FINANCIAL PROFITABILITY AND TECHNICAL EFFICIENCY OF CHILI CULTIVATION IN SOME SELECTED AREAS OF SYLHET DISTRICT OF BANGLADESH

HASAN MD. KAWSAR

DEPARTMENT OF AGRICULTURAL ECONOMICS
SHER-E-BANGLA AGRICULTURAL UNIVERSITY
DHAKA-1207

June, 2021

FINANCIAL PROFITABILITY AND TECHNICAL EFFICIENCY OF CHILI CULTIVATION IN SOME SELECTED AREAS OF SYLHET DISTRICT OF BANGLADESH

BY

HASAN MD. KAWSAR

REGISTRATION NO. : 1910109

A Thesis

Submitted to the Department of Agricultural Economics

Sher-e-Bangla Agricultural University, Dhaka,

In partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE
IN
AGRICULTURAL ECONOMICS
SEMESTER: JANUARY- JUNE, 2021

APPROVED BY

(Dr. Rokeya Begum)	**(Dr. Bazlul A. A. Mustafi)**
Supervisor	Co-supervisor
Professor	Former Director (Research and Admin)
Dept. of Agricultural Economics	Bangladesh Rice Research Institute
Sher-e-Bangla Agricultural University	

(Dr. Ripon Kumar Mondal)

Chairman

Examination Committee

Dept. of Agricultural Economics

Sher-e-Bangla Agricultural University

Department of Agricultural Economics
Sher-Bangla Agricultural University
Sher-e-Bangla Nagar, Dhaka-1207, Bangladesh.
Website: www.sau.edu.bd

CERTIFICATE

This is to certify that thesis entitled, ***"FINANCIAL PROFITABILITY AND TECHNICAL EFICIENCY OF CHILI CULTIVATION IN SELECTED AREAS OF SYLHET DISTRICT OF BANGLADESH"*** *submitted to the Department of Agricultural Economics, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of* ***MASTER OF SCIENCE IN AGRICULTURAL ECONOMICS,*** *embodies the result of a piece of bona fide research work carried out by* ***HASAN MD. KAWSAR****, Registration No.****1910109*** *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.

Dated:

Dhaka, Bangladesh

Dr. Rokeya Begum
Supervisor
Professor
Dept. of Agricultural Economics
Sher-e-Bangla Agricultural University,
Dhaka -1207

THIS THESIS

DEDICATED

TO

MY PARENTS

ACKNOWLEDGEMENT

By the grace of Allah, I start who has bestowed on me all the physical and mental attributes that I possess and the skill to cut through and heal a fellow human. I take the golden opportunity to express my heartfelt, humble, and deepest sense of gratitude to those who helped me to complete my research. These words are small acknowledgments but never fully recompensed for their great help and co-operation.

Now, I would like to pay ineffable gratitude to my supervisor Dr. Rokeya Begum, Professor, Department of Agricultural Economics, Sher-e-Bangla Agricultural University, Dhaka- 1207, for her ever inspiring guidance, keen interest, scholarly comments and scholastic and constructive suggestions throughout the research work and preparation of thesis. I am deeply indebted to and grateful for her prompt comprehensive feedback, encouragement and patience throughout the duration of the research undertaken for this thesis.

I am especially grateful to my respected Co-supervisor, Dr. Bazlul A. A. Mustafi, Former Director (Research and Admin), Bangladesh Rice Research Institute (BRRI), for his proper guidance, inspiring cooperation and encouragement during the research work and preparation of thesis.

I would also like to extend my appreciation to Dr. Ripon Kumar Mondal, Chairman, Department of Agricultural Economics, Sher-e-Bangla Agricultural University, Dhaka-1207, for his sincere cooperation, valuable suggestions and encouragement at every stage of this thesis.

I would like to express my gratitude to 70 farmers who actively participated in this survey and most importantly helped me to understand their initiatives and activities related to chili farming in general. They provided important data upon which different models were employed to evaluate the efficiency of farming activities. Their invaluable cooperation during my data collection process is highly acknowledged.

Last but not the least; I would like to convey my cordial thanks to all the teachers and well-wishers from my schooling days onwards who have directly or indirectly helped me to reach up to this level in my life.

Hasan Md. Kawsar

FINANCIAL PROFITABILITY AND TECHNICAL EFFICIENCY OF CHILI CULTIVATION IN SOME SELECTED AREAS OF SYLHET DISTRICT OF BANGLADESH

ABSTRACT

The study was planned to measure the financial profitability and technical efficiency of chili cultivators in selected Jaintapur, Gowainghat and Kanaighat upazila of Sylhet district. From 70 farmers, primary data has been gathered randomly during November to December. Both tabular and functional analyses were offered in this study. The study proved that chili cultivation is profitable. The total cost of cultivation was Tk. 426736 per hectare. Gross returns were Tk. 785343.93 per hectare and net returns were Tk. 358607.93 per hectare. Benefit Cost Ratio (BCR) was 1.84 which reveals that one taka investment in chili cultivation generated Tk. 1.84. The Cobb-Douglas stochastic frontier production function was used for this study to determine the technical efficiency of chili growers. The coefficients of parameters like human labor, fertilizers, and insecticides were positive where human labor and fertilizers are not significant but insecticides are significant and indicated a positive effect on chili cultivation. Seed and irrigation were negative and significant noted that negative effect on chili cultivation. Technical inefficiency effects the model, experience, farm size, extension have negative coefficients defining that this helps in deducting the technical inefficiency of chili farmers. The study also identified some issues like an insect- pests and diseases, use of fertilizer and pesticide, dearth of high yielding variety of seed mainly experienced by the chili cultivators and proposed some recommendations to enhance the present cultivation so that per hectare cultivation of chili would possibly be increased.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS AND ACRONYMS

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

₦	: Nigerian currency
IPM	: Integrated Pest Management
ICM	: Integrated Crop Management
Rs.	: Rupees
CV	: Coefficient of Variation

CHAPTER I

INTRODUCTION

Most of the people who live in Bangladesh are involved in farming activities for their livelihood. The contribution of agriculture in Gross Domestic Product, in shot GDP of the country, is great. 50% of GDP came from this agricultural sector in the past. After the revolution of industrialization, the professions of the population got diversification towards different sectors. As a consequence, the contribution of this sector is gradually declining and nowadays it stands at 14.10% of the GDP (BBS 2021). Nevertheless, agriculture takes a vital part and is now an important sector of the economy. According to FY 2020-21, the crop sub-sector alone earns 52 percent share of agricultural GDP in spite of raising the shares of fisheries, livestock, and forestry (Figure 1.1). But the share of the crop sub-sector in GDP gradually reduced from 9.13 percent to 9.12 percent by FY 2018-19 to FY 2020-21.

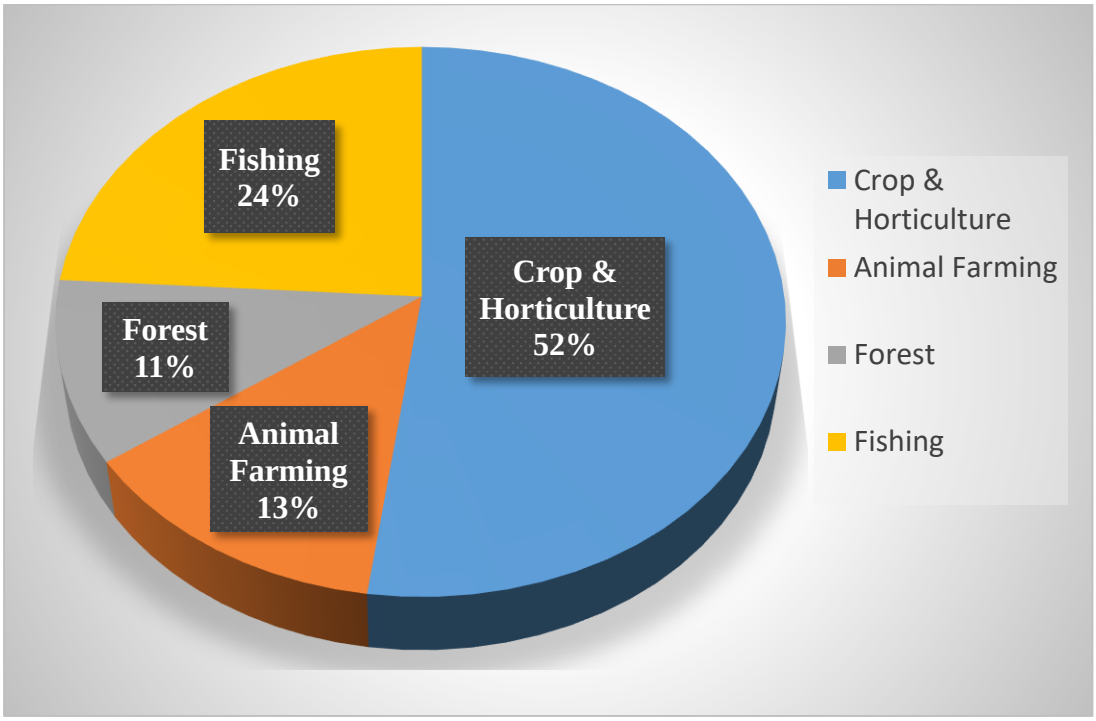

Figure 1.1: Sub-Sectorial Share of Broader Agricultural GDP in 2020-21

Source: Bangladesh Economic Review (BER), 2021

Bangladesh by birth possesses very fertile land in which diversified crops grow very easily. Various types of crops are produced in this country. Chili is a valuable spice and also one of the most important cash crops grown in Bangladesh. It is available and used in the form of green, dried and powdered. It has become an essential ingredient in Bangladeshi meals. Most of our households always keep a stack of fresh hot green chilies at hand, and use them to flavor most curries and dry dishes. It is typically lightly fried with oil in the initial stages of preparation of the dish.

The peoples of Bangladesh are usually using chilies in all curry preparation like meat, fish, vegetables, pulses etc. for its typical color, taste and flavor. Red chilies contain large amounts of vitamin-C and small amounts of carotene. They are very high in potassium, magnesium and iron. Part of the capsicum family, chilies come in scores of varieties and colors and are one of the most popular spices in the world. The level of heat of chili varies from type to type, from sweet and mellow to blisteringly hot as a general rule, the smaller the chili, the hotter the taste. But it's not all about heat -each type has its own distinct flavor.

Chili is the most essential and important spices crops in Bangladesh. The cultivation of chili largely depends on the use of fertilizers, irrigation, pesticide etc. The Government of Bangladesh has, therefore, provided priority to the agriculture sector to increase the cultivation of chili by giving subsidy to the farmers on different inputs such as seeds, fertilizer, irrigation etc. to achieve self-sufficiency in chili cultivation.

Poverty cannot be reduced to a desired level excepting increasing productivity of agriculture sector and at the same time it is to be assured that farmers get fair price of the crops. Natural calamities like draught, flood, cyclone, tornado etc. are a very regular phenomenon which hinders the cultivation of agriculture to a great extent. Cultivable land is being decreased due to the pressure of massive population. As a result, food security is being threatened and the risk of poor people is being increased.

Bangladesh government is remarkably concerned about this agriculture sector. Notable portion of annual budget has consistently been allocated for the last couple of years for the development of the sector. Government has also been launching many programs one after another in order to boost up the agriculture cultivation.

