family from non-agriculture sources (business service, service, day labor, remittance, other family members and others income source) were also determined by asking question to the respondent farmer. Annual income of individual was measured by their agricultural and non-agricultural incomes. Figure 5.5 represent that non-agricultural income of the brinjal farmers in the study areas.

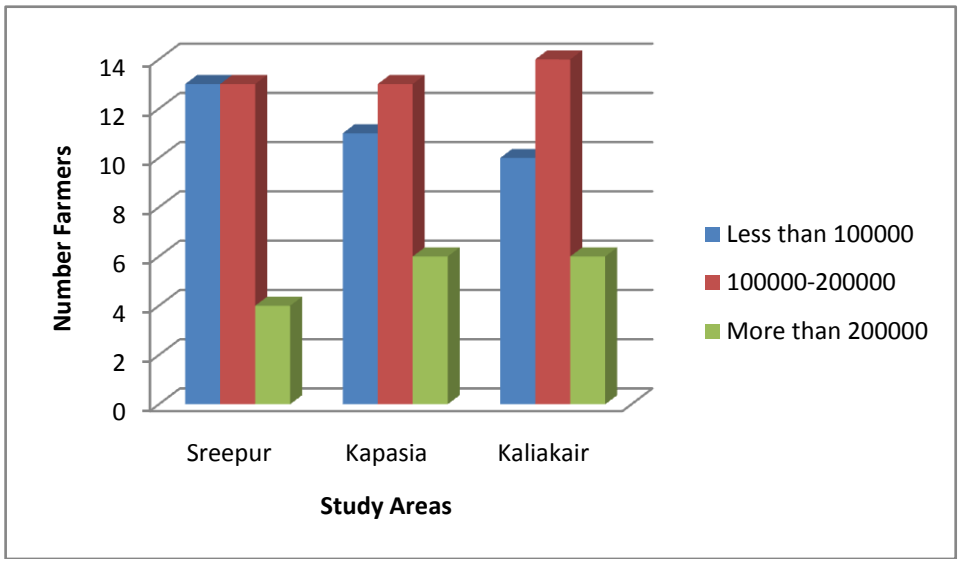

Figure 5.5 Non-agricultural incomes of brinjal farmers

Source: Field survey, (2019)

5.11 Family Expenditure of Brinjal Farmers

Farmer expenditure is important in socio-economic characteristic. Most of the poor farmer income comes from agricultural sources. We identified actual expenses and detailed consumption items for basic subsistence at the household level in the brinjal farming areas. Middle farmer and other farmer income come from both agriculture and non-agricultural sources. Farmer expense their money food, energy (petrol, gas and electricity), health care, transportation, clothing, festivals and social economics, house rent, cell phone expense, entertainments and others etc. The expenditure function indicates that off-farm income and number of family members are the major determinants influencing the expenditure level.

CHAPTER 6

FINANCIAL PROFITABILITY OF BRINJAL FARMING

6.1 Introduction

This chapter presents the input use pattern and yield of brinjal production. The main purpose of this chapter is to assess the costs, returns and profitability of growing brinjal. The average gross return and average net return was also estimated in this chapter. Besides these undiscounted Benefit Cost Ratio (BCR) was also estimated for determining the profitability of brinjal farming. In the decision making process of farmers, cost of any input used for producing an enterprise plays a vital role. In calculating profit or loss the cost benefit items need clarification. Farmers used both purchased and home supplied inputs in producing brinjal vegetable.

6.2 Estimation of Variable Costs of Brinjal Production

Cost estimation is necessary for determining the viability of the enterprise from the view point of producers. Costs refer to the total amount of funds used in production. In the present study, the total cost per hectare was worked out. For calculating the costs, return and profitability of brinjal, the costs items were classified into two groups:

(1) Variable cost and;

(2) Fixed cost.

Variable costs included the cost of all variable factors like human labor, seedling, land preparation cost, manure, chemical fertilizer, irrigation water, pesticides and others (bamboo stick). These costs vary with the level of production. Higher the production more will be the variable costs; lower the production lower will be the production. Variable costs which were taken into account in the present study are discussed below:

6.2.1 Cost of Hired Labor

Hired labor was considered the most important and largely used input in producing brinjal. It shared a large portion of total cost of production. There were two sources of human labor in the study area, one was family supplied labor and another one was hired labor. It can be seen from (Table 6.1) that the amount of hired labor used for brinjal cultivation was 209 man-days per hectare. The quantity of hired labor used in brinjal cultivation was about Tk. 373, Tk. 400 and Tk. 375 man-days for Sreepur, Kapasia and Kaliakair respectively (Table 6.1). The cost of hired labor per hectare was Tk. 83925, Tk. 83250, Tk. 71600 and Tk. 79592 for Sreepur, Kapasia, Kaliakair and All areas which represented 31.60, 31.70, 28.34 and 31.54 percent respectively of the total cost (Table 6.2).

6.2.2 Cost Land preparation

Power tiller was used in lieu of animal power. It is time and labor saving modern technology. In the study area, power tiller has widely been used for land preparation. Per hectare land preparation cost for brinjal production was TK. 10643, TK. 10433 and TK. 10787 in Sreeur, Kapasia and Kaliakair respectively which covers 4.01, 3.97 and 4.27 percent of the total cost. For brinjal production, the average per hectare power tiller cost was estimated at Tk. 10621. In percentage terms it shared 4.08 percent of total cost (Table 6.2).

