PROFITABILITY AND TECHNICAL EFFICIENCY ANALYSIS OF BANANA PRODUCTION IN SOME SELECTED AREAS OF NARSINGDI DISTRICT IN BANGLADESH

RAWSHANARA YEASMIN

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

JUNE, 2021

PROFITABILITY AND TECHNICAL EFFICIENCY ANALYSIS OF BANANA PRODUCTION IN SOME SELECTED AREAS OF NARSINGDI DISTRICT IN BANGLADESH

BY

RAWSHANARA YEASMIN

REGISTRATION NO. 14-05927

A Thesis
Submitted to the Faculty of Agribusiness Management
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:

(Prof. Dr. Rokeya Begum)	**(Dr. Fauzia Yasmin)**
Department of Agricultural Economics	**Director (TTMU)**
Sher-e-Bangla Agricultural University, Dhaka-1207	**Bangladesh Agricultural Research Council (BARC), Dhaka**
Supervisor	**Co-supervisor**

(Dr. Ripon Kumar Mondal)
Associate Professor and Chairman
Examination Committee
Department of Agricultural Economics
Sher-e-Bangla Agricultural University, Dhaka-1207

Dedicated to my beloved parents and respected teachers

DEPARTMENT OF AGRICULTURAL ECONOMICS
Sher-e-Bangla Agricultural University
Sher-e-Bangla Nagar, Dhaka-1207, Bangladesh
Website: www.sau.edu.bd

CERTIFICATE

This is to certify that the thesis entitled **"PROFITABILITY AND TECHNICAL EFFICIENCY ANALYSIS OF BANANA PRODUCTION IN SOME SELECTED AREAS OF NARSINGDI DISTRICT IN BANGLADESH"** *submitted to the Faculty of Agribusiness Management, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of* **MASTER OF SCIENCE (MS) in AGRICULTURAL ECONOMICS** *embodies the results of a piece of bona fide research work carried out by* **RAWSHANARA YEASMIN** *bearing Registration. No.* **14-05927** *under my supervision and guidance. No part of this 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

(Prof. Dr. Rokeya Begum)
Department of Agricultural Economics
Sher-e-Bangla Agricultural University,
Dhaka-1207
Supervisor

ACKNOWLEDGEMENT

All the praises and gratitude to Almighty Allah Whose mercy has enabled the author to pursue the higher education and to complete the research work successfully for the degree of MS in Agricultural Economics.

The author expresses her deepest sense of gratitude, sincere appreciation, profound regards and indebtness to her reverend and beloved teacher and research Supervisor, ***Dr. Rokeya Begum****, Professor, Department of Agricultural Economics, Sher-e-Bangla Agricultural University, Dhaka for her scholastic guidance, valuable suggestions, constructive criticism, cooperation and encouragement throughout the research work and completion of this manuscript.*

The author deems it a proud privilege to acknowledge her gratefulness, boundless gratitude and the best regards to her respectable Co-supervisor ***Dr. Fauzia Yasmin,*** *Director (TTMU), Bangladesh Agricultural Research Council (BARC), Dhaka for her valuable advice, constructive criticism and factual comments in upgrading the research work and this documents.*

The author expresses her deepest respect to ***Gazi M.A. Jalil****, Professor, Department of Agricultural Economics and* ***Dr. Ripon Kumar Mondal****, Associate Professor and Chairman, Department of Agricultural Economics, Sher-e-Bangla Agricultural University, Dhaka for their valuable suggestions and untiring effort to complete the research work smoothly.*

The author expresses her immense respect and indebtness to all the respective teachers of Department of Agricultural Economics, Sher-e-Bangla Agricultural University, Dhaka for their valuable teaching, cooperation and inspirations throughout the course of this study and research work.

The author thankfully remembers all the staffs of the Department of Agricultural Economics, Sher-e-Bangla Agricultural University, Dhaka for their cooperation during the research work.

The author is highly thankful to the ***Ministry of Science and Technology****, Govt. of the People's Republic of Bangladesh for providing National Science and Technology (NST) Fellowship to conduct this research work in the year 2020.*

Special thanks to the MS students of Department of Agricultural Economics, Sher-e-Bangla Agricultural University, Dhaka for their cooperation and encouragement in the entire period of study.

The author is also thankful to ***Md. Jahedul Alam Forhad*** *and* ***Asif Noor*** *for their cordial support, cooperation and encouragement.*

The author is ever indebted to her family members for their immeasurable love, continuous support, sacrifices and inspiration during the critical moment of her studies.

Eventually, omissions and discrepancies are completely up to the author.