1.1 Present status of spices in Bangladesh

Flavoring food and making it tasty by adding different plant parts during cooking or making paste or salad is a very common practice everywhere. Spices are the symbol for aristocracy, health, tonic, immunity, vigor and stimuli. The people of Bangladesh cannot think a meal without use of spice. Most of the spices are high value crops. Net returns of major spices are also profitable. It can contribute a vital role to increase the cultivator's income, generate employment, alleviate poverty, ensure food security, empower women and increase social development of Bangladesh. Underneath the taste and flavor the spices possess immense nutritional and medicinal value which is proved by the today's scientists. Since ancient times, spices have also been used in traditional treatment of a number of diseases. The widely used spices are onion, garlic, ginger, turmeric, chili, pepper, cinnamon, cardamom, clove, coriander, cumin, mints, fenugreeks, fennel and tamarind etc. Besides these, there are many more spices being used by the people of different localities.

Spices are the plant parts may be the whole plant, bark, stem, leaf, root, rhizome, flower, fruit, and seed. Spices contain alkaloids, flavor-proteins, carotenoids, oleoresins, steroids, and oils etc., which are the sources of flavor, color and stimuli. Oils extract from some types of spices are used as ingredients of cosmetics and scented items of goods. For instance, onion, garlic, ginger, pepper and mustard have demonstrated antimicrobial activity against several types of bacteria. In injured stomach, cumin and coriander increase gastric secretion, and red pepper has an inhibitory effect. In FY 2019-20, total area under spices was 239 thousand acres with the total cultivation of about 158 thousand metric tons in our country (BBS, 2021).

Table 1.1 Area and cultivation of chili in different years (2015-16 to 2019-20) in Bangladesh

Year	Area (000 acres)	Cultivation (000 M. tons)
2015-16	252	130
2016-17	255	137
2017-18	255	141
2018-19	239	149
2019-20	239	158

Source: Agriculture Wing, BBS, 2021

1.2 Chili cultivation in Bangladesh

The chili is a plant of tropical and sub-tropical region. It grows well in warm and humid climate. Deep, loamy, fertile soils rich in organic matter are preferred by the crop for satisfactory growth. Also need well drained soils with adequate soil moisture for the growth of the crop. Chili grows well in the dry and the intermediate part of the country. Chili plants should be in a position that receives a good amount of light. Chilies should not be in a position where the night temperature falls below 12°C. Growth will be inhibited if temperatures fall below 15°C.

Chili plant is a type of seasonal crop which only live for one season then die. If cultivated, this plant can grow and produce for several months after planting after which it will die.

Chilies plants should be watered regularly. Overwatering on a regular basis will cause the roots to rot. When flowers developing on the plants, leave them on and they will die after a few weeks and chilies will form. Once the plants are producing fruits, required amount of organic liquid fertilizer should be applied for few weeks which are necessary for the plants fruiting.

Chili are harvested when the chili are either green or red. Red chili are hotter than green chilies. If anyone wants to harvest green chili peppers, allow them to grow as large as possible. Harvesting of chilies should be done when they start to turn red. Clip the peppers from the plant by cutting the stems where they connect to the main branch. The chilies farmers of Bangladesh cultivate local cultivars which produce very low yields. The main reasons of low yield are lacking of high yielding varieties and limited availability of irrigation facilities. Though the area and cultivation have been raised but per unit yield of chili is very low. In Bangladesh, chilies are grown in all the districts but plenty of chilies are produced in the district of Sylhet, Bogura, Rangpur, Jamalpur, and Jessore.

Cultivators of Bangladesh are cultivating chilies following indigenous methods with the poor yield rate. The reasons behind such low yield are to lack of high yielding variety and traditional method of cultivation practices followed by the local cultivators. The yield of chili can be increased by adopting improved cultivation technology like proper plant spacing. Although chili is a major spice crop of Bangladesh, but its cultivation technologies has not been standardized from the scientific and economic

point of view. Therefore, research is needed to bring improvement in cultivation technologies as well as economic return. If nature favors, farmers get moderately good harvest.

1.3 World picture of chili cultivation

When you look at the worldwide globe, the cultivation of chili is around 38.0 million tons. In 2019, given in Table 1.2, China was the largest Chili cultivating country and second, third position occupied by Mexico and Turkey. China produced 19.0 millions of tons chili which was highest cultivation in the world.

Table 1.2 Five world's largest countries of chili cultivation in 2019.

Countries	Cultivation (millions of tons)
China	19.0
Mexico	3.3
Turkey	2.6
Indonesia	2.6
Spain	1.4
World	**38.0**

Source: Scienceagri, 2019

1.4 Area, productivity, and cultivation of chili in Bangladesh

The area under chili cultivation is 253 thousand acres and the cultivation is 133 thousand tons and the average yield is 1.9 ton per acre (BBS 2021).The area of cultivable land for chili cultivation is decreasing day by day whereas the demand for chili is increasing. Unfortunately, the cultivation cannot meet the demand. The main reason behind low yield is that we have no sufficient land for chili cultivation. Another reason is the uses of low yielding variety that cannot produce good yield.

1.5 Economic significance of the chili cultivation

The chili cultivation has vital importance as it provides three to four times more calories of energy and cash incomes as compared to cereals. Chili crops hold a great promise for fostering economic growth and improving the diet of the people. Chili cultivation gives much higher returners per unit of land, labor and capital investment as compared to cereals crops. It has become indispensable in every Bangladeshi home. Chili is

valued for its diverse commercial uses. Demand is increasing for value added products using chilies such as chili paste, curry powders and sauces for the convenience of food industry. It occupies an important place in Bangladesh economy.

1.6 Statement of the problem

The economic growth of an agro-based country like Bangladesh mainly depends on the development of agriculture sector. The agro-climatic conditions of Bangladesh are suitable for the cultivation of a wide variety of crops but 80 percent of the gross cropped areas are at present confined to the cultivation of cereal crops mainly rice. Due to increasing population, demand for cereal food increased significantly.

Recently, Spices Research Centre (SRC) has released two new varieties of chilies, which are grown in summer season. They hoped that chili cultivation in the region would continue to increase due to the new impetus being given to the sector by various organizations and the crop is being cultivated twice a year during the summer and winter seasons in place of only once during the winter in the past.

Prior to giving emphasis on the cultivation of chili, it requires relevant and adequate information on different aspects of cultivation at the farm level. Such knowledge of cultivation is also necessary to make appropriate decision by the growers especially when several alternatives are open to them. However, little systematic economic investigations on chili cultivation have been undertaken by the government or private organizations in order to satisfy the demand of extension worker, policy makers, research personnel and the farmer. There are several factors like institutional, economic, physical and natural calamities that can limit agricultural cultivation.

Cultivation of chili can be increased by increasing the technical efficiency of chili using existing technology. It is generally assumed that farmers are inefficient at producing chili crop and there are significant inefficiency differences among farm groups. Agriculture cultivation policy in Bangladesh is concerned by lack of information about the relative profitability of different agricultural cultivation.

In the past so far the author's knowledge is concerned, there was no study on the technical efficiency or inefficiency as well as factors affecting the level of technical efficiency or inefficiency of chili producers. For this reason, the present study makes an attempt to analyze the profitability of chili cultivation and to estimate the technical

efficiency of chili cultivating farmers which depends on the different socio-economic variables like farm size, age, education, experience and training of the farmers. The study may be informative in this field and may serve as a foundation for further research. Finally, it is expected that the findings of the study will be helpful for the individual farmers for increasing the productive efficiency by effective operation and management of their farms through pointing drawbacks and policy makers and extension workers to frame out a useful policy.

1.7 Objectives of the study

1. To know the socio-economic features of chili cultivators in the study region.
2. To determine the cost, return and profitability of chili cultivators.
3. To estimate technical efficiency of chili growers and
4. To find out some problems for enhancing chili cultivation.

1.8 Organization of the thesis

This thesis has been divided into eight chapters including the chapter I which consists of introduction and objectives of the study. A review of literature of work done in the past is given in Chapter- II, Chapter-III deals with material and methods, Chapter IV has Socio-Demography Chapter-V consists Profitability Chapter-VI is Technical Efficiency, Chapter-VII deals with Problems and Chapter- VIII includes summary, conclusion and recommendations for future research work.

CHAPTER II

REVIEW OF LITERATURE

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

Adinarayan (1967) reported on the basis of cultivation function analysis that only area under chilies and human labor were positively contributing to the yield of chilies. Plant protection charges and size of holding were negatively significant. The elasticity of land, human labor, plant. Protection charges and size of holding were worked out to be 1.95, 3.45, 0.82 and 0.19 respectively.

Sharma and Pant (1988) studied marketing of chilies in south Saurashtra zone of Gujarat. They found that per quintal marketing cost incurred by the producer was (101.84 Rupees). The commission paid to the commission agent formed the major component of total marketing cost. At the retailer's level, per quintal expenditure incurred was also the highest in the case of chilies was (65.98 Rupees). The producer's share in consumer's rupee was found 61.01percent.

Sharma *et al.* (1992) reported on the basis of regression equation that keeping bullock labor and working capital fixed at their geometric mean levels. 1 percent increase in human labor will lead to 0.67 percent increase in income from chilies.

Hiremath (1994) studied on Cultivation and marketing of dry chilies in Karnataka. The study has analyzed the cost and returns of dry chilies in Dharwad district. Per acre cost of cultivation of chili was estimated at 5942.64 Rupees. The value of gross output was observed as 5531.72 Rupees. The farm business income and family labor income was estimated at 1466.08 Rupees per acre and 221.33 Rupees per acre respectively.

Kariem *et al.* (1999) carried out a study to estimate the neutral technology, non-neutral technology and observed that input use contributed differences between large and small farms producing summer chili (Capsicum). Decomposition technique was used to

achieve the objectives. Only the neutral technology contribution was in favor of large farms. The non-neutral technologies and input use contributed differences in small farms and to perform better than large farms in summer chili cultivation. The study revealed that the highest input use contributing factor differences were seen for fertilizers followed by seedling, insecticide, manure, human labor, top dressing, animal power and weeding between large and small farms. Small farms were more productive than large farms.

Korikanthimath *et al.* (2000) conducted a study to evaluate the efficient utilization of cash input resources and made an attempt to draw optimality in the use of these resources in chili cultivation system in Dharwad district, in Karnataka. A total sample of 30 farmers following the system was selected randomly interviewed through survey method using well-structured schedules. It revealed that there existed an indiscriminate use of almost all cash external inputs except nitrogenous and phosphatic fertilizers of which former found to bear a significant effect on output, while seeds and human labor inspite of their excess utilization had significant effect on the yield indicating irrational 23 behavior of the farmers for the same. It was evident that about 92% of the variation in yield was explained by those variables which were included in the function representing a significant goodness in fitting the regression.

Mutkule *et al.* (2001) reported that important constraints experienced by the chili growers include less adoption of chili cultivation technology costly insecticides and pesticides non awareness of concentration of pesticides, fluctuation of price of chili, non-timely availability of fertilizers, high cost of fertilizers, lack of disease resistant varieties, non-availability of transport facilities to city area, lack of cold storage and non-availability of sprayers on hire basis at the time of spraying.

Prajapati *et al.* (2002) reported that the important constraints experienced by the chili growers in adoption of recommended chili cultivation practices were lack of knowledge pertaining to recommended variety (85.00 percent), non-availability of fertilizers in time and in adequate power supplies (83.16 percent) in the rural areas.

Shrivastava (2003) revealed that the problems include high cost of fertilizers followed by high cost of plant protection chemicals and insecticides (98.33 percent), insects and diseases attack (96.67 percent), unavailability of irrigation facility (67.00 percent), chili

cultivation technology (56.67 percent) and effect of climate (55.00 percent) were important constraints.

Hanumanaikar *et al.* (2006) revealed that cent percent (100 percent) of the respondents expressed the problems of increased pest and disease infestation to the chili crop which forced them to use the excess pesticide doses. Ninety percent of the respondents expressed their inability to read the instructions given by the manufactures on the label of containers about the right uses of pesticides due to illiteracy and language problem.