Table 6.1 Per hectare level of input use for brinjal cultivation

Items	Areas			
	Sreepur	**Khapasia**	**Kliakair**	**All**
Human labor (Man -days)	335	327	303	322
Family labor (Man -days)	225	222	179	209
Hired labor (Man -days)	110	105	124	119
Land preparation (Tk.)	10643	10433	10787	10621
Seedling (pieces)	11896	11570	12650	12039
Manures (kg)	8051	8747	7707	8168
Chemical fertilizers (kg)				
Urea	365	388	393	382
TSP	829	749	753	777
MP	402	335	351	363
Gypsum	101	105	88	98
Boron	32	42	28	34
Pesticides(Tk.)	22648	23194	20049	21964
Irrigation(Tk.)	15814	16071	14646	15510
Others(Bamboo stick)Tk.	12745	11894	12809	12483

Source: Field survey, (2019)

6.2.3 Cost of Seedling

The production quantity and quality of crops or vegetables mainly depends on good quality of seed/seedling. In the study area, most of the farmers used purchased seedlings. They used to buy packet seedling of brinjal. The average seedling requirement per hectare for producing brinjal was 12039 pieces (Table 6.1). Per hectare seedling cost for brinjal production was TK. 9990, TK. 10128 and TK. 10372 in Sreeur, Kapasia and Kaliakair respectively which covers 3.76, 3.86 and 4.11 percent of the total cost. For brinjal production, the average per hectare seedling cost was estimated at Tk. 10163. In percentage terms it shared 3.90 percent of total cost (Table 6.2)

6.2.4 Cost of Manure

In the study area it was found that farmers also used cow dung as manure. For brinjal production the average amount of manure was 8168 Kg per hectare (Table 6.1). Per hectare manure cost for brinjal production was TK. 13770, TK. 15328 and TK. 13137 in Sreeur, Kapasia and Kaliakair respectively which covers 5.18, 5.83 and 5.20 percent of the total cost. In case of bottle gourd production per hectare total cost of manure was Tk. 14078 (Table 6.2) which shared 5.14 percent of its total cost.

6.2.5 Cost of Chemical Fertilizers

In the study area commonly used chemical fertilizers were Urea, TSP and MOP, Gypsum and Boron etc. In the study area, average amount of Urea, TSP, MoP, gypsum and Boron were 382 Kg, 777 Kg, 363 Kg, 98 Kg and 34 Kg per hectare respectively (Table 6.1). Per hectare average costs of Urea, TSP, MoP, Gypsum and Boron per were Tk. 6521, TK. 19286, TK. 6189, TK 979 and TK. 2969 respectively which covers 2.51, 7.41, 2.38, 0.38 and 1.14 percent of the total cost for brinjal production (Table 6.2).

6.2.6 Cost of Pesticides

In the survey area, farmers applied pesticides to protect their vegetables from the attack of pests and diseases. In the study area, per hectare pesticide cost for brinjal production was Tk. 22648, Tk. 23194 and Tk. 20049 in Sreeur, Kapasia and Kaliakair respectively which covers 8.53, 8.83 and 7.94 percent of the total cost. In case of brinjal production per hectare total cost of pesticide was Tk. 21964 (Table 6.2) which shared 8.44 percent of its total cost.

6.2 7 Cost of Irrigation

Irrigation water is an important input in brinjal cultivation. In the study area, per hectare irrigation cost for brinjal production was Tk. 15814, Tk. 16071 and Tk. 14646 in Sreeur, Kapasia and Kaliakair respectively which covers 5.95, 6.12 and 5.80 percent of the total cost. Per hectare average cost of irrigation water was Tk. 15510 for brinjal production, which represented 5.96 percent of total cost (Table 6.2).

6.2.8 Cost of Others (Bamboo Stick)

Bamboo stick is important for brinjal production. In the study area, per hectare others cost for brinjal production was Tk. 12745, Tk. 11894 and Tk. 12809 in Sreeur, Kapasia and Kaliakair respectively which covers 4.8, 4.53 and 5.07 percent of the total cost. Per hectare average cost of bamboo stick was Tk. 12483 for brinjal production, which represented 4.80 percent of total cost (Table 6.2).

6.2.9 Interest on Operating Capital

Interest on operating capital was calculated by taking into account all the variable cost incurred during the production period of brinjal. Interest on operating capital was computed at the rate of 5.5 % for six month. Per hectare interest on operating capital was estimated at Tk. 5710, Tk. 5655 and Tk. 5165 in Sreepur, Kapasia and Kaliakair respectively which covers 2.15, 2.15 and 2.04 percent of the total cost. Per hectare average interest on operating capital was estimated at Tk. 5510 for brinjal production which covered 2.12 percent of the total cost (Table 6.2).

6.2.10 Total Variable Cost

Summation of all the costs of variable inputs gave the total variable costs of brinjal production in the study area. In the study area, per hectare variable cost for brinjal production was Tk. 213360, Tk. 211301 and Tk. 192935 in Sreeur, Kapasia and Kaliakair respectively which covers 80.32, 80.45 and 76.37 percent of the total cost. The average variable cost of brinjal cultivation was Tk. 205865 per hectare. In percentage terms total variable cost covered 79.09 percent (Table 6.2).

6.3 Estimation of Fixed Costs of Brinjal Production

Hence variable costs and fixed costs were calculated separately. On the other hand, fixed cost was calculated for family labour and land use cost. Fixed costs do not change in magnitude as the amount of output changes and are incurred even when production is not undertaken. In the present study, family labour cost and land use cost was considered as fixed cost for brinjal cultivate.

6.3.1 Family Labor Cost

It can be observed from Table 6.1 that brinjal grower's used 322 man-days/ha as total human labor where as on an average 119 man-days/ha was family supplied labor. In the study area, per hectare family labor cost was Tk. 41030, Tk. 39375 and Tk. 49600 in Sreepur, Kapasia and Kaliakair respectively which covers 15.45, 14.99 and 19.63 percent of the total cost. The average cost of family supplied labor for brinjal amounted to Tk. 43335 per hectare which shared 16.65 percent of total cost of production (Table 6.2).