The Author

ABSTRACT

The present study was designed to examine economic analysis on profitability and technical efficiency of banana farmers in selected Monohardi, Shibpur, Palash upazilas in Narsingdi district. Primary data were collected from randomly selected 100 farmers during February to April 2020. Both tabular and functional analyses were applied in this study. The Cobb-Douglas stochastic frontier production function was used for this study to measure technical efficiency of banana farmers. The study revealed that banana production was profitable. Total cost of production was Tk. 193978.60 per hectare. Gross return was Tk. 346923.73 per hectare and net return was Tk. 286603.40 per hectare. Benefit Cost Ratio (BCR) was 2.48, which implies that one taka investment in banana production generated profit of Tk. 1.48. The coefficients of parameters like cost of mechanical power, sucker, irrigation, fertilizer, insecticides and bamboo were positive and significant at different level of significance, which indicated positive effect on banana production. Whereas coefficients of parameters such as, cost of human labor and manure were negative and insignificant which implied negative effect on banana production. In the technical inefficiency effect model, experience, farm size, extension service and credit service had negative coefficients indicating that this helped in reducing technical inefficiency of banana farmers. The study also identified some problems faced by the banana farmers like insect-pest and diseases, use of fertilizer and pesticide, scarcity of High Yielding Variety and suggested some recommendations to improve the present production situation so that per hectare yield of banana would possibly be increased.

CONTENTS

CONTENTS (Contd.)

CONTENTS (Contd.)

CONTENTS (Contd.)

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS AND ACRONYMS

BARI	: Bangladesh Agricultural Research Institute
BBS	: Bangladesh Bureau of Statistic
BCR	: Benefit Cost Ratio
BDT	: Bangladeshi Taka
BER	: Bangladesh Economic Review
DAE	: Department of Agricultural Extension
et al.	: and others (at elli)
GR	: Gross Return
gm	: Gram
ha	: Hectare
HIES	: Household Income and Expenditure Survey
HYV	: High Yielding Variety
IOC	: Interest on Operating Capital
kg	: Kilogram
MoP	: Muriate of Potash
mt	: Metric Ton
NGO	: Non-Government Organization
q	: Quintal
t	: Ton
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
$	: Dollar

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Banana (*Musa paradisiaca*, family Musaceae) is a central fruit crop of the tropical and subtropical regions of the world grown on about 8.8 million hectares (Mohapatra *et al.*, 2010). It is possibly the world's oldest cultivated plants which is widely consumed as both food and medicine (Kumar *et al.*, 2012). As a diet, banana is an opulent source of carbohydrate with 67 calories per 100 g fruit and is one of the most preferred and widely traded fruit across the world (Emaga *et al.*, 2008; Kumar *et al.*, 2012). Moreover, it is highly nutritious (Sharrock and Lustry, 2000) and is more easily digestible than many other fruits including apple (Mohapatra *et al.*, 2010). Apart from the nutritional value banana is also one of the economically important food crops grown both in homestead and commercial farms (Ahmed, 1984). Banana is considered as one of the finest fruits and the most important in terms of food value, food security, food availability and above all, it is a crop that has a positive impact on increasing household income and alleviating poverty (Fonsah *et al.*, 2018).

Worldwide 116,781,658 tonnes of banana is produced per year. India is the largest banana producer in the world with 30,460,000 tonnes production per year and average yield is 35,173.2 kg/ha. With 833,309 tonnes of production per year, Bangladesh is one of the largest producers of banana but the average yield is much lower (17,058.5 kg/ha) (AtlasBig.com, 2021). In Bangladesh, the average per capita intake of bananas is around 4.7 kg per year. This is far less than what Europe consumes, particularly Belgium (26.7 kg), Sweden (16.7 kg), and Germany (14.5 kg), whereas the USA consumes 13.1 kg and the UK consumes 10.5 kg (Siti Hawa, 1998). Banana is mainly cultivated for its ripen fruits, cooked vegetables and leaves in India and many other countries including Bangladesh (Khanum *et al.*, 2000). Ripe banana mixed with rice and milk is the traditional dish for Bangladeshis (Hossain, 2014).

Bangladesh is a developing country and its economy is largely dependent on agriculture. GDP from Agriculture in Bangladesh increased to BDT 11023.20 Million in 2020 from BDT 10799.10 Million in 2019, which was expected to reach BDT 11629.00 Million by the end of 2021. In the long-term, the Bangladesh GDP from Agriculture is projected to trend around 12385.00 BDT Million in 2022 and 13252.00 BDT Million in 2023 (Tradingeconomics, 2021). Contribution of agriculture in GDP is 13.47 percent in FY2020-2021 (BER, 2021). Employment in agriculture (% of total employment) (modeled ILO estimate) is about 40%. (World Bank, 2018). GDP growth rate of Bangladesh mainly depends on the performance of the agriculture sector.