Rajput *et al.* (2007) revealed that the following factors were responsible for the declining of chili area. These constraints were technical aspects (85.14 percent) and economic aspect (85.33 percent). Lack of information sources (70.00 percent), non-availability of labor (67.32 percent), and erratic climatic condition (94.66 percent), were the important constraints.

Gaganjot (2009) the net returns over variable costs for green chili were estimated to be 29114 rupees and 35400 per acre in Punjab, respectively. The net returns over variable costs for 12570 rupees per acre in the above said districts. This shows that chili cultivation is profitable crop in the study area. The chili crop, being highly labor intensive, will provide employment to the family members on farm itself particularly so in the case of small and marginal farmers.

Ruchira (2010) Economic analysis of data indicated that the total cost of chili cultivation was 25155.00 rupees per ha. Fertilizer, plant protection measures and labor cost constituted the major portion of the total cost of cultivation. The total return from chili cultivation was 83273.40 rupees per ha, with the benefit cost ratio of 3.31.

Venkataramalu *et al.* (2010) revealed that the majority of the respondents (95.83 percent) faced problems of water scarcity for irrigation and 82.50 percent faced constraints of high incidence of pests and diseases. Whereas 68.33 percent and 48.53 percent respondents faced problems of price fluctuation and lack of technical guidance respectively as important constraints in chili cultivation.

Islam *et al.* (2011) determined the productivity, profitability and resource use efficiency of four promising spices crops such as garlic, chili, ginger and turmeric. The data were collected from 480 farm households in the crop year 2010- 2011. Cultivations

of all the crops were profitable as estimated by net returns and benefit cost ratios. The average estimated technical efficiencies for garlic, chilies, ginger and turmeric were 88, 80, 69 and 79% respectively which indicated that garlic cultivation could be increased by 12%, chili by 20%, ginger by 31% and turmeric by 21% with the same level of inputs without incurring any additional cost.

Hireematha and Hilli (2012) conducted frontline demonstrations in Haveri district of Karnataka with objective of study on yield gap analysis in chili cultivation technology. Chili is one of the important commercial crops in Karnataka, which plays a major role in supplementing the income to small and marginal farmers of Haveri district in Northern Karnataka. One of the major constraints to traditional chili farming is low productivity due to non-adoption of recommended package of practices and inferior seeds. To solve these problems frontline demonstrations on chili were conducted in adopted villages of Krishi Vigyan Kendra, Hanumanamatti in Haveri district. The impact of varieties on yield data indicates the Byadagi kaddi and Byadagi dabbi varieties recorded 22.80 and 19.91 percent increased yield over local, respectively. The technology gap (5.77) and technology index (92.77) was highest in Byadagi dabbi compared to Byadagi kaddi. While the extension gap (1.60) was maximum in Byadagi kaddi.

Jagtap *et al.* (2012) observed that chili (*capscicum annuam L.*) is most widely used and universal spice of India. The study was conducted in Achalpur tahsil of Amravati district of Maharashtra in India. Total four villages and twenty farmers from each village and total 80 farmers were selected randomly as sample size. Data used were pertaining to the period 2009-10. Economic analysis of data indicated that Cost was found to 40541.72 Rupees, 42811.07 Rupees and 53421.29 Rupees per acre for small, medium and large farmers respectively. Net returns over cost was 19329.52 Rupees, 24114.59 Rupees and 21400.51 Rupees per acre and input-output ratio at cost was 1.

Naik *et al.* (2012) the estimated per acre cost of cultivation of organic and inorganic chili was 18337.00 rupees and 19115.00 rupees respectively. The per acre average yield of organic chili was 4.10 tons as against 4.86 tons in inorganic chili. The per ton market prices for organic and inorganic chili were 9830.00 rupees and 6300.00 rupees, respectively. The transportation cost including loading and unloading for organic chili was 265.00 rupees per ton as against 285.00 rupees for inorganic chili. The per ton

commission charges for organic and inorganic chili were 644.00 rupees and 432.00 rupees, respectively. The total marketing cost per acre for organic chili was 3726.00 rupees as against 3485.00 rupees for inorganic chili. The gross returns of organic chili were 40290.00 rupees per acre as against 30583.00 rupees for inorganic chili. The net returns of organic chili 18227.00 rupees were higher than that of inorganic chili 7984.00 rupees. The benefit cost for organic chili was 1.83 as against 1.35 for inorganic chili.

Singh (2012) studied on the extent of adoption of recommended chili cultivation technology. The data were collected from 160 chili growers in Abhanpur block of Raipur district of Chhattisgarh during 2011-12 using an interview schedule. Overall findings of adoption showed that majority of respondents (73.12 percent) had medium level of adoption in case of selected practices. Majority of the respondents reported incidences of more pest and diseases followed by high cost of pesticides, non-availability of fertilizers and pesticides locally, inadequacy of labor at the time of picking, complicated techniques of seed treatment, poor germination and lack of skill about use of pesticides and equipment. Chili growers suggested that pest and disease resistant variety of chili should be available, fertilizers and pesticides should be available locally in subsidized rate and storage facility should be provided to the chili growers.

Biradar and Chandrgi (2013) a study was conducted on technological gap in adoption of chili cultivation practices in Raichur and Yadgir districts of North Eastern Karnataka during 2011-12. Manavi and Deodurga taluks from Raichur district and Shahapur and Shorapur taluks from Yadgir district were selected based on highest area under chili cultivation. From each of the selected taluks, three villages were selected based on highest area of chili under irrigation condition. A sample of 10 farmers from each village was selected as random. Thus, making a total sample size of 120 respondents. The ex-post facto research design was used for the study. The findings revealed that Majority (78.33%) of the farmers expressed problem of price fluctuation followed by inadequate irrigation (62.50%) and same per cent of them expressed the non-availability of laborers at critical stages and high wages, non-availability of good quality inputs at proper price at right time (59.17%). And the major suggestions made by the respondents were minimum support price should be fixed for chili (86.67%), followed by market should be nearer, (65.83%), should provide good quality of inputs at right time at proper price (54.16%).

Olayiwola (2014) performed the economic analysis of chili cultivation in Nigeria. On per acre basis, total cost was estimated for small (34,225.05 Naira), medium (38,612.48 Naira) and large (42,086.84 Naira) farmers. The gross income was higher for large farmers (73,883.49 Naira) and less for small (49,104.38 Naira) farmer. Similarly, large farmers had higher benefit cost ratio (1.91) as compared with medium (1.87) and small (1.56) farmers.

Dangore (2015) the study revealed that, the chili farmers have major problem of the lack of technical knowledge in production while non-remunerative prices and high cost of transportation is major problem in marketing.

Daundkar and Bairagi (2015) explored the economics of capsicum in India. Total cost was 125,260 Rupees with net returns (273,388 Rupees) and input-output ratio (3.11).

Mariyono et al. (2015) the results indicate that younger farmers, and also farmers with more experience, were more likely to adopt chili farming. Availability of chili production technology and the use of mobile phones prompted farmers to adopt chili farming. Access to vegetable markets, credit, and market information were other factors driving farmers' decisions to take up chili production. Most farmers were motivated to grow chili to increase their incomes. Ecological factors were also the reasons.

Patel *et al.* (2015) the average cost of cultivation of chili was estimated at 122935.62 rupees per hectare and observed highest i.e. 130302.58 rupees per hectare at small farms. The yield of green chili was observed 95.81 quintal per hectare, 107.11 quintal per hectare, 123.50 quintal per hectare and 141.31 quintal per hectare at marginal, small, medium and large farms respectively along with 117.40 quintal per hectare on an average. The gross return from chili crop was observed as 257072.66 rupees per hectare across the farms. The net return from this crop was calculated as 127451.60 rupees per hectare while farms are spent on an average of 1047.15 rupees for produce the one quintal of chili. The average ratio of input-output was estimated at 1:2.04 across the different farms of district which shows cultivation is profitable to the farms of the district. The average use of human labor was estimated at about 521 labor days per hectare.

Velayutham and Damodaran (2015) demonstrated the economic performance of chili cultivation in India. Regression coefficients of Cobb-Douglas model were positive for labor man-days (0.406), manure (0.0778), fertilizer (0.368) and chemicals (0.251).

Sharma (2016) the present study was undertaken on sixty farmers to examine the economic analysis of Naga King Chili and to assess the resource use efficiency and sustainability value indices of Naga King Chili on different farm size groups. The resource use-efficiency on pooled data for Naga King Chili was found to be maximum on human labor (5.388), followed by seed cost (3.458133) and it found to have negative impact on marketing cost (-3.42835).

Srikala *et al.* (2016) the per hectare cost of cultivation of chilies for Andhra Pradesh indicated that the operational costs 1,84,391 rupees. Similarly, the total costs 2, 21,656 rupees for the period. Analogously, among fixed costs, rental value of owned land as a percent of total cost 15.79. During the period, net returns 1,63,430 rupees per hectare. The price spread analysis for the selected channel indicated that the producer received 64.45 percent of consumer's price. The share of the wholesaler and the retailer worked out to 9.85 and 8.21 percent respectively.

Khan *et al.* (2017) the total cost of chili 277,064.82 rupees was higher for small farmers and it was followed by large 258,178.11 rupees and medium 256,496.42 rupees farmers. Total production 21,209.27 kilogram per acre^{-}, average price 25.33 rupees per kilogram and revenue 537,264.67 rupees per acre were higher for small farmers. According to BCR, medium farmer received 2.02 rupees by investing rupee one in this activity followed by small 1.94 rupees and large 1.70 rupees farmers. Result showed a positive impact on revenue due to education, experience in capsicum production, extension services and labor cost.

Sowjanya and Kumari (2017) the paper studies on "Constraints faced by the farmers in adoption of Integrated crop Management in Chili crop in Telangana". In this study was comparison between IPM (Integrated Pest Management) and Non-IPM farmers. For the study, 30 ICM (Integrated Crop Management), 30 IPM and 30 Non-IPM farmers were randomly selected from two districts. The first source of market price information for all the two categories of farmers were the commission agents in the market with the mean scores of 73.33, 72.83 and 74.87 respectively for ICM, IPM and Non-IPM farmers. Labor scarcity for farm operations, power cut, requirement of more labor for production of quality chili and more expenditure towards plant protection chemicals were ranked first, second, third and fourth with mean scores of 71.03, 70.17, 63.17 and 59.40 respectively by ICM farmers. IPM farmers ranked power cut, labor

scarcity for farm operations, high cost of plant protection chemicals and requirement of more labor as first, second, third and fourth problems with mean scores 70.83, 70.33, 63.43 and 62.33 respectively.

Ila *et al.* (2019) the total cost (TC) for green Chili is Tk. 128011.13; gross return (GR) of Green Chili is Tk. 240864; gross margin (GM) for green Chili is Tk. 137698. All the calculations are based on per hectare. Thus, producing green Chili net return (NR) is Tk. 112852.87. The green chili is attractive for farmers to produce as its benefit cost ratio (BCR) shows 1.88 in our study.

Saidah *et al.* (2019) this research aimed to analyze the transaction cost structure and the effect of transaction costs on the revenue and profit of red chili farming. The research results showed that the highest percentage of transaction cost components was at implementation costs of 25.1 percent, followed by information search costs of 23.1 percent and negotiation costs of 22.3 percent. The number of transaction costs formed in red chili farming was 3,990 727.74 rupiah per year. The ratio of transaction costs to total costs was 0.0285. This indicated that farmers had to issue 2.85 percent of the total costs for transaction costs. In addition, the percentages of transaction costs for revenue and profit of red chili farming were 4.65 and 5.27 percent respectively.