Table 6.2 Per hectare cost of brinjal cultivation in the study areas

Items	Areas			
	Sreepur	**Khapasia**	**Kaliakair**	**All Areas**
A. Variable Cost				
Hired labor	83925(31.60)	83250(31.70)	71600(28.34)	79592(30.58)
Land preparetion	10643(4.01)	10433(3.97)	10787(4.27)	10621(4.08)
Seedling	9990(3.76)	10128(3.86)	10372(4.11)	10163(3.90)
Manures	13770(5.18)	15328(5.83)	13137(5.20)	14078(5.41)
Chemical fertilizers				
Urea	6387(2.40)	6542(2.49)	6633(2.63)	6521(2.51)
TSP	20732(7.81)	18591(7.08)	18535(7.34)	19286(7.41)
MP	6971(2.62)	5624(2.14)	5971(2.36)	6189(2.38)
Gypsum	1012(0.38)	1049(0.40)	877(0.35)	979(0.38)
Boron	3013(1.13)	3542(1.35)	2354(0.94)	2969(1.14)
Pesticides	22648(8.53)	23194(8.83)	20049(7.94)	21964(8.44)
Irrigation	15814(5.95)	16071(6.12)	14646(5.80)	15510(5.96)
Others(Bamboo stick)	12745(4.80)	11894(4.53)	12809(5.07)	12483(4.80)
Interest on operating capital @5.5%	5710(2.15)	5655(2.15)	5165(2.04)	5510(2.12)
Total Variable cost(TVC)	**213360(80.32)**	**211301(80.45)**	**192935(76.37)**	**205865(79.09)**
B. Fixed Cost				
Family labour	41030(15.45)	39375(14.99)	49600(19.63)	43335(16.65)
Rental Value of Land	11227(4.23)	11976(4.56)	10105(4.00)	11103(4.26)
Total Fixed cost(TFC)	**52257(19.68)**	**51351(19.55)**	**59705(23.63)**	**54438(20.91)**
C. Total Cost (A+B)	**265617(100)**	**262652(100)**	**252640(100)**	**260303(100)**

Source: Field survey, (2019)

(Figures inside the parentheses indicate percentage of total cost)

6.3.2 Rental Value of Land Cost

Rental value of cost was calculated on the basis of current rental value of land in the study area. In the study area, per hectare rental value of land was Tk. 11227, Tk. 11976, Tk. 10105, and Tk. 11103 for Sreepur, Kapasia, Kaliakair and All areas respectively which represents 4.23, 4.56, 4.00 and 4.26 percent of total cost respectively (Table 6.2).

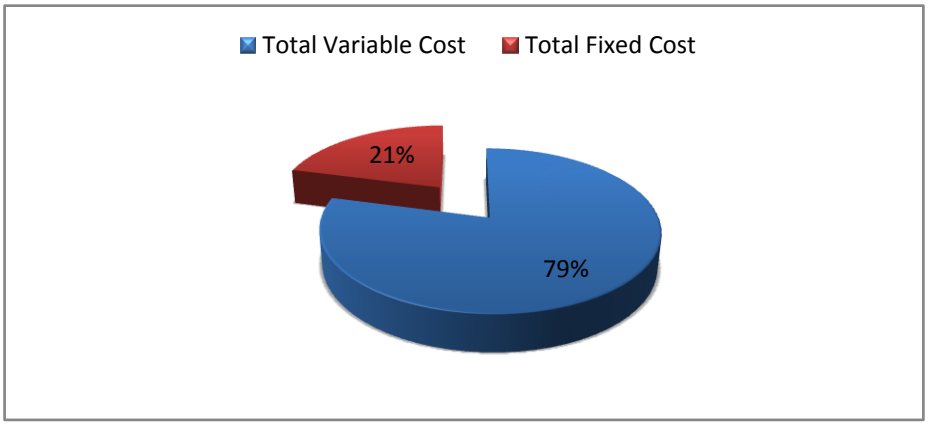

Figure 6.1 Share of Variable Cost and Fixed Cost to Total cost of Brinjal

Source: Field survey, (2019)

6.3.3 Total Fixed Cost

The total fixed costs of brinjal production in the study area, per hectare for brinjal production total fixed cost was Tk. 52257, Tk. 51351 and Tk. 59705 in Sreeur, Kapasia and Kaliakair respectively which covers 19.68, 19.55 and 23.63 percent of the total cost. The average fixed cost of brinjal cultivation was Tk. 54438 per hectare. In percentage terms total fixed cost covered 20.91 percent (Table 6.2).

6.4 Total Cost

In order to estimate gross cost per hectare, all the resources used in production have been recaptured together. All of the variable costs and fixed costs were taken into account. In this study, per hectare the total cost of brinjal production was estimated at Tk. 265617, Tk. 262652, Tk. 252640 and Tk. 260303 for Sreepur, Kapasia, Kaliakair and All areas respectively. It can be seen from the table total cost higher in Sreepur upazila than the other two upazila (Table 6.3).

6.5 Estimation of Returns of Brinjal Production

6.5.1 Gross Return

Gross return is the money value of total output. In this study, gross return was calculated by summing up all the returns earned from selling brinjal. Per hectare brinjal yield was 26890 kg, 29905 kg and 26812 kg for Sreepur, Kapasis and Kalialair respectively. Gross return per hectare was Tk. 430240, Tk.418670 and Tk. 402180 for Sreepur, Kapasis and Kalialair respectively. The average per hectare brinjal yield was higher in Kapasia but gross return was higher Sreepur upazila. The average yield for all areas was found to be 27869 kg and gross return was Tk. 418035 per hectare (Table 6.3).

Table 6.3 Per hectare profitability of brinjal cultivation in the study areas

Items	Sreepur	Khapasia	Kaliakair	All Areas
A. Total cost (Tk.)	265617	262652	252640	260303
Total Variable cost	213360	211301	192935	205865
Total Fixed cost	52257	51351	59705	54438
B. Yield (Kg.)	26890	29905	26812	27869
C. Price(TK/Kg)	16	14	15	15
D. Gross return (Tk.)	430240	418670	402180	418035
E. Gross margin (Tk.)	216880	207369	209245	212170
F. Net return (Tk.)	164623	156018	149540	157732
G. Benefit Cost Ratio(undiscounted)				
BCR on full cost	1.62	1.60	1.59	1.60
BCR on variable cost	2.02	1.98	2.08	2.03

Source: Field survey, (2019)

6.5.2 Gross Margin

Gross margin calculation was done to have an estimate of the difference between total return and variable costs. Gross margin was found to be Tk. 216880, Tk. 207369 and Tk. 209245 per hectare for Sreepur, Kapasis and Kalialair respectively. Per hectare overall gross margin was found Tk. 212710. Gross margin was higher in sreepur upazila compared to other two upazila (Table 6.3).