Banana is cultivated almost everywhere in Bangladesh round the year. The foremost banana growing areas in Bangladesh are Narsingdi, Gazipur, Tangail, Rangpur, Bogura, Natore, Pabna, Noakhali, Faridpur and Khulna. In addition, Sylhet, Moulvibazar, Netrokona, Rangamati, Khagrachari and Bandarban are wild banana grown area in Bangladesh. The acreage and production of ripe banana in Bangladesh is about 121777 acres and 817908 M. tons respectively, among the total acreage and production Narsingdi district contributes 3858 acres and 26170 M. tons respectively (BBS, 2019). Therefore, it can be said that Narsingdi district plays an important role in terms of banana production in Bangladesh.

1.2 Importance of Banana

Banana is one of the major fruit crops of Bangladesh. Banana cultivation had positive impact on farmers' livelihood and it occupies an important position among the fruits of the country not only for its highest production among the fruits but also for its increasing popularity to many farmers as an economic crop (Tabassum *et al.*, 2018). In order to meet the demand for fruits and vegetables for the increasing population, the government of Bangladesh has given much more emphasis on year-round crop like banana to achieve overall self-sufficiency. In Bangladesh, banana is a significant fruit crop. The edible portion

is healthy, palatable, readily digestible, rich in carbohydrate and mineral content, and has high calorie content. Additionally, bananas are adaptable to all agricultural systems, even marginal farmers' homestead land. Additionally, the fruit crop generates a substantial financial return (Haque, 1983). Bananas are in great demand on the home market, and there is also the option of exporting bananas in bulk to international nations (Rahman, 1995).

Bangladesh is one of the world's most populated nations, with over 168 million people living in an area of 147570 square kilometers (BBS, 2019), requiring around 23.08 million tons of food grains. The population density is one of the highest in the world, with 990 inhabitants per square kilometer. There has been an average yearly food shortfall of roughly 4 million tons, which has been covered by food assistance and imports (BBS, 2019). The nation is mostly agricultural, and the majority of its inhabitants reside in rural regions. There is no food security for all of these individuals. Adequate food supplies must be accessible, and individuals must have access to land and other resources in order to cultivate their own food or earn enough money to buy the food they need. As a result, food security is dictated by asset distribution, food availability and costs, and work prospects and pay. Food security is a problem of transcendent national significance in Bangladesh, where around 60-70 percent of the rural population and over half of the total population live below the poverty line (Hussain, 1994). One may become self-employed and solvent by cultivating banana, since it grows in plenty throughout the year. Increased banana production may help alleviate food and fruit shortages associated with hunger, as well as satisfy certain export requests in other nations.

1.3 Area, Production and Yield of Banana in Bangladesh

The banana, or "Kola," is a member of the *Musa* genus of the Musaceae family. There are a number of banana cultivars cultivated in Bangladesh. Among them, BARI Kola-1, Amritsagar, Sabri, Champa and Kabri are the commercial cultivars in Bangladesh (Mukul and Rahman, 2013).

Banana grows in almost all soil types but thrives in high, sandy, loam, and clayey soils. For banana growth, well-drained soils are recommended. September-October is the optimum time to sow this cultivar (Haque, 1983). The cold temperatures that occur from December to February severely limit its vegetative development. Bananas are typically harvested nine to twelve months after planting. Bananas may be cultivated in the highlands in a variety of soil types, most often with a pH value of 4.5 to 7.0. However, soils with a pH of 6.0 or above are more conducive to banana production. The rainfall should never be less than 127 cm and not more than 254 cm per year. The reduced rainfall necessitates irrigation, and the maximum temperature may reach 35^{o}C, whereas 35^{o}C is preferable (Nargis, 1997). However, due to the variety in topographical and climatic circumstances, certain regions seem to be particularly well-suited for the cultivation of certain banana varities.

Bangladesh's total expected banana production in 2020-21 was 826151.76 metric tons, up from 817908 metric tons the previous year (Table 1). In 2020-21, total cultivated land was 122192.19 acres, up from 121777 acres in 2019-20. The yearly banana output in the nation is indicated in Table 1.1.

Table 1.1 Area and Production of Banana by District, 2018-2019 to 2020-2021.