Subiksa and Suastika (2019) chili is one of most valuable crop in some part of Indonesia due to high price and profitability compared to another crop. Advanced technologies in fertilizer and water management have been assessed at Bukit Kijang Village, Bangka Island and showed very promising results for expansion. Although attained yield of chili was 5.7 ton per hectare, which is about 23.7 % from the average of agronomic potential yield, the net profit ranged from 51.8 to 92.9 million rupiah per year. The main constraints identified included low water holding capacity due to sandy texture. However, this constraints could be solved by drip irrigation technique and fertigation system. Pest and diseases were another constraints that also contributed significantly to decreased chili yield.

Channa *et al.* (2020) the yield of chilies obtained was 1785.53 kilograms per acre and price per kilograms was 102.81 rupees. Total cost of production of chili with opportunity cost was 102543.44 rupees and 85334.45 rupees without opportunity cost per acre. Moreover, per acre revenue was 183506.74 rupees, similarly net return of chili

with opportunity cost was 80963.30 rupees and without opportunity cost was 98172.29 rupees per acre respectively.

Geo *et al.* (2020) land size, seeds, fertilizer, pesticide, and the number of labors jointly had a significant and positive effect on red chili production. The use of pesticides had no significant effect on the level of production; the annual net returns of the red chili farming, on average, was 42,632,440 rupiah per hectare, with return cost ratio being 2.92. Production factors of land size, seeds, fertilizer, pesticide, and the number of labors jointly had a significant and positive effect on red chili production. Partially, they also had significant and positive effect on the production, except for the use of pesticide. Red chili farming is profitable and financially feasible.

Karyani *et al.* (2020) red chili is a commodity with high economic value, yet it has high risks. It can be observed from the price fluctuation as a result of the unstable supply, while it has a high demand from the consumers. This research was conducted in Sukalaksana Village, Banyuresmi District, Garut Regency, which is one of the red chili production centers in Indonesia. The results showed that the red chili farming possesses high risks, shown by the coefficient of variation (CV) of production risk (CV = 0.69), cost risk (CV = 1.25), and income risk (CV = 2.11). The main source of risks in the red chili farming is weather changes, which make the chilies very prone to pests and diseases.

Mohanachandran and Wijetunga (2020) Increasing the productivity of green chili is important to meet the market demand as well as to reduce the food import bill. This study focuses to evaluate the technical efficiency of green chili farmers and subsequently identifying the determinants of technical inefficiency in the Vavuniya district of Northern Province in Sri Lanka. The stochastic frontier analysis was used to evaluate technical efficiency. The coefficients for land, labor, and fertilizer had positive values of 1.07, 1.93, and 1.99 respectively. The results show that the mean technical efficiency of farmers is 93% ranges from 74% to 97%. This implies that there is room to improve the efficiency level of farmers on average by 7% using current technology and available inputs. The variables of age, education level, access to extension, and household size negatively affected technical inefficiency.

Nabi *et al.* (2020) estimated that the cultivation of chilies was 1785.53 Kilograms per acre and the price per Kilogram was 102.81 rupees. The total cost of cultivation of chili

with opportunity cost was 102543.44 rupees and 85334.45 rupees without opportunity cost per acre. But, per acre revenue profit was 183506.74 rupees, similarly net return of chili with opportunity cost was 80963.30 Rupees and without opportunity cost was 98172.29 rupees per acre respectively.

Purwasih and Bahtera (2020) in Central Bangka, the red chili productivity is still considered at low level. It is corroborated from comparison between the productivity of red chili pepper which is computed as 35.6 quintal per hectare while the potential productivity of the genetics of red chili pepper is 200-220 quintal per hectare. It is presumed that the productivity of red chili pepper is technically inefficient. The study also determines the level of technical efficiency of red chili on smallholders who participate in the agriculture productivity improvement program in Central Bangka Regency. The productivity of red chili was considered as technically inefficient which was shown from the average score of technical efficient, 0.54.

Tsopoe *et al.* (2020) from the study on economic analysis of chili cultivation revealed that on an average per hectare total cost of chili cultivation was 1,38,596.67 rupees with a gross income of 3,00,440 rupees. The average yield of chili was found to be 75.00 quintal per ha. Considering the prevailing price of chili in the study area which is 4,000.00 rupees per quintal the gross income was found that the average net return from chili cultivation 1,52 888.66 rupees. Out of the total cost, the share of variable cost and fixed cost constitute 93.59 percent and 6.41 percent respectively. Whereas the benefit cost ratio was found out to be 2.24.

Gregorio *et al.* (2021) the purpose was to analyze the performance, investment and profitability of three chili hybrids in Mexico. The hybrids evaluated were: Caloro, Serrano Platino and Jalapeno Valquiria. The yield (ton per hectare) was calculated with the number of harvested, multiplied by 30 kilograms for Caloro and Jalapeno, and 25 kilograms for Serrano. Economic income, cost / benefit ratio, equilibrium point and invested weight gain were estimated. Chile Serrano registered to 41 ton per hectare, surpassed Caloro and Jalapeno by 8.39 and 36.0%, respectively. Caloro's production cost was 556,347.00 dollar per hectare, 34 and 51% higher than Serrano and Jalapeno. The income obtained from the sale of Serrano pepper was 969,050.00 dollar, 3.9 and 31% higher than Caloro and Jalapeno. The benefit cost ratio for Serrano was 1.78; Caloro, 1.67 and Jalapeno, 1.21.

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

CHAPTER III

METHODOLOGY

3.1. Introduction

Farm management research depends on the proper methodology of the study. Proper methodology is a prerequisite of a good research. The design of any survey is predominantly determined by the nature, aims, and objectives of the study. It also depends on the availability of necessary resources, materials and time. There are several methods of collecting data for farm management research. A farm business study usually involves collection of information from individual farmers; collection of data for farm business analysis involves judgment of the analyst in the selection of data collection methods within the limits imposed by the resources available for the work (Dillon and Hardaker 1993). In this study, “survey method" was employed mainly due to two reasons:

i. Survey enables quick investigations of large number of cases; and

ii. Its results have wider applicability.

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

3.2. Selection of the Study Area

Selection of the study area is an important step for farm management study. The selection of an area fulfilled the particular purpose which was set for the study and also the possible cooperation from the cultivator. Although chili is grown all over Bangladesh, the district Sylhet is one of the important districts where it is grown. So, on the basis of chili cultivation, 3 Sub-Districts namely Jaintapur, Gowainghat and Kanaighat under Sylhet region were purposively selected for the study.

The main reasons in selecting the study area were as follows:

a) Availability of a large number of chili cultivators in the study area;

b) These villages had some identical physical characteristics like topography, soil and climatic conditions for cultivating chili;

c) Easy accessibility and good communication facilities in these villages; and Co-operation from the respondents was expected to be high so that the reliable data would be obtained.

3.3. Sampling technique and sample size

In selecting samples for a study two factors need to be taken into consideration. The sample size should be as large as to allow for adequate degrees of freedom in the statistical analysis. On the other hand, administration of field research, processing and analysis of data should be manageable within the limitation imposed by physical, human and financial resources. However, because of diversity in the technical and human environment, it is necessary to sample several numbers of the population before any conclusion can be drawn. Therefore, the purpose of sampling is to select a sub-set of the population that is representative of the population.

It was not possible to include all the farmers of the study area due to limitation of time, money and personnel. In total 70 farmers were randomly selected. From Jaintapur 25, Gowainghat 20 and Kanaighat 25 cultivators had taken. A **purposive random sampling** technique was followed in the present study for minimizing cost, time and to achieve the ultimate objectives of the study.

3.4. Preparation of the survey schedule

A draft questionnaire was prepared for collecting information from the sample farmers. Keeping the objectives of the study in mind, the questionnaire was pre-tested by interviewing some cultivators who cultivated chili and necessary modifications, additions and alternations were made and then draft questionnaire was finalized.

The final questionnaire contained three categories of information. The purpose of the first category was to obtain information about the socioeconomic conditions of the selected farmers. The second category contained information related to costs and returns. The third category of information was related to constraints and problems faced by the farmers in cultivating chili.

3.5. Period of the Study

Data had been collected during the period from November to December, 2020. Data associated with inputs and outputs were gathered by giving energy and making time to time visit in the study area in those times.

3.6. Data collection techniques

For the present study, data were collected from the chili growing farmers through field survey. The researcher himself collected the relevant data from the selected chili growers. Before interviewing, the selected farmers were contacted so that they could be interviewed according to their convenience of time. At the time of interview, the researcher asked questions systematically and explained the aims and objectives of the study whenever it was felt necessary. It was explained to the farmers that the study was purely academic. Farmers were also explained the usefulness of the study in their farm business context. Each time, when interview was over, the interview schedule was checked to be sure that information to each of the item was properly recorded. If there were such items which were overlooked or contradictory, they were corrected through a revisit. In addition to survey, observation method was also applied to collect information by the researcher.

3.7. Data processing, tabulation and analysis

The collected data were manually edited and coded. Then all the collected data were summarized and scrutinized carefully. Moreover, data entry was made in computer and analyses were done using the concerned software Microsoft Excel and STATA. It may be noted here that information was collected initially in local units. After necessary checking it was converted into standard international units.

3.8. Analytical techniques

Data were analyzed with a view to achieving the objectives of the study. Several analytical methods were employed in the present study. Tabular method was used for a substantial part of data analysis. This technique is intensively used for its inherent quality of purporting the true picture of the farm economy in the simplest form. Relatively simple statistical techniques such as percentage and arithmetic mean or average were employed to analyze data and to describe socioeconomic characteristics of chili growers, input use, costs and returns of chili cultivation and to calculate

undiscounted benefit cost ratio (BCR). In order to estimate the level of technical efficiency in a manner consistent with the theory of cultivation function, Cobb-Douglas type stochastic frontier cultivation function was used in the present study.

3.8.1 Analysis of profitability

The net returns of chili were estimated using the set of financial prices. The financial prices were market prices actually received by farmers for outputs and paid for purchased inputs during the period under consideration in this study. The cost items identified for the study were as follows-

a. Preparation of Land

b. Human labor

c. Seedlings

d. TSP

e. Urea

f. MoP

g. Irrigation

h. Insecticide

i. Use of land

j. Interest on operating capital

The returns from the crops were estimated based on the value of main products. In this study variable cost, fixed cost and total cost had been described. Total variable cost (TVC) included land preparation, human labor, seedlings, organic manure, urea, TSP, MoP, insecticides, irrigation and interest on operating capital. Fixed cost (FC) included only rental value of land. Total cost (TC) included total variable cost and fixed cost.

Cost of land preparation

Land preparation considered one of the most important components in the cultivation process. Land preparation for chili cultivation included ploughing, laddering and other activities needed to make the soil suitable for planting seedling. It was revealed that the

number of ploughing varied from farm to farm and location to location. The average land preparation cost was 3753 taka per hectare.

Cost of human labor

Human labor cost was considered one of the major cost components in the cultivation process. It is generally required for different operations such as land preparation, sowing and transplanting, weeding, fertilizer and insecticides application, irrigation, harvesting and carrying, threshing, cleaning, drying, storing etc. In order to calculate human labor cost, the recorded man-days per hectare were multiplied by the wage per man-day for a particular operation. The average wage rate was 450 taka man per day.

Cost of seed

Cost of seed varied widely depending on its quality and availability. Market prices of seeds of respected chili were used to compute cost of seed. The total quantity of seed needed per hectare was multiplied by the market price of seed to calculate the cost of seeds for the study areas. The cost of seed was 3765 taka per hectare.