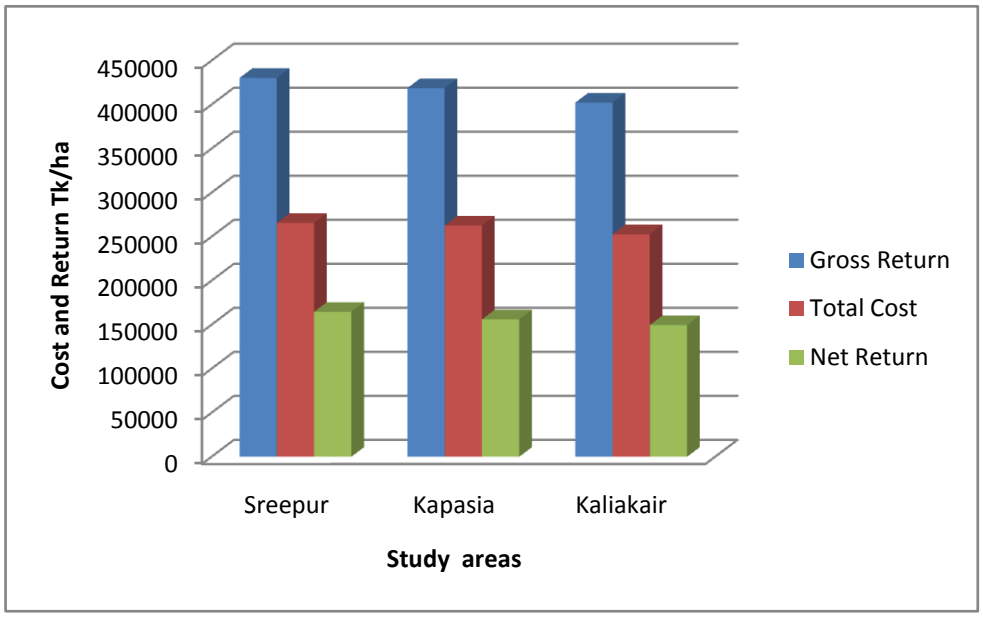

Figure 6.2 Chart showing the GR, TC and NR in the study areas

Source: Field survey, (2019)

6.5.3 Net Return

Net return was measured by substituting the total cost from the gross return. Per hectare net return was TK. 164623, Tk. 156018 and Tk. 149540 for Sreepur, Kapasis and Kalialair respectively. The average net return per hectare for all areas was Tk. 156732. Net return was higher in sreepur upazila compared to other two upazila (Table 6.3).

6.5.4 Benefit Cost Ratio (undiscounted)

The undiscounted Benefit Cost Ratio (BCR) of brinjal cultivation was calculated as a ratio of gross returns and total costs. BCR on full costs of brinjal production per hectare was 1.62, 1.60 and 1.59 for Sreepur, Kapasis and Kalialair respectively. BCR on variable costs of brinjal production per hectare was 2.02, 1.98 and 2.08 for Sreepur, Kapasis and Kalialair respectively. . Per hectare overall BCR on full cost and on variable were found 1.60 and 2.03 respectively (Table 6.3). Per hectare BCR on full cost was higher in Sreepur upazila but BCR on variable cost was higher in Kaliakair upazila.

6.6 Concluding Remarks

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

CHAPTER 7

EFFECTS AND RESOURCE USE EFFICIENCY OF INPUTS USED

7.1 Introduction

The main focus in this section was to estimate and compare the relative economic potential of brinjal production in tabular form. In this chapter an attempt had been made to identify and measure the effects of some important variables on gross return. For this reason Cobb-Douglas production model had been used to determine the effects of different variables on gross return of brinjal production.

7.2 Factors Affecting of Brinjal Cultivation

In the study area, for cultivating brinjal some vital inputs namely hired labor, land preparation, seedling, manure, chemical fertilizers, irrigation and pesticides were considered as explanatory variables responsible for the variation of brinjal gross return. Considering the effects of explanatory variables on yield of brinjal seven explanatory variables namely hired labor cost (X_1), seedling cost (X_2), land preparation cost (X_3), manure cost (X_4), chemical fertilizers cost (X_5), irrigation cost (X_6) and pesticide cost (X_7). Multiple regression analysis was conducted to understand the relationship between input and output.

The following Cobb-Douglas production model was used in the present study:

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

In linear form, model is written as follows:

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

The estimated production function for brinjal was:

Y = 5.171*+ 0.099*** + 0.103+ 0.084**-0.002 + 0.174*** + 0.099***+0.218*****

(0.826) (0.019) (0.074) (0.033) (0.022) (0.036) (0.031) (0.029)

(The figures in the parentheses are standard errors and the asterisk sign indicates the level of significance.)

7.3 Interpretation of the Estimated Values

The estimated values of the coefficients and related statistics of the production function are presented in Table 7.1.

Important features of the model are:

- ✓ For testing the significance level of each variable at one, five and ten percent probabilities.
- ✓ Total variation of the output was measured by co-efficient of multiple determinations (R^2).
- ✓ Goodness of fit of the model was measured by F-value. The F-values was highly significant implying that all the included explanatory variables are important for explaining the variation of income of farmers in brinjal production.
- ✓ The value of coefficient of multiple determinations R^2 was .79 which indicates that 79 percent of the total variations in return were explained by the independent variables included in the model.
- ✓ The result from the summation of all production co-efficient was 0.774. These figures imply that production function for brinjal farmers presents decreasing returns to scale.

7.3.1 Hired labor cost (X_1)

The magnitude of the regression coefficient of hired labor cost was 0.099 with a positive sign. It was significant at 1 percent probability level. It implies that 1 percent increase of human labor cost, keeping other factors constant, would lead to an increase in the gross return by 0.099 percent for brinjal production in the study areas (Table 7.1).

7.3.2 Seedling Cost (X_2)

The regression coefficient of seedling cost was 0.103 which was positive but insignificant. It implies that seedling cost had no effect on the gross return of brinjal production in the study areas (Table 7.1).

7.3.3 Land Preparation Cost (X_3)

The regression coefficient of land preparation cost was 0.084 which was positive and significant at 5 percent level. It implies that 1 percent increase in land preparation cost, remaining other factors constant, would increase the gross return by 0.084 percent in the study areas (Table 7.1).