District/ Division	2018-19		2019-20		2020-21	
	Area (acre)	Production (MT)	Area (acre)	Production (MT)	Area (acre)	Production (MT)
Narsingdi	3904	26824	3858	26170	3677.74	25074.45
BANGLADESH	120709	833309	121777	817908	122192.19	826151.76

Source: BBS 2019

1.4 Justification of the study

Banana is a commercial fruit; however, it is cultivated commercially in small areas in Bangladesh. Adequate care is not taken while cultivating it or, more importantly, in promoting it properly. Inadequate banana marketing facilities have a negative impact on farmers' revenue and trade, hence limiting the

country's banana output increase. There is no government-sponsored initiative to promote banana farming and commercialization in Bangladesh.

Despite the banana's significance to the Bangladeshi economy, just a few research studies on banana cultivation have been conducted in the nation. The available literature review suggests that some studies (Prodhan *et al.*, 2017, Kamal *et al.*, 2014a; Rahman, 2006) were conducted on the socio-economic characteristics of banana growers, their problems, etc. while there are few studies (Islam *et al.*, 2018; Kamal *et al.*, 2014b, Mukul and Rahman, 2013, Parvin *et al.*, 2013) conducted on profitability of banana production in Bangladesh. However, most of these studies analyzed the profitability only by descriptive analysis and not by a combination of both descriptive and econometric analysis except Mukul and Rahman (2013). Several studies have been conducted to analyze the banana production in Bangladesh (Ara *et al.*, 2011; Mukul and Rahman, 2013; Mohiuddin *et al.*, 2014; Hossain *et al.*, 2015). Thus, it is believed that a research on the economics of banana production might be quite significant. Until recently, little efforts have been made to measure the factors influencing economic returns of banana production. It is expected that the systematic calculation of costs and returns, as well as the profitability of banana under this study, will add up knowledge to the researchers, policymakers as well as other interested farmers who will conduct farther study on banana farming in Bangladesh.

1.5 Objectives of the Study

The findings of the study will help individual growers to increase profitability. Under this circumstance, the present study was conducted with the following objectives:

- To examine the socio-demographic profile of banana growers of Narsingdi district in Bangladesh.
- To estimate the profitability of banana production.
- To assess the technical efficiency of banana production of Narsingdi district in Bangladesh.
- To identify the factors affecting banana production.

1.6 Limitation of the study

There are some limitations associated with the present study. They are as follows:

1. The research was limited to a specific location with a high concentration of banana production. A random selection of three upazila was made. The study's findings could be more significant if it included a sufficient number of banana-producing upazilas.

2. Another significant constraint was a lack of time and funding, which precluded the research from including a large number of farmers and intermediaries and therefore expanding the study area.

3. Due to illiteracy, the majority of respondents did not keep written records, forcing the researcher to rely entirely on their recollection.

4. Due to their fear of income tax, it was difficult to acquire data from merchants for this research. As a consequence of their trade secret, they were rather hesitant to share the true facts.

5. Another significant issue was the respondents' initial unwillingness to cooperate.

However, this difficulty was overcome through persuasive explanation with the respondents of the study area.

CHAPTER TWO
REVIEW OF LITERATURE

The number of small-scale commercial banana farmers has been declining in recent years in various regions of Bangladesh. Historically, banana was planted in homestead areas, with some farmers farming banana as a field crop. However, farmers are no longer planting bananas on a wide scale because they are unwilling to take a risk, and selling bananas is particularly difficult due to their perishability. This nation has undertaken just a few economic research on banana production to date. However, this chapter makes an effort to evaluate some of the research relevant to the current topic.

Arputharaj and Nair (1986) concluded that on an average, an amount of 36,252 per hectare had been incurred towards cost of cultivation of plantain. The highest item of expenditure was human labor forming about 23% of the total cultivation expenses. The average output per hectare was 14,991 kg. of plantain bunches, valued at Rs. 56,205. The benefit cost ratios at cost A1, A2, B and C worked out to 2.16, 2.10, 1.84 and 1.64, respectively.

Bairagi (1990) conducted a study to determine the profitability of banana production in Jhenaidah district of Bangladesh. His study period was September, 1989 to October, 1989. The relative economic advantage of banana and sugarcane and the factors that affect banana production and marketing were also analyzed in his study. He found that per hectare costs and returns of banana production were Tk. 53714.50 and Tk. 116674.84, respectively. The study compared costs and returns from banana with those of sugarcane. He found that production of banana was more promising than sugarcane.

Bastine and Radhakrishnan (1988) reveal that the cost of cultivation per hectare was 36,249. The returns worked out to 45,068 and the net income was

8,819. The main items of expenditure are the cost of both family and hired labor and manure per hectare of plantain cultivation. The study showed that the contribution of family labor was 30.50 percentage of the total expenditure for labor. The contribution of family labor showed a decreasing trend as the size of holding increased.