Cost of TSP

The cost of TSP was also computed on the basis of market price. In order to calculate cost of TSP the recorded unit of TSP per hectare were multiplied by the market price of TSP. The price of TSP was 22 taka per kilogram.

Cost of urea

Urea was one of the important fertilizers in chili cultivation. The cost of urea was computed on the basis of market price. In order to calculate cost of urea the recorded unit of urea per hectare were multiplied by the market price of urea. The price of Urea was 20 taka per kilogram.

Cost of MoP

Among the three main fertilizers used in chili cultivation, MoP was one of them. To calculate the cost of MoP per hectare, the market price of MoP was multiplied by per unit of that input per hectare for a particular operation. The price of MoP was 15 taka per kilogram.

Cost of irrigation

Water management helps to increase chili cultivation. Cost of irrigation varies from farmers to farmers. It was calculated based on how many times irrigation was needed per hectare and what was its cost. The cost of irrigation was 35373 taka per hectare.

Cost of insecticides

Farmers used different kinds of insecticides for 5-7 times to keep their crop free from pests and diseases. Cost of insecticides was calculated based on the market price of the insecticides which was used in the study areas per hectare. The cost of insecticides was 83753 taka per hectare.

Interest on operating capital

Interest on operating capital was determined on the basis of opportunity cost principle. The operating capital actually represented the average operating cost over the period because all costs were not incurred at the beginning or at any single point of time. The cost was incurred throughout the whole cultivation period; hence, at the rate of 10 percent per annum interest on operating capital for four months was computed for chili. Interest on operating capital was calculated by using the following formula:

IOC= AIit

Where,

IOC= Interest on operating capital

i= Rate of interest

AI= Total investment / 2

t = Total time period of a cycle

Land use costs

Land use cost was calculated on the basis of opportunity cost of the use of land per hectare for the cropping period. So, cash rental value of land has been used for cost of land use. The average rental value of land was 63653 taka per hectare.

Calculation of returns

Gross return

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

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

Gross margin

Gross margin is defined as the difference between gross return and variable costs. Generally, farmers want maximum return over variable cost of cultivation. The argument for using the gross margin analysis is that the farmers are interested to get returns over variable cost. Gross margin was calculated on total variable cost. Per hectare, gross margin was gained by subtracting variable costs from gross return. Therefore,

Gross Margin (GM) = Gross return (GR) – Variable cost (VC)

Net return

Net return or profit was determined by deducting the total cultivation cost from the total return or gross return. Therefore,

Net Return (NR) = Total return (TR) – Total cultivation cost (TPC).

Undiscounted Benefit-Cost Ratio (BCR)

Average return to each taka spent on cultivation is an important criterion for measuring profitability. BCR was estimated as the ratio of total return to the total cost per hectare. Therefore,

BCR = Total return (Gross return)/ Total cost

3.8.2 Technical efficiency evaluation

Technical efficiency refers to the ability of a firm to produce the maximum possible output from a given set of inputs and given technology. A technically efficient farm will operate on its frontier cultivation function. Given the stated relationship the firm is technically efficient if it produces on its outer-bound cultivation function to obtain the

maximum possible output which is feasible under the current technology. Putting it differently a firm is considered to be technically efficient if it operates at a point on an isoquant rather than interior to the isoquant. The homogeneity of inputs is a vital factor for achieving technically efficient output. No one would dispute that the output produced from given inputs is a genuine measure of efficiency, but there is room for doubt whether, in a particular application, the inputs of a given firm are really the same as those represented by the corresponding point on the efficient isoquant. But it is important to note that mere heterogeneity of factors will not matter, as long as it is spread evenly over firms, it is when there are differences between firms in the average quality (or more strictly, in the distribution of qualities) of a factor, that a firm's technical efficiency will reflect the quality of its inputs as well as the efficiency of its management.

3.8.2.1 Stochastic frontier models

The most widely discussed, theoretically reasonable and empirically competent method of measuring efficiency is the stochastic frontier model. It is an improvement on the traditional average cultivation function and on all types of deterministic frontiers in the sense that it introduces in addition to one-sided error component a symmetric error term to the model. This permits random variation of the frontier across farms, and captures the effects of measurement error, other statistical noise arid random shocks outside the firm's control. A one-sided component captures the effects of inefficiency relative to the stochastic frontier. The stochastic frontier model is also called the 'composed error' model introduced by Aigner, Lovell and Schmidt (1977). It was later extended and elaborated by Jondrow et al. (1982). The notion of a deterministic frontier shared by all farms ignores the very real possibility that a farm’s performance may be affected by factors entirely outside its control (such as poor machine performance, bad weather, input supply breakdowns, and so on), as well as by factors under its control (inefficiency). But stochastic frontiers consider all the factors while estimating the model and accordingly it separates firm- specific efficiency and random error effect. Thus the efficiency measurements as well as the estimated parameters are unbiased.

3.8.2.2 Stochastic cobb-douglas frontier production function

The Cobb-Douglas cultivation function is probably the most widely used form for fitting agricultural cultivation data, because of its mathematical properties, ease of

interpretation and computational simplicity (Heady and Dillion, 1969; Fuss and Mcfadden, 1978). The Cobb-Douglas function has convex isoquants, but as it has unitary elasticity of substitution; it does not allow for technically independent or competitive factors, nor does it allow for Stages I and III along with Stage II. That is, MPP and APP are monotonically decreasing functions for 35 all X- the entire factor-factor space is Stage II-given $0 < b < 1$, which is the usual case. However, the Cobb-Douglas may be good approximation for the cultivation processes for which factors are imperfect substitutes over the entire range of input values. Also, the Cobb-Douglas is relatively easy to estimate because in Logarithmic form it is linear in parameters; it is parsimonious in parameters (Beattie and Taylor, 1985).

A stochastic cobb-douglas frontier model could be written as

$$\mathbf{Y_i = f(X_i, \beta) \exp.(V_i - U_i)} \qquad \mathbf{i = 1, 2, 3, \ldots\ldots, N}$$

Where,

The stochastic cultivation frontier is $f(X_i, \beta) \exp.(V_i)$,

V_i having some symmetric distribution to capture the random effects of measurement error and exogenous shocks which cause the placement of the deterministic kernel $f(X_i, \beta)$ to vary across farms.

The technical inefficiency relative to the stochastic cultivation frontier is then captured by the one-sided error component $U_i > 0$. The explicit form of the stochastic Cobb-Douglas cultivation frontier is given by

$$Y = a\Pi_{i=1}^{\lambda} X_i^{bi} \exp.(\varepsilon)$$

Where,

Y is the frontier output,

X is physical input,

b is the elasticity of Y with respect to X,

a is intercept

$\mathcal{E} = V-U$ is a composed error term as defined earlier.

For simplicity, we have ignored the subscript. The estimation of the model and derivation of technical efficiency is the same as described earlier.

3.8.2.3 Specification of Cultivation Model

Cobb-Douglas Stochastic Frontier Cultivation Function has taken in order to estimate the level of technical efficiency.

The stochastic frontier could be written as follows:

$Y_i = \beta_0 X_1\beta_1 X_2\beta_2 \ldots\ldots\ldots X_5\beta_5 \quad e^{Vi-Ui}$

Stated function is linearized double-log form:

$\ln Y = \ln\beta_0 + \beta 1\ln X_1 + \beta 2\ln X_2 + \beta 3\ln X_3 + \beta 4\ln X_4 + \beta 5\ln X_5 + V_i - U_i$

Where,

Y = Output (kg/ha)

X_1 = Cost of human labor (man days/ha)

X_2 = Cost of seed (Kg/ha),

X_3= Cost of fertilizer (kg/ha)

X_4 = Cost of insecticide (Tk./ha)

X_5 = Cost of irrigation (Tk./ha).

i = Number of variable

The effects of the technical inefficiency model in the stochastic cultivation frontier equation is stated as follows:

$U_i = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \delta_3 Z_3 + \delta_4 Z_4 + \delta_5 Z_5 + + W_i$

Where,

Z_1 to Z_5 are explanatory variable

The equation can be formed as:

$U_i = \delta_0 + \delta_1$ Chili farming experience + δ_2 Farm size + δ_3 Extension service + δ_4 Training + δ_5Taking loan + W_i

V is a two-sided uniform random variable beyond the control of farmer having N (0, σ 2) distribution.

U is a one-sided technical inefficiency effect under the control of a farmer having a positive half-normal distribution {U_i~|N (0, σu2)|} and

W_i is two-sided uniform random variable.

W is an unobservable random variable having a positive half-normal distribution. The model was estimated simultaneously using STATA.

CHAPTER IV

SOCIO-DEMOGRAPHIC PROFILE OF HOUSEHOLD POPULATION

4.1 Introduction

The point of this part is to present a brief description of the socio-economic characteristics of the growers delivering chili. Socioeconomic l parts of the growers can be viewed from various perspectives relying on various factors identified with their degree of living, the financial condition where they live and the nature and the degree of the growers ' support in national advancement exercises. It was impractical to gather all the data with respect to the financial attributes of the example growers because of confinement of time and assets. Financial state of the example growers is significant in the event of research arranging in light of the fact that there are various interrelated and constituent qualities describes an individual and significantly impacts advancement of his/her conduct and character. Individuals contrast from each other for the variety of financial perspectives. Nonetheless, for the present research, a couple of the financial qualities have been contemplated for exchange.

4.2 Education

25, 20, and 25 samples are respectively cover Jaintapur, Gowainghat, and Kanaighat upazila that represented the total population.

Table 4.1 Level of education of study areas participants

Level of Education	Study Area			
	Jaintapur	Gowainghat	Kanaighat	Total
Primary	14	10	13	37
Secondary	9	8	9	26
Higher Secondary	1	2	2	5
Above	1	0	1	2
Total	25	20	25	70

Source: Field survey, 2020

In Jaintapur upazila, out of 25 cultivators, 14 cultivators have completed primary education, 9 were secondary and 1was higher secondary and above higher secondary level was completed by 1 farmers.

In Gowainghat upazila, out of 20 cultivators, 10 cultivators have completed primary education, 8 were secondary and 2 was higher secondary and none above higher secondary level was completed.

In Kanaighat upazila, out of 25 cultivators, 13 cultivators have completed primary education, 9 were secondary and 2 were higher secondary and above higher secondary level was completed by 1 farmers. (Table 4.1).

4.3 Age

In Jaintapur upazila, 20% of the 25 sample populations were 0-35 years, 68% were 35-60 years and 12% were above 60 years old.

Table 4.2 Age of study areas participants

Age of the Respondents	Study Area			
	Jaintapur	Gowainghat	Kanaighat	Total
0-35	5	2	3	10
35-60	17	14	18	49
Above 60	3	4	4	11
Total	25	20	25	70

Source: Field survey, 2020

In Gowainghat upazila, 10% of the 20 sample populations were 0-35 years, 70% were 35-60 years and 20% were above 60 years old.

In Kanaighat upazila, 12% of 25 the sample populations were 0-35 years, 72% were 35-60 years and 16% were above 60 (Table 4.2).