Table 7.1 Estimated values of co-efficient and related statistics of Cobb-Douglas production function

Regression Variables	Regression Co-efficient	Standard Error	t-Value
Intercept/Constant(a)	5.171***	0.826	6.26
Hired labor cost(X_1)	0.099***	0.019	5.09
Seedling cost(X_2)	0.103	0.074	1.39
Land preparation cost(X_3)	0.084**	0.033	2.53
Manure cost(X_4)	-0.002	0.022	-0.10
Chemical Fertilizer Cost(X_5)	0.174***	0.036	4.85
Irrigation cost(X_6)	0.099***	0.031	3.21
Pesticide cost(X_7)	0.218***	0.029	7.56
F- Value	43.48***		
R^2	0.79		
Returns to scale	0.774		

Source: Field survey, (2019)

Note: * Significant at 10% level

** Significant at 5% level

*** Significant at 1% level

7.3.4 Manure Cost (X_4)

It can be seen from the Table 7.1 that the estimated coefficient of manure cost was negative for farmers (0-.002) which indicated an inverse relationship between gross return and manure cost. That means, in 1 percent increase of this cost decreased gross return by 0.002 percent while other factors were kept constant. However, this coefficient was not statistically significant. The possible cause of this insignificancy might be the irrational use of manure items. In the study area it was found that the price of manure items was very high. So, farmers can have better per hectare return of brinjal by reducing the use of this variable input (Table 7.1).

7.3.5 Chemical Fertilizer Cost (X_5)

The estimated value of the co-efficient of chemical fertilizer cost was 0.174 which was significant at 1 percent level. It can be said that 1 percent increase in chemical fertilizer cost keeping other factors constant, would increase the gross returns by 0.174 percent in the study areas (Table 7.1).

7.3.6 Irrigation Cost (X_6)

The regression co-efficient of the irrigation cost was 0.218 which was significant at 1 percent level. This suggests that an additional spending of 1 percent on irrigation water would enable the owner farmers to earn 0.218 percent of gross return from brinjal production in the study areas (Table 7.1).

7.3.7 Pesticide Cost (X_7)

The regression co-efficient of the pesticide was 0.099 which was significant at 1 percent level. This reveals that an additional spending of 1 percent on pesticides would enable the farmers to earn 0.099 percent of gross return from brinjal production in the study areas (Table 7.1).

7.3.8 Coefficient of Multiple Determination (R^2)

The coefficient of multiple determinations was 0.79. It indicated that 79% variation in the gross return was explained by the explanatory variables which were included in the model. In other words the excluded variables accounted for 21 percent of the total variation in return of brinjal (Table 7.1).

7.3.9 Goodness of Fit (F-value)

The F-value of brinjal cultivation was 43.48 and highly significant at 1% level which indicated that the entire explanatory variables in the model were important for explaining variation in the gross return of brinjal production (Table 7.1).

7.3.10 Returns to Scale

The elasticity of production refers to the percentage increase in output compared to the percentage increase in input**.** The summation of all the production coefficients indicates returns to scale. Returns to scale of brinjal production were computed by adding all the coefficients. The sum of all the production coefficients of the equation was 0.774 (Table 7.1). It indicates that the production function exhibits diminishing returns to scale.

7.4 Measurement of Resource Use efficiency

Resource use efficiency of vegetables production is presented in Table 7.2. All the ratios obtained as can be seen from the table are different from 1 which indicates inefficient use of resources. Farmers can get maximum profit up to the point where value of added product is greater than the cost of the added resources in producing it. When 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**.**

The resources are considered to be efficiently used when the ratio of MVP to MFC is one. If the ratio is greater than 1, yield can be increased by using more resources and if the ratio is less than 1, the resources are overused which will minimize the profit(Sapkot et.al,2018).

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

Where,

bi = Regression coefficient per resources

Y = Mean value (GM) of gross return

Xi = Mean value (GM) of inputs

Table: 7.2 Estimated resource use efficiency in brinjal cultivation

Variables	GM	Coefficient	MVP	MFC	MVP/ MFC	Comment
Gross Return	414937					
Hired Labor	76383	0.099	0.54	1	0.54	Over utilized
Seedling	10138	0.103	4.25	1	4.25	Underutilized
Land preparation	10488	0.084	3.32	1	3.32	Underutilized
Manure	13593	-0.002	-0.06	1	-0.06	Over utilized
Chemical Fertilizers	35489	0.174	2.03	1	2.03	Underutilized
Irrigation	15177	0.099	2.71	1	2.71	Underutilized
Pesticide	21441	0.218	4.22	1	4.22	Underutilized

Source: Field survey, (2019)

(Note: GM= Geometric Mean)

The ratio of MVP and MFC of hired labor was positive and less than one which implies over utilization of resources. Use of hired labor should be reduced to minimize the cost of production (Table 7.2).

The ratio of MVP and MFC of seedling, land preparation, chemical fertilizers, irrigation and pesticide was positive and greater than one which implied under use of those resources. To attain efficiency and to increase the output, use of those resources should be increased. Ultimately this will maximize the gross return (Table 7.2).

The ratio of MVP and MFC of manure was negative and less than one which indicated that farmer in the study areas using these inputs inefficiently. Cost of manure should be reduced to mitigate the total cost of production (Table 7.2).

CHAPTER 8

PROBLEMS OF BRINJAL CULTIVATION

8.1 Introduction

Bangladesh is an agro-based country where agriculture is considered as backbone of her economy. Although agriculture plays a vital role through employment generation, poverty alleviation, food security, and income generation but it has a number of problems particularly in cultivation practices. Farmers in Bangladesh do not get the sufficient quantity of seeds, fertilizers, pesticides, technical supports and finally the desirable price of their products (Akter, 2006). Moreover, the farmers are economically unable to invest the required amount inputs for producing crops due to their low capital base. Farmers generally complain of getting insufficient support from governmental agencies. As a result they fail to achieve their target. However, this chapter is design to identify the major problems and constraints confronted by the brinjal growers in the study area. Although brinjal production was profitable at the farm level, multiple numbers of constraints were reported by the farmers in the production of brinjal in the study area.

8.2 Major Problems Reported by the Farmers

The respondents were asked to give their opinion regarding the problems and constraints of brinjal production. It was observed that the problems were not identical and they were differed from farmer to farmer. However, major problems according to the intensity reported by the farmers are given below:

8.2.1 Insect Infestation

In case of brinjal production, insect infestation is a major constraint. Attack by pest and disease was a serious problem in production of brinja in the study area. Some incidence of pest and disease attack was noticed. However the main problem is that most of the farmers have no scientific knowledge of production technology and,

management of pests and disease. They have to rely on the dealer of the insecticide about what insecticide is for what kind of insects and diseases. About 89.63 percent of the brinjal farmers reported that the insect infestation problem is very high (Table 8.2).

8.2.2 Higher Price of Pesticides

Pesticide is vital inputs in the production of brinjal. Farmers reported that they have to apply pesticide for vegetative growth of the plants as well as to persuade the production of fruits. It was reported that about 87.78 percent vegetable growers complained about high price rate of pesticides (Table 8.2).

8.2.3 Non Availability and Higher Price of Labor

Labor is the third most important factor of production. The cultivation practice of brinjal is labor intensive. Especially the land preparation and hilling up, making fence, weeding and mulching, irrigation are the most labor intensive parts. But the wage rate of labor is very high in the study area. Among all sampled farmers this problem was reported by highest 86.67 percent farmers (Table 8.2).

8.2.4 High Input Cost (seed/seedling and fertilizer)

Seedling and fertilizer are an important factor of brinjal production. Fertilizer is vital inputs in the production of brinjal. Farmers reported that they have to apply fertilizer for vegetative growth of the plants as well as to persuade the production of fruits. It was reported that about 79.26 percent vegetable growers complained about high price rate of seedling and fertilizer (Table 8.2).

Table 8.1 Problems faced by the farmers in brinjal cultivation

Items	Sreepur	Kapasia	Kaliakair
Insect infestation	93.33	88.89	86.67
Higher price of pesticides	88.89	91.11	78.89

Non availability and higher price of labor	83.33	87.78	88.89
High input cost (seed/seedling and fertilizer)	77.78	83.33	76.67
Scarcity of quality verity of seed, fertilizer and pesticides	76.67	77.78	80.00
Marketing problem	77.78	72.22	71.11
Low price of product at late harvesting period	71.11	68.89	73.33
Lack of technical information	66.67	65.56	64.44
Lack of financial capital	57.78	64.44	66.67
Excessive weed infestation	54.44	57.78	58.89
Carrying and Handling Problems	50.00	44.44	36.67
Problems faced by female family labor	33.33	54.44	35.56
Lack of knowledge about proper time of sowing/planting	27.78	33.33	38.89

Source: Field Survey, (2019)

8.2.5 Scarcity of Quality Verity Seeds, Fertilizer and Pesticides

Verity seeds, fertilizer and pesticides are another most important input of brinjal production. Production of crops or vegetables are mainly depends on quality of seed or seedling, fertilizer and pesticides. But non-availability of improved seeds, fertilizer and pesticides were other limiting factor in producing brinjal. In the study area it was found that about 91.15 percent of farmers used purchased seeds. They reported that in local market HYV seeds were not available at their desired level. Most of the growers purchased seedling from local markets as HYV seed but they opined that in many cases, those seeds were not good quality which ultimately results in low production of vegetables. About 78.15 percent farmers reported this problem as the root cause of low productivity (Table 8.2).

8.2.6 Marketing Problems

Most of the vegetables farmer faces the marketing problem. They cannot get the proper price of their product. In our country, the market monitoring system is not good for the business purpose. As a result the farmer cannot get proper price of their product. About 73.70 percent farmers reported this problem as the root cause of low productivity (Table 8.2).

8.2.7 Low Price of Product at Late Harvesting Period

At the beginning of the season farmers get high price of brinjal. But in late season they get low price of the vegetable. About 71.11 percent small farmers reported that they have faced with this problem (Table 8.2).

8.2.8 Lack of Technical Information

Lack of technical information is another important factor of brinjal production. Most of the farmers do not know about technical information about brinjal production. Due to leakage of technical knowledge brinjal production cost was high. For that the farmer cannot get actual price of brinjal production. About 65.56 percent farmers reported this problem as the root cause of low productivity (Table 8.2).

8.2.9 Lack of Financial Capital

Like labor, capital is another important factor of production. However, approximately 62.96 percent farmers' in this study area reported that they faced scarcity of operating capital during production period particularly land preparation, seedling, making fence and fertilizer application which require cash money (Table 8.2). They were unable to produce brinjal commercially in the large scale due to lack of operating capital. They often have to borrow money from relatives or in some cases different institutional and non-institutional sources at a high rate of interest.

Table 8.2 Major problems faced by brinjal farmers

Major Constraints	Percent	Rank
Insect infestation	89.63	1
Higher price of pesticides	87.78	2
Non availability and higher price of labour	86.67	3
High input cost (seed/seedling and fertilizer)	79.26	4
Scarcity of quality verity of seed, fertilizer and pesticides	78.15	5
Marketing problem	73.70	6
Low price of product at late harvesting period	71.11	7
Lack of technical information	65.56	8
Lack of financial capital	62.96	9
Excessive weed infestation	57.04	10
Carrying and Handling Problems	43.70	11
Problems faced by female family labor	41.11	12
Lack of knowledge about proper time of sowing/planting	33.33	13

Source: Field Survey, (2019)

8.2.10 Excessive Weed Infestation

Excessive weed infestation is one of the major problems of brinjal production. High growth of weed infestation decreases the total brinjal production. Cost of weeding need high labor charge. About 57.04 percent farmers reported this problem as the root cause of low productivity (Table 8.2).

8.2.11 Carrying and Handling Problems

About 43.70 percent of the selected vegetable growers treated about carrying and handling as a problem (Table 8.2). Due to carrying and handling problem the growers

used to sell their product in large market and a few growers sold their products in the local market. As a result most of the growers deprived from their desirable price.

8.2.12 Problems Faced by Female Family Labor

Vegetables production is a profitable enterprise for small farmers mainly due to its labor intensive characteristic. In the study area most of the small farmers use their home supplied female labor in production. Female labors mainly engaged in seed sowing, hilling up, making fence, and irrigation. But in most cases these female labor face the problems of social criticism and bindings. In most of the society of our country people consider female works outside their home as impertinences. About 41.11 percent of all sample respondents reported this as a problem (Table 8.2).