4.4 Family size:

The average family size was 5.7, 5.3, and 5.9 respectively for Jaintapur, Gowainghat, and Kanaighat upazila. (Figure 4.1)

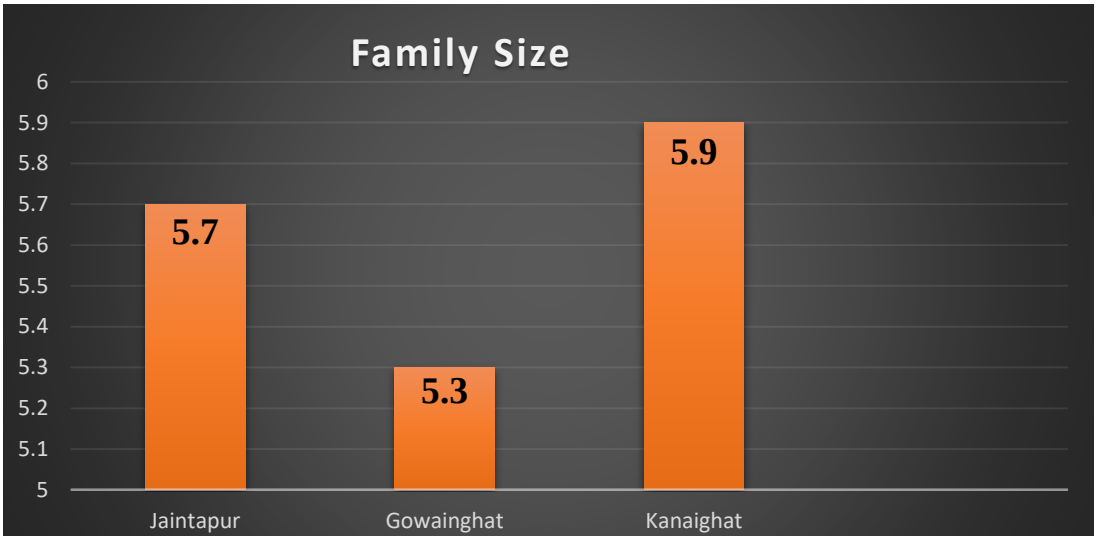

Figure 4.1 Participants family size of study area

Source: Field survey, 2020

4.5 Agricultural Training

Among the respondent farmers in Jaintapur Upazila, only 44% of farmer's got training in chili farming.

Whereas, 45% of farmers got training in Gowainghat upazila.

And 40% farmers got training in Kanaighat upazila (Table 4.3).

These trainings have improved their perceptions of good seed use, use of resistant varieties, application of insecticides and pesticides, water management, and so on.

Table 4.3 Agricultural training of study areas participants

Training taken	Jaintapur		Gowainghat		Kanaighat	
	No.	Percentage (%)	No.	Percentage (%)	No.	Percentage (%)
Yes	11	44	9	45	10	40
No	14	56	11	55	15	60
Total	25	100	20	100	25	100

Source: Field survey, 2020

4.6 Conclusion

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

CHAPTER V

FINANCIAL PROFITABILITY OF CHILI CULTIVATION

The identity of this chapter is to estimate the costs, returns and financial profitability of cultivating chili and to focus on the main factors affecting the return of chili cultivation. The items of costs include fertilizer, manure, insecticide and pesticide, irrigation, seed, labor cost, land preparation cost, land use cost and cost on operating capital. The costs and returns of chili cultivation are discussed below.

5.1 Variable Costs

Cost of human labor

Human labor cost is one of the major cost components in the cultivation process. It is one of the most important and largely used inputs for producing chili. It is generally required for different operations such as land preparation, sowing, weeding, fertilizer and insecticides application, irrigation, harvesting and carrying, threshing, cleaning, drying, storing etc. The quantity of human labor used in chili cultivation was found to be about 460 man-days per hectare and average price of human labor was Tk. 450 per man-day. Therefore, the total cost of human labor was found to be Tk. 207000 representing 48.51 percent of total cost. (Table 5.1)

Cost of land preparation

Land preparation is the most important component in the cultivation process. Land preparation included ploughing, laddering and other activities needed to make the soil suitable for chili cultivation. For land preparation in chili cultivation, no. of tiller was required 3 with Tk. 3753 per tiller. Thus, the average land preparation cost of chili cultivation was found to be Tk. 11259 per hectare, which was 2.64 percent of total cost. (Table 5.1)

Cost of seed

Cost of seed varied widely depending on its quality and availability. Per hectare total cost of seed for chili cultivation were estimated to be Tk. 3765, which constituted 0.88 percent of the total cost. (Table 5.1)

Cost of TSP

Among the different kinds of fertilizers used, the rate of application of TSP 148 kilogram was similar to urea fertilizers. The average cost of TSP was Tk. 3256 which representing 0.76 percent of the total cost. (Table 5.1)

Cost of urea

In the study area, farmers used different types of fertilizers. On an average, farmers urea 253 kg used per hectare. Per hectare cost of urea was Tk. 5060, which represents 1.19 percent of the total cost. (Table 5.1)

Cost of MoP

The application of MoP per hectare 127 kilogram was found lower than other fertilizers. Per hectare cost of MoP was Tk. 1905, which represents 0.45 percent of the total cost. (Table 5.1)

Cost of insecticides

Farmers used different kinds of insecticides to keep their crops free from pests and diseases. The average cost of insecticides for chili cultivation was found to be Tk. 83753 which was 19.63 percent of the total cost. (Table 5.1)

Cost of irrigation

Cost of irrigation is one of the most important costs for chili cultivation. Cultivation of chili largely depends on irrigation. Right doses application of irrigation water help to increase bulb diameter, number of cloves, and number of leaves and plant height. As a result yield per hectare is being increased. The average cost of irrigation was found to be Tk. 35373 per hectare, which represents 8.29 percent of the total cost. (Table 5.1)

Interest on operating capital

The interest on operating capital was calculated by taking in to account all the operating costs incurred during the cultivation period of chili. Interest on operating capital for chili cultivation was estimated at Tk. 11712 per hectare, which represents 2.74 percent of the total cost. (Table 5.1)

Total variable cost

Different cost items that stated before, it was clear that the total variable cost of chili cultivation was Tk. 363083 per hectare, which was 85.09 percent of the total cost. (Table 5.1)

Table 5.1 Cost of chili cultivation by per hectare

Cost items	Quantity (No./ha) (man-days/ha) (Kg/ha)	Price (Tk./ha) (man/day) (Tk./Kg)	Cost (Tk./ha)	Percentage of Total cost
Preparation of land by power tiller	3	3753	11259	2.64
Human labor	460	450	207000	48.51
Seed			3765	0.88
Urea	253	20	5060	1.19
TSP	148	22	3256	0.76
MoP	127	15	1905	0.45
Cost of insecticides			83753	19.63
Cost of irrigation			35373	8.29
A.Total Operating Cost (TOC)			**351371**	**82.34**
Interest on operating capital @ of 10% for month			11712	2.74
B.Total Variable Cost (TVC)			**363083**	**85.09**
Rental value of land			63653	14.92
C. Total Fixed Cost (TFC)			**63653**	**14.92**
D. Total Cost (B+C)			**426736**	**100.00**

Source: Field survey, 2020

5.2 Fixed cost

Land rent

Land rent was estimated on the basis of the opportunity cost of the use of land per hectare for the cropping period of three months. The cash rental value of land has been

used as the cost of land use. On the basis of the data collected from the chili growers, the cost of land use was identified as Tk. 63653 per hectare, and it was 14.92 percent of the total cost. (Table 5.1)

5.3 Total cost of chili cultivation

Cost of total was calculated by adding all the costs of variable and fixed inputs. In the present study per hectare, the total cost of producing chili was got to be Tk. 426736. (Table 5.1)

5.4 Return of chili cultivation

Gross return

Per hectare gross return was determined by multiplying the total amount of product with respective per unit price. It is evident from the table that the average yield of chili per hectare was 37397.33 kg and the average price of chili was Tk. 21. Therefore, the gross return was received to be Tk. 785343.93 per hectare. (Table 5.2)

Table 5.2 Cost and return of chili cultivation of per hectare

Measuring Items	Result
Cultivation of Chili (Kg. /ha)	37397.33 Kg.
Price of Chili (Tk. /kg)	21
Value of Main Product	785343.93 Tk.
Gross Return (GR)	785343.93 Tk.
Total Variable Cost (TVC)	363083 Tk.
Total Cost (TC)	426736 Tk.
Gross Margin (GM = GR - TVC)	422260.93 Tk.
Net Return (NR = GR – TC)	358607.93 Tk.
Benefit-Cost Ratio (BCR = GR / TC)	1.84

Gross margin

Gross margin offers the gross come back over variable value. The ratio was estimated by subtracting the entire variable value from the gross come back. On the idea of the info, the ratio was found to be Tk. 422260.93 per area unit. (Table 5.2)

Net return

Net return or profit was determined by subtracting the total cultivation cost from the gross return. According to data, the net return was obtained as Tk. 358607.93 per hectare.

Benefit-Cost Ratio (Undiscounted)

Benefit-Cost Ratio (BCR) is a comparative measure, which is applied to compare benefit per unit of cost. We found BCR 1.84 that implies, one taka investment in chili cultivation, yielded Tk. 1.84 (Table 5.2). We can also made a decision that chili cultivation is profitable in Sylhet.

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

CHAPTER VI

TECHNICAL EFFICIENCY OF CHILI CULTIVATORS

6.1 Interpretation of maximum likelihood estimates of the stochastic frontier production function

Maximum likelihood estimation begins with writing a mathematical expression known as the Likelihood Function of the sample data. The likelihood of a set of data is the probability of obtaining that particular set of data, given the chosen probability distribution model. This expression contains the unknown model parameters. The values of these parameters that maximize the sample likelihood are known as the Maximum Likelihood Estimates or MLE's. (Table 6.1)

The maximum likelihood estimates for parameters of the Cobb-Douglas stochastic frontier cultivation function and technical inefficiency effect model for chili cultivation for all farmers are presented in Table 6.1. Asides from estimates of coefficients in the model, the output also provides other variance parameters such as sigma square ($\sigma 2$), gamma (γ) and log-likelihood function.

Cost of human labor (X_1)

The regression coefficients of human labor (X_1) was not significant. (Table 6.1)

Cost of seed (X_2)

The regression coefficient of seed cost (X_2) of chili production was negative and significant at 1 percent level of significance, which implied that if the expenditure on seed was increased by 1 percent then the yield of chili would be decreased by 0.5979 percent, other factors remaining constant. (Table 6.1)

Cost of fertilizer (X_3)

The regression coefficients of fertilizer (X_3) was not significant. (Table 6.1)

Cost of insecticide (X_4)

The regression coefficient of insecticides cost (X_4) of chili production was positive and significant at 1 percent level of significance, which implied that if the expenditure on insecticides was increased by 1 percent then the yield of chili would be increased by 0.4041 percent, other factors remaining constant. (Table 6.1)

Cost of irrigation (X_5)

The magnitudes of the coefficients of irrigation cost (X_5) was negative and significant at 5 percent level of significance. The result of the analysis indicated that, keeping other factors constant, a 1 percent increase in additional expenditure on irrigation would decrease the yield of chili by 0.4073 percent. (Table 6.1)

Table 6.1 Maximum likelihood estimates for parameters of cobb-douglas stochastic frontier production function and technical inefficiency model for chili cultivators

Variables	Parameter	Coefficients
Stochastic Frontier:		
Constant (X_0)	β_0	5.8793*
Human Labor (X_1)	β_1	0.5772
Seed (X_2)	β_2	-0.5979
Fertilizer (X_3)	β_3	0.0131
Insecticide (X_4)	β_4	0.4041***
Irrigation (X_5)	β_5	-0.4073
Inefficiency Model:		
Constant	δ_0	0.7231*
Experience (Z_1)	δ_1	-0.0631*
Farm size (Z_2)	δ_2	-0.1471***
Extension service (Z_3)	δ_3	-0.0287
Training (Z_4)	δ_4	0.7431
Credit service (Z_5)	δ_5	-0.8421
Log-likelihood Function		-52.7363

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

Source: Field survey, 2020

6.2 Interpretation of technical inefficiency model

In the technical inefficiency effect model experience, farm size, extension service and credit service have anticipated negative coefficients.