8.2.13 Lack of Knowledge about Proper Time of Sowing/ Planting

Lack of knowledge about proper time of sowing seedling the production is decrease. Good production depends on proper time of sowing seedling. The actual time of sowing seedling the brinjal production is increase then the late sowing/ planting seedling. About 33.33 percent farmers reported this problem as the root cause of low productivity (Table 8.2).

8.3 Problems Solution Suggested by Farmers

The farmers in the rural Bangladesh have been facing a lot of problems during the production circle of different crops. Brinjal farmers are not an exception. They also faced a lot of constraints at the time of producing brinjal. After identification of different problems and constrains some probable solutions were suggested by the farmer in the study area. They are briefly described below:

i. Government should take necessary steps to decrease the price of fertilizer used in brinjal farming
ii. Government should take necessary steps to inform them about pesticides use and provide different pesticides at reasonable prices
iii. Most of the farmers suggested that supply of quality high yielding variety (HYV) seeds/seedling should be available in sowing period
vi. Formation of cooperative market for ensuring fair price of brinjal and increasing bargaining power of farmers is very important suggested by the

farmers in the study area.

From the above discussion it is clear that farmers of the study area are facing numerous problems regarding cultivation practices of brinjal. However, in spite of these problems and constraints the farmers in the study area are still producing this vegetable because of its high profitability and easy cultivation process. Moreover, its production is labor intensive. Thus, the idle family labor could be utilized during the production period.

8.4 Concluding Remark

Brinjal can play an important role in earning cash money. Since it is profitable and has huge domestic demand, its production should be expanded. Therefore, it may be concluded that brinjal production per hectare as well as its commercial production could possibly be increased to a large extent if the above mentioned problems and constraints could be solved. Then it could help farmers to increase their income as well as their living standard.

CHAPTER 9

SUMMARY, CONCLUSION AND RECOMMENDATIONS

9.1 Introduction

This chapter highlights the major findings and conclusions of the research. This chapter was summarized on the basis of previously discussed chapter. The findings of the study and farmer's observation and perception on various issues related to cultivation of brinjal as well as its impact on their socio economic status are summarized in this chapter. Finally, conclusion and some important policy recommendations of the study were also presented in this chapter.

9.2 Summary of the Study

Agriculture plays a vital role in Bangladesh national economy. Most of the people of Bangladesh are directly or indirectly dependent on the agricultural sectors and most of the employment sectors are circled in agriculture base. This sector has a great impact on macroeconomic objectives like employment generation, poverty alleviation and food security. Agriculture provides employment to 40.1% of her total labor forces. It also contributes to 13.60% GDP (BER, 2019).

In the study areas, samples were randomly collected from three upazila of Gazipur where brinjal cultivation was intensive. A total of 90 farmers were selected where each upazila represents 30 respondents. Data were collected during the period of June to August in 2019. Primary data were collected from selected farmers through face to face interview. Questions were asked based on the pre-scheduled questionnaires. All the data were computerized, summed up and scrutinized carefully to mitigate all possible errors. Both tabular and functional analysis had been done by using MS Excel and SPSS programs to get the related statistics and parameters.

Socio-economic characteristics of the farmers include age, farms size, family size, male-female ratio, education level, occupation level, farming experience, annual income and family expenditure etc. It was evident from the study that all farmers were more or less educated. It is found that the percentage of primary level education was

largest in all areas. Agriculture is the main occupation in the study areas.

Prevailing market price was used to estimate the cost of purchased inputs and for home supplied inputs opportunity cost principles was used. 5.5% bank interest rate per annum was used to calculate the opportunity cost of operating capital.

Profitability was measured on the basis of net return, gross margin and benefit cost ratio. The quantity of human labor used in brianjal cultivation was 373, 400 and 375 man-days per hectare for Sreepur, Kapasia and Kaliakair respectively. On an average, per hectare human labor was 383 man-days. The total cost of hired labor was Tk. 83925, Tk. 83250, Tk. 71600 and Tk. 79592 per hectare for Sreepur, Kapasia and Kaliakair and all areas respectively. Per hectare total cost of brinjal were Tk. 265617, Tk. 262652, Tk. 252640 and Tk. 260303 for Sreepur, Kapasia, Kaliakair and all areas respectively.

Per hectare yield for Sreepur, Kapasia and Kaliakair was 26890 kg, 29905 kg and 26812 kg. The average yield and price per kg were 27870 kg and Tk. 15. Per hectare average gross return, gross margin and net return were Tk. 418050, Tk. 212185 and Tk. 157747 for all areas respectively. BCR on full cost was higher in Sreepur (1.62) and BCR on variable cost was higher in Kaliakair (2.08) due to high yield and high per unit price. The average BCR for all areas was 1.60 which implies that one taka investment generated 0.60 taka. From the above results we can see that brinjal cultivation was profitable in the study areas.

To estimate the effects of main variables, Cobb-Douglas production function model was used. The explanatory variables were hired labor, seedling, land preparation, manure, chemical fertilizers, irrigation and pesticide. Among the included variable hired labor, land preparation, chemical fertilizers, irrigation and pesticide showed positive and significant effect. Seedling and manure showed insignificant effect on gross return and rest of them had insignificant effect.

The coefficient of multiple determinations, R^2, was 0.79 which indicates that 79% of the variation of output was explained by included explanatory variable. The F-value was 43.48 and highly significant at one percent probability level which indicates good fit of the model. The return to scale was 0.774 which implies diminishing return to scale.

In measuring resource use efficiency, it indicated that all the resources were under used except hired labor and manure.

9.3 Conclusion

The green revolution with high yielding package drove Bangladesh out of the shadow of famine. Bt brinjal reduced the toxicity of pesticides as much as 76%. Farmers growing Bt brinjal who had pre-existing chronic conditions consistent with pesticide poisoning were 11.5% points less likely to report a symptom of pesticide poisoning and were less likely to incur cash medical expenses to treat these symptoms. Insect infection is the major problem and lack of knowledge is the major technical problem in production of brinjal. From the result of present study, it revealed that brinjal cultivation was highly profitable. So, brinjal cultivation in the study areas can help in increasing income, employment and overall standard of living of brinjal farmers. Farmers in the study areas did not know about the application of right doses of inputs. Farmers do not get proper market linkage facility to sell the brinjal. Providing training according to their needs and problems may lead them to enhance production and income from brinjal cultivation.