The negative and 1 percent significant coefficient of experience (Z_1) reveals that experienced farmers are technically more efficient than other farmers.

The negative coefficient and significant at 10 percent level of significance of farm size (Z_2) implies that large farm households are technically more efficient than other farm households.

The negative coefficient of extension service (Z_3) indicates that farmers having contacts with extension officers are technically more efficient than others. Although this coefficient is not statistically significant.

The coefficients of training (Z_4) is positive meaning that these factors have no impact on the technical inefficiency. That is, these factors do not reduce or increase technical inefficiency of cultivating chili.

The negative coefficient of credit service (Z_5) shows that farmers taking loan for cultivating chili are technically more efficient than others. Although this coefficient is not statistically significant. (Table 6.1)

6.3 Frequency distribution of technical efficiency

The mean estimated technical efficiencies for chili are 81 percent which reveals that chili cultivation could be increased by 19 percent with the same level of inputs without incurring any further cost.

It was observed that 34.29 percent of sample farmers were found to have received outputs which were very close to the maximum frontier outputs maintaining the efficiency level more than 95 percent.

On the other hand, 44.29 percent of sample farmers obtained 71 to 90 percent technical efficiency level.

The minimum and maximum technical efficiencies were observed to be 10 and 99 percent respectively, where standard deviation was estimated at 0.17. (Table 6.2)

Table 6.2 Technical efficiency and its distribution of chili cultivators

Efficiency (%)	No. of growers	Percentage of growers
0-50	3	4.29 %
51-60	5	7.14 %
61-70	7	10 %
71-80	10	14.29 %
81-90	21	30 %
91-100	24	34.29 %
Total no. of cultivators	70	100%
Minimum	0.10	
Maximum	0.99	
Mean	0.81	
Standard Deviation	0.17	

Source: Field survey, 2020

6.4 Concluding remarks

By observing, it is discerned that cultivation of chili is a labor-intensive work. Use modern inputs such as seeds, fertilizers, human labor, power tiller, pesticides, and irrigation efficiently are very crucial part. Timely and efficient use of these inputs is the most vital to augment yield and profitability. Chili cultivation could help the cultivators to increase their livelihood. Within the technical inefficiency effect model; experience, farm size, extension service, and credit service have anticipated negative coefficients. The negative and 1percent significant coefficient of experience reveals that experienced cultivators are technically efficient than others. Based on discussion we can be concluded here that the cultivation of chili is profitable.

CHAPTER VII

PROBLEMS OF CHILI CULTIVATION

The constraints which are responsible for lowering the yield of the selected cultivators have been discussed in this chapter. The growers concerned about the barriers in the cultivation and marketing of chili in this district are depicted in Table 7.1.

Most of the growers noticed that the major problems are insect- pests and diseases, generally leaf curl, and powdery mildew and fruit borers.

Out of 70 farmers, 63 which is 90% concerned the problems of insect pests and diseases in the observed area. They suggested that diseases and insect pest-resistant varieties must serve to the farmers.

Table 7.1 Problems noticed by the cultivators of chili

Serial No.	Elements	No. of Cultivators	Percentage of total no of Cultivators
A.	**Problems in cultivation**		
1.	Issue of insect-pest and diseases	63	90
2.	Inappropriate application of fertilizer and pesticide	53	75.71
3.	Dearth of HYV variety	52	74.29
4.	Insufficient of soil testing facility	35	50
5.	Lack of organizational support	35	50
6.	Lack of technical know-how	17	24.29
B.	**Marketing problem**		
1.	Lack of regulate market and co-operative market	21	30

Source: Field survey, 2020

An important issue occupied that about 75.71% of farmers is unable to properly use of fertilizers and pesticides. Technical know-how may be a due for properly use of fertilizers and pesticides. Therefore, it is vital that the department of agriculture should organize training programs to develop aware of the farmers in exact use of fertilizers, pesticides, and other technical knowledge.

Soil testing facility is one of the issues faced by the 50% growers. So, soil testing equipment should be available at least at block level along with a recommended dose of fertilizer and manure according to the soil test.

Another constraint is the unavailable of seed during peak period faced by chili growers of the Sylhet district. The dearth of High yielding seed is recorded to be a severe issue noticed by 74.29% of the producers.

Do not get any organizational support in chili cultivation such as supply of seed, supply of plant protection chemicals, and technical support about 50% of cultivators.

There is no serious problem in the marketing of chili by the chili cultivators because of the high demand of chili.

CHAPTER VIII

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

8.1 Summary of the study

Chili is one of the most vital commercial crops of Bangladesh. Chili is a crop of tropical and sub-tropical areas and needs a warm humid environment. A number of varieties of chilies are grown, which can be used as vegetables, condiments, and pickles. Chili occupies an important place in the Bangladeshi diet and it is a vital element in the kitchen, as it is taken daily as a spice in various forms. Chili is affluent in vitamin A and C which has many medicinal attributes. The global area and cultivation of chili are around 38.0 millions of tons.

Bangladesh produced 158 metric tons by cultivating around 239 acres of land in 2019-20 session. Chilies are produced in almost all districts of Bangladesh and Sylhet is one of the major growing district in terms of cultivation. The total area under spices is 92769 hectares in the Sylhet district with a cultivation of 632031 metric tons.

Chili is one of the vital spice crops of Sylhet district with an area and cultivation of 1315 hectares and 8912.47 tons respectively and productivity was 21.73 metric tons green chili per hectare during 2019-20.

Not only for a huge country market but also for export destination Chili has been cultivating all over Bangladesh. The cultivation of chilies plays a crucial role in improving the economic situation of the growers and fulfill the nutritional needs of the people of Bangladesh. The present study will give the answers to some of the important questions related to the aspects such as the advancement of this crop, cost of cultivation, returns from this crop, and drawbacks to its cultivation and marketing. However, organized research work was essential to carry out for this crop in order to make available complete information to the growers who want to cultivate this crop. So, the study was conducted under in Sylhet district of Sylhet division to fulfillment of the following specific objectives.

1. To know the socio-economic features of chili cultivators in the study region.

2. To determine the cost, return and profitability of chili cultivators.

3. To estimate technical efficiency of chili growers and

4. To find out some problems for enhancing chili cultivation.

Purposively the sampling frame was taken where the chili cultivation was intensive. Based on the higher concentration of chili crop cultivation, three upazila namely Jaintapur, Gowainghat and Kanaighat in Sylhet was accepted.

A sample size of 60 is normally related as the minimal needs for a larger population that will yield a sufficient level of certainty for decision-making (Poate and Daplyn, 1993).

For this reason, the farmers who were cultivating different varieties of robi chili in the accepted areas were taken as samples. Cultivators generally sow robi chili from September to November and harvest after three months.

For the study, data have collected during the period of November to December 2020. Primary data were accumulated from primary actions. Selected respondents were interviewed personally by pre-tested questionnaires. The collected data were checked and reviewed for the targets of consistency, accuracy, and completeness. All the collected data were summarized properly to remove all possible errors. Data entry was done in computer and analysis was done by Microsoft Excel and STATA.

It is crucial to determine the financial profitability to generate decisions for producing any crop at the farm level. Based on net return, gross margin, and the ratio of return to the total cost; it can be calculated. The average land preparation cost of chili growing was gotten Tk.11259 per hectare. Human labor cost in chili cultivation was about 460 man-days per hectare and the average price of human labor was Tk. 450 per man-day. Then we got the total cost of human labor almost Tk. 207000 representing 48.51 percent of the total cost. Per hectare total cost of seed for chili cultivation was determined, Tk. 3765. Growers used Urea, TSP, MoP approximately 253 Kg, 148 Kg, and 127 Kg per hectare. The average cost of insecticides for chili cultivation was found around Tk. 83753. Whereas the average cost of irrigation was Tk. 35373 per hectare. The total variable cost of chili yield was Tk. 363083 per hectare that was 85.09 percent of the total cost.

The value of the average cultivation of chili per hectare was around Tk.785343.93. The gross return, gross margin, and net return were found approximately Tk. 785343.93, Tk. 422260.93, and Tk. 358607.93 per hectare.

Benefit-Cost Ratio (BCR) was estimated about 1.84 which expresses that one taka investment in chili cultivation made Tk. 1.84.

The ability of a farmer to attain the maximum possible output from a given level of inputs determined by the technical efficiency. It measured according to the deviation of a grower from the best-practice frontier. The regression coefficients of Human labor (X_1), Fertilizer (X_3), and Insecticides cost (X_4) were positive but the coefficient of Seed (X_2) and Irrigation (X_5) was gotten negative. It indicates that if Human labor, Fertilizer, Insecticides cost were increased by 1%, then the cultivation of chili could be increased by 0.5772, 0.0131, and 0.4041 percent of sample farmers respectively. The mean estimated technical efficiencies for chili are 81 percent which defines that chili cultivation could be increased by 19 percent with the same level of inputs without accumulating any additional cost.

A lot of issues in growing chili such as social and cultural, financial and technical. Scarcity of quality seed was one of the most important drawbacks of producing chili in the study area. Dearth of operating capital, high price of quality seed, high cost of irrigation water, shortage of human labor, and lack of quality tillage were the main issues experienced by growers. Hinders for the producers of chili in the study area need to be mitigated. Public and private measures should be taken to abate or eliminate these issues for the better cultivation of chili.

8.2 Conclusions

Chili is one of the important spice crops grown by farmers mainly for market purpose. The study areas have tremendous potential for chili cultivation. The findings of the present study indicate that chili cultivation is highly profitable and it would help to improve the socioeconomic condition of sample farmers in the study areas. As chili is a labor intensive crop, it would help to create employment opportunities. In Bangladesh, it is difficult to increase chili cultivation by increasing the area of land under cultivation due to the limitation of land. But, there is an opportunity to increase production of chili by improving the existing production technology. Farmers are relatively inefficient due to land fragmentation, less experience, illiteracy, etc. The present study indicate that farmers are technically efficient that means there is an opportunity to increase production to a large extent using the existing level of agricultural inputs, the agricultural extension services and the available technology.

If the modern inputs could be made available to the farmers in time, cultivation of this crop might be increased which could help them in alleviating rural poverty in many areas. Chilies are only produced in winter season. But now the BARI introduced some verities of summer chili. However, farmers in the study areas, to some extent have started to cultivate summer chili. Farmers were not known about the application of inputs in right time with right dose. Thus, well-planned management training in accordance with their problems, needs, goals and resources base may lead to viable production practices and sustainable income from chili cultivation.

8.3 Recommendations

On the basis of the finding of the study it was evident that chili cultivation was profitable and it can generate income earnings and employment opportunity to the rural people of Bangladesh. But some problems and constraints bared to attain the above mentioned objectives. The policy makers should, therefore, take necessary measures. According to the findings of the study; some policy recommendations may be advanced which are likely to be useful for policy formulation. The following specific recommendation may be made for the development of chili cultivation.

- As most of the chili farmers are technically efficient at present production technology, improved method of production technology with sufficient storage ability should be introduced.
- As chili cultivation is profitable, government and concern institutions should provide adequate extension program to expand its area and production.
- Chili based cropping pattern should be developed and disseminated to those areas of Bangladesh where their production is suitable.
- Government should take necessary measures to lower the price of inputs which have positive significant impact on yield. It will increase the net benefit of chili producers.
- Adequate training on recommended fertilizer doses, insecticides, use of good seed, intercultural operations, etc., should be provided to the chili farmers which will enhance production as well as technical efficiency by improving the technical knowledge of the farmers.

- ❖ Chili farmers had to sell their product at low price during harvesting or just after harvest. An appropriate storage scheme should be developed so that the farmers are not forced to sell their product at low price during the harvest period.