9.4 Recommendations

On the basis of the findings of the study, it was evident that brinjal was highly profitable and it can generate income earning and employment opportunity to the rural people of Bangladesh. But some problems and constraints came out into the cultivation of brinjal. So, policy recommendations constitute important guidelines for overcoming these constraints and increasing brinjal cultivation in Bangladesh. Some policy recommendations based on the findings and conclusion of the study are presented below:

I. Necessary inputs such as disease resistance, good quality and high yielding varieties of seeds/seedling, chemical fertilizers and pesticides need to be provided to farmers before growing season at reasonable price.

II. Supply of inputs should be ensured in right time at reasonable price and adulteration should be controlled strictly.

III. Fair price should be ensured after harvesting period.

IV. Capital shortage was another problem faced by the farmers throughout their production process. So credit facilities should be made available to farmers on easy terms.

V. To develop technical knowledge of the farmers, training on brinjal cultivation should be provided by government and NGOs.

VI. The manure cost was higher the brinjal production, this cost was inverse relationship and insignificant the total gross return of brinjal production in the study areas.

VII. The seedling cost was high; this cost was insignificant the total cost of brinjal production in the study areas.

9.5 Scope of the Study

The main focus of the study was to determine the brinjal production technologies. The findings of the study will be specifically applicable to three upazila of gazipur district. However, the findings will also have implications for other areas of the country having relevance to the socio-cultural context of the study area. The investigator believes that the findings of the study will reveal the phenomenon related to diffusion of innovation. These will be of special interest to the policy makers. A study on financial profitability of brinjal cultivation based on different farmer categories can be done.

I. Comparative study can be undertaken to assess the relative profitability of brinjal and eggplant or other vegetables in the study areas.

II. The present study is performed to assess the profitability of brinjal but there is a scope for analyzing technical efficiency of brinjal in the study areas.

III. A study on different brinjal varieties can be undertaken to assess the effect on yield.

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APPENDIX

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An Interview on

FINANCIAL PROFITABILITY AND RESOURCE USE EFFICIENCY OF BRINJAL CULTIVATION IN SOME SELECTED AREA OF GAZIPUR DISTRICT

1 .Primary information of the farmer:

Name: …… Gender: ……..

Village …… Thana…… ….

Age: ……Years Education: …… Years

Occupation**:** …… Other occupation**:** ……

Note: Illiterate= (0 years), PSC =(1-5 Years), JSC=(6-8 years), SSC=(9-10 years), HSC=(11-12 years), Above=(13-above Years)

2. Farming Experiences:

How long you have involved in farming……Years

3. Family type: Nuclear family/ Joint family

4. Family size:

What is the number of your family members included yourself?

Total members…… Children (<12yrs)……

Adult Male…… Adult Female……

6. Farm size

(Please indicate the area of your land in your possession)

Types of land	Area (bigha)
a. Own Cultivated Land	
b. Share In	
c. Share Out	
d. Mortgaged In	
e. Mortgaged Out	

f.Others(……)	
Total=(a+b+d-c-e)	

7. Farmers Income sources

(Please mention the amount of annual income from the following sources)

a) Agricultural sources

SL. No.	Crop Name	Amount of income (in Tk.)
1	Rice	
2	Jute	
3	Maize	
4	Potato	
5	Mustard	
6	Pulse crop	
7	Brinjal	
8	Tomato	
9	Vegetables	
10	Fruits	
11	Cow, goat, sheep	
12	Fish resources	
13	Poultry	
Total		

b) Non-Agricultural sources

SL. No.	Income resources	Amount of income (in Tk.)
1	Business Service	
2	Service	
3	Remittance	
4	Day labor	
5	Other family members	
6	Others income source	
Total		

8. Farmer Expenditure

(Please mention you monthly expenditure in following source)

SL. No.	Items	Monthly Expenditure (Taka)	Yearly Expenditure (Taka)
1	Food		
2	Energy (Petrol, Gas, Electricity)		
3	Health care		
4	Education		
5	Transportation		
6.	Clothing		
7	Festivals & Social Economics		
8	House Rent		
9	Cell phone expense		
10	Entertainments		
11	Others(……)		

9. Crop Management Information

Please mention the following regarding brinjal cultivation

Management practices	Brinjal Cultivation
Amount of land (Acre)	
Variety	
Seed/Seedling rate (Unit)	
Number of irrigation	
Number of Inter-cultural operation	

10. Cost of Cultivation

A. Human Labor Requirement (man/day), please mention of your Human Labor requirement

Name of items	**Brinjal Cultivation**				
	No. of labor		**Working Hour**	**Taka/labor**	**Total(Tk)**
	Own	**Hired**			
Main land Preparation (tillage & laddering)					
Seedling Planting					
Manure & fertilizer					
Weeding					
Irrigation					
Pest management					
Harvesting, carrying & storing					
Total					

B. Cost of mechanical powers used

(Please mention your cost of mechanical powers used)

Name of practice	**Brinjal Cultivation**			
	Name of Machine/Animals	**Rent Per Bigha (Taka)**	**Cultivated area (Bigha)**	**Total (Taka)**
Tillage				
Total				

C. Materials inputs used

(Please mention about material input used)

Inputs	**Unit Price**	**Brinjal Cultivation**	
		Amount (kg)	**Taka**
Seedling(Pieces)			
Manure (Kg)			
Chemical Fertilizer (Kg)			
a. Urea			

b. TSP			
c. MP			
d. Gypsum			
e. Boron			
Pesticide (Tk.)			
Irrigation (Tk.)			
Others(……) Tk.			
Total			

11. Amount of Brinjal Production
(Please mention about brinjal production)

crop	**Total Production (Kg)**	**Unit Price (Tk)**	**Total taka**
1	**2**	**3**	**(2*3)**
Brinjal			

12. Please mention the problems faced by you in brinjal cultivation
a)……..
b)……..
c)……..
d)……..
e)……..

13. What are your suggestions to overcome the above problems?
a)……
b)……..
c)……..
d)……..
e)……..

Thank you for kind co-operation