8.4 Limitations for the study

There are several restrictions of the study these are indicated below.

- ➢ The information and data were collected mostly through the thoughts for the cultivators which were not always proper.
- ➢ The majority of the data had been gathered through interviews of the farmers and sometimes they did not well-cooperate with the interviewer.
- ➢ Due to resource and time constraints, broad based and in-depth study was hampered to some extent.

REFERENCES

Adinarayan, L. (1967). A study of production and marketing of chili in Bapatala block. Unpublished thesis, A.P. Agril.University:58.

BB (2021). Annual Review of Import Payments, Bangladesh Bank, Head Office, Bangladesh Bank, Motijheel, Dhaka.

BBS (2011). Household Income and Expenditure Survey-2010, Bangladesh Bureau of Statistics, Ministry of Planning, Government of the People's Republic Bangladesh, Dhaka.

BBS (2012). Community Report, Population and Housing Census, Bangladesh Bureau of Statistics, Ministry of Planning, Government of the People's Republic Bangladesh, Dhaka.

BBS (2013). Statistical Yearbook of Bangladesh, Bangladesh Bureau of Statistics, Ministry of Planning, Government of the People's Republic Bangladesh, Dhaka.

BBS (2014). Yearbook of Agricultural Statistics, Bangladesh Bureau of Statistics, Ministry of Planning, Government of the People's Republic Bangladesh, Dhaka.

BBS (2021). Statistical Pocketbook of Bangladesh, Bangladesh Bureau of Statistics, Ministry of Planning, Government of the People's Republic Bangladesh, Dhaka.

Beattie, B.R. and Taylor, C.R. (1985). The Economics of Production. Montana State University, John Wiley & Sons, New York.

BER (2021). Bangladesh Economic Review, Department of Finance, Ministry of Finance, Government of the People's Republic of Bangladesh, Dhaka.

Biradar, G. S., & Chandrgi, D. M. (2013). Socio Economic Profile of Chili Farmers and their Constraints in Chili Cultivation in North Eastern districts of Karnataka. *Research Journal of Agricultural Science*, *4*.

Channa, M. H., Sial, M., Dahri, G. N., & Jamro, A. S. (2020). Measuring profitability of chilli pepper production in Sindh, Pakistan. *Journal of Economics and Sustainable Development*, *11*(8), 81-89.

Chile Pepper Institute (2007). The Story of chili pepper, Chile Pepper Institute News Letter, Las Cruces, New Mexico State University.

Dangore, U. T., Bahekar, A. K., Datarkar, S. B., & Darekar, A. S. (2015). Constraints faced by dry chilli growers in production and marketing of dry chilli in Wardha district of Maharashtra. *Agriculture update*, *10*(3), 252-254.

Daundkar KS, Bairagi SK (2015) Economics of production of capsicum in Akola district. International Journal of Commerce, Business and Management 8: 81-83. DOI: 10.15740/HAS/IJCBM/8 .1 /81-83.

Dillon, J.L. and Hardaker, J.B. (1993), Farm Management Research for Small Farmer Development, Food and Agricultural Organization, Rome.

Fuss, M. and Mcfadden, D.(1978). Production Economics: A Dual Approach to Theory and Application. North Holland, Amsterdam.

Gaganjot, S., & Chahal, S. S. (2009). An economic analysis of chilli cultivation in Punjab. *Haryana Journal of Horticultural Sciences*, *38*(3/4), 366-371.

Geo, L., Ariani, W. O. R., & Saediman, H. (2020). Determinants and profitability of small-scale red chili production in Konawe District of Southeast Sulawesi. *Journal of Agriculture and Veterinary Science*, *13*(3), 51-55.

Gregorio, G. T., Ricardo, G. M., & Juan, P. H. (2021). Yield and economic analysis of three chili hybrids (Capsicum annuum, L.) in cuatro caminos, san gabriel, jalisco, Mexico. *Horticult Int J*, *5*(1), 10-12.

Hanumanaikar, R.H., Rajeshwari, N. and Nimbal, M.F. (2006). Socio-economic status, constraints Faced and suggestions expressed by Chili growers in optimum use of pesticide in Tunga Bhadra project area of Bellary district. Mysore Journal of Agricultural Science. 40(2):261-266.

Heady, E.O. and Dillon (1969). Agricultural Production Functions. Iowa State University Press, Ames.

Hiremath SM and Hill. (2012). Yield gap analysis in chili under front line demonstration in Haveri District. *International Journal of science research*, 3 (10) 2277- 8179.

Hiremath, A. P. (1994). Production and marketing of dry chillies in Karnataka-An economic analysis (Doctoral dissertation, University of Agricultural Sciences).

Ila, I. A., Saha, S., & Mukul, A. Z. A. (2019). Financial profitability of green chilli production: a case study in Bogra district of Bangladesh. *Journal of Bioscience and Agriculture Research*, *19*(01), 1606-1612.

Jagtap PP, Shingane UU, Kulkarni KP. (2012). Economics of chili production in India. *African Journal of Basic & Applied Sciences*, 4 (5): 161-164.

Jan, J. A., Nabi, G., Khan, M., Ahmad, S., Shah, P. S., & Hussain, S. (2020). Foliar application of humic acid improves growth and yield of chilli (Capsicum annum L.) varieties. *Pakistan Journal of Agricultural Research*, *33*(3), 461.

Jondrow, J., Lovell, C.A.K., Masterov, L.S. and Schmidt, P. (1982). On the Estimation of Technical Efficiency in the Stochastic Frontier Production Function Model. *Journal of Economics.* 19: 233-238.

Kariem, M.R.; M. Ahmed; A.K.M.H. Haqque and A.S.H.M. Talukdar (1999). Contribution of factors to summer chilli productivity differential between large and small farms in Bangladesh. *Thai J.Agric. Sci*., 32(3): 377-383.

Karyani, T., Susanto, A., Djuwendah, E., & Hapsari, H. (2020). Red chili agribusiness and the risks faced by the farmers. In *IOP Conference Series: Earth and Environmental Science* (Vol. 466, No. 1, p. 012002). IOP Publishing.

Khan, M. T. I., Qamar, A., Muhammad, A., & Muhammad, W. (2017). Economic analysis of open field chilli (Capsicum annuum L.) production in Punjab, Pakistan. *Journal of Experimental Biology and Agricultural Sciences*, *5*(1), 120-125.

Korikanthinath,V.S.; Govardhan Rao; G.M. Hiremath; K.V. Peter and G. Rao (2000). Resource productivities and their optimum utilization pattern in chilli based mixed cropping system — An Economic analysis, 57(1):83-86.

Mariyono, J., & Sumarno, S. (2015). Chilli production and adoption of chilli-based agribusiness in Indonesia. *Journal of Agribusiness in Developing and Emerging Economies*.

Mishra J.P.,Vishwakaram R.S. and Rawat K. (1999). Production and marketing of chillies. *The Bihar journal of Agricultural Marketing* 7(1): 36-43.

Mohanachandran, K., & Wijetunga, C. S. (2020). Technical Efficiency and Inefficiency Determinants of Chili Cultivation in Vavuniya District of Sri Lanka.

Mutkule, S. R., Wattamwar, V. T., Narkar, G. S. and Geete, M. H. (2001). Constraints in adoption of chili technology. *Maharashtra Journal of Extension Education* 20: 85-87.

Naik, V. R., Kunnal, L. B., Patil, S. S., & Guledgudda, S. S. (2012). Organic and inorganic cultivation of chilli and its marketing-an economic analysis. *Karnataka Journal of Agricultural Sciences*, *25*(2).

Olayiwola (2014). An economic analysis of chili crop production in Ilora area of Oyo State. *International Monthly Refereed Journal of Research*, Management & Technology 3: 47-53.

Patel, V. K., Gupta, S. P., & Patel, K. L. (2015). Economics performance of chilli (Capsicum annuum L.) cultivation in Raigarh district of Chhattisgarh state. *International Journal of Agricultural Science and Research (IJASR)*, *5*(4), 363-368.

Prajapati, M.R., Patel, V.T., Chaudhary, N.V. and Soni, M.C. (2002). Constraints experienced by chili growers in adoption of recommended chili technology. *Gujarat journal of Extension Education*. 12-13: 55-58.

Purwasih, R., & Bahtera, N. I. (2020). An Estimation of Technical Efficiency of Red Chili Pepper's Growers in Central Bangka. *Indonesian Journal of Agricultural Research*, *3*(1), 31-39.

Rajput, H.D., Supe, S.V. and Chinchmalatpure, U.R. (2007). Factors association for declining Chili area and its diversification. *Indian Research Journal of Extension Education* 7(2): 76-78.

Ruchira, S. (2010). Economics of chilli cultivation in Jaipur district of Rajasthan. *International Journal of Commerce and Business Management*, *3*(2), 267-269.

Saidah, Z., Harianto, H., Hartoyo, S., & Asmarantaka, R. W. (2019). Transaction cost analysis on revenues and profits of red chili farming. *Jurnal Manajemen & Agribisnis*, *16*(1), 66-66.

Scienceagri (2019). Worldwide Chili Cultivation at https://scienceagri.com/the-5-worlds-largest-countries-of-chili-cultivation-in-2019/

Serajul Islam, Mostafizur Rahman KM, Kamrul Hasan. (2011) profitability and resource use efficiency of producing major spices in Bangla-desh. *Bangladesh Journal Agricultural Economics*, 56 (1-2) 1-13.

Sharma, A. (2016). Sustainable economic analysis and constraints faced by the Naga King chilli growers in Nagaland. *Indian Journal of Agricultural Research*, *50*(3), 220-225.

Sharma, A.K.; T.V. Moorthy and R.C. Oberoi (1992). Economics of chili farming in mid hills of Himachal Pradesh. *Agricultural Situation in India,* XLVII (1):11

Sharma, R.C. and D.C. Pant (1988). Impact of regulation on marketing of chilies, *Indian Journal of Marketing*, 2(1): 91-92.

Shrivastava, K.K. (2003). Constraints of chili cultivation and their suggestions in Kheda district of Gujrat. Krishi Vistar Samiksha. 13(1):18-21.

Singh Moorat (2012). A study on extent of adoption of recommended chili production technology among the farmers of Abhanpur block of Raipur district of Chhattisgarh state.MSc. (Ag.) Thesis submitted to Indira Gandhi Krishi Vishwavidyalaya Raipur (C.G.).

Sowjanya, S., & Kumari, R. V. (2017). Constraints faced by the farmers in adoption of Integrated crop Management in Chilli crop in Telangana. *International Journal of Pure & Applied Bioscience*, *5*(4), 1135-1140.

Srikala, M., Devi, I. B., Subramanyam, V., & Ananda, T. (2016). Cost of cultivation and price spread of chillies in guntur district of Andhra Pradesh. *International Journal of Agriculture, Environment and Biotechnology*, *9*(2), 299.

Subiksa, I. G. M., & Suastika, I. W. (2019). Chili cultivation on tin mined land at Bangka Island: prospects and constraints. In *IOP Conference Series: Earth and Environmental Science* (Vol. 393, No. 1, p. 012096). IOP Publishing.

Tsopoe, J., & Murry, N. (2020). Economics of Chilli Cultivation in Wokha District of Nagaland, India. *Current Agriculture Research Journal*, *8*(1).

Velayutham, L. K., and K. Damodaran. "An economic analysis of chillies production in Guntur district of Andhra Pradesh." *Int J Res Econ Soc Sci* 5 (2015): 43-8.

Venkataramulu, M., Hanchinal, S.N. and Hirevenkanagoudar, L.V. (2010). Adoption of improved cultivation practices among chili growers. *Karnatak Journal of Agricultural Science* 22(5):722-725.