Begum (2001) conducted a study on production and marketing of banana of three union of Sirajgong Upazila major Bogura district. The sample size for input dealer, eight-fertilizer dealer and eight insecticide dealers were randomly selected and banana producer farmer was fixed at 30 taking 10 from each of selected three unions. The size of population of the farmers and traders were 80 and 70 respectively to determine the existing marketing system of small, medium and large farmers per hectares gross cost was respectively Tk. 122926, Tk. 110579 and Tk. 96058 and gross returns were respectively Tk. 184066, Tk. 129689 and 185959. The study revealed the marketing cost for small, medium and large was respectively Tk.3554, Tk.3237 and Tk. 4389 per hectare. The reported banana marketing in the study area was Farmer, Faria, Beparies, Wholesaler-1, Wholesaler-2 and retailer. Total marketing cost per 85 bananas of Faria, Bepari, Wholesaler-1, Wholesaler-2 and retailer were Tk.6.00, 8.50, 12.00, 6.50 and 9.50 respectively.

Changadeya *et al.* (2012) carried out a study to determine the adoption potential of improved banana cultivars by smallholder farmers in Malawi. The study was carried out in five major banana production districts of Mulanje, Thyolo, Nkhata Bay, Karonga and Chitipa. Structured questionnaires were administered to 118 farmers in order to obtain data on several variables including; education level, experience in banana farming, income from bananas, proportion of land given to bananas, names and number of cultivars grown, preferred cultivars, and willingness to adopt new cultivars. The results showed that the majority of farmers in the south, unlike in the north, are aware of and willing to adopt

improved cultivars. Region, experience in banana farming and awareness of improved banana cultivars were significant predictors of adoption of modern banana cultivars ($p \leq 0.05$). The level of diversity of cultivars on the farm informed farmer's cultivar preferences and socio-economic needs met by such diversity.

Duraisingh *et al.*, (2008) in their study suggested that, fair price markets may be started in Nazareth area to sell out the marketable surplus. The government should publish the actual ruling price list of the different commodities and also suggested that the government should arrange adequate and cheap means of transport facilities in their study area.

Fonsah *et al.* (2018) conducted a study on a survey of agricultural value chain: a case study of Bangladesh banana industry. This survey focuses on bananas, one of the most important and popular fruits of the country and analyzes the complete value chain (VC) functions and relationships, targeting the producers, intermediaries and consumers' willingness to pay (WTP) for quality produce in three municipalities, Barisal, Faridpur, and Dhaka districts respectively. A total of 177 survey questionnaires were distributed amongst the three groups of VC key participants, out of which 130 were usable. Results showed that 8% of the respondents in Barisal were willing to pay from 11-15 BDT/Kg of bananas compared to 43% in Faridpur and 49% in Dhaka. Furthermore, it also illustrated that 100% of the farmers actually sold their bananas at prices ranging from 151-250 BDT, thus, an average price of from 193-225 BDT/bunch despite the quality of the produce. Finally, the major problems observed were lack of good agricultural practices, which affects overall quality, distribution, and marketing of this important fruit. Bangladesh has the potentials to become producer, marketer and exporter of premium quality bananas. Domestically there is a growing market demand and per capita consumption is more than 4.3 kg/annum. With a population growth rate of 1.6%, the demand for bananas, which is their

most favorite fruit crops out of over 118 different fruits, will continue to increase, especially that the fruit is used for multiple functions including medicinal and health reasons. The problems plaguing the industry are pest and disease and lack of modern agricultural practices in producing quality bananas for both local and export market. Survey results across the complete banana VC indicate a willingness to adopt new technology and willingness to purchase (WTB) any variety of quality bananas at higher prices. A Total Quality Management (TQM) strategy, which is an integrated banana management approach, was recommended to revamp the whole industry.

Geetha and Meena (2010) have adopted factor analysis to find out the problems faced by the farmers in the production of banana. They found that financial, environmental, farming, natural and personal risk and spoilage factors were the important problem factors in the production of banana.

Hanumantharaya *et al.* (2009) conducted a study based on data collected from 80 farmers in 12 villages of two taluks in Tungabhadra and Malaprabha command areas of Karnataka. Results of the study revealed that, in crop-I, per ha production cost of sucker banana was Rs. 82,298 and tissue culture banana was Rs. 1,17,563. The gross returns obtained were 1,60,113.81 and Rs. 1,97,295.94, respectively. The net returns obtained were Rs. 77,815.81 and Rs. 79,732.94, respectively. In crop-II, production cost of sucker banana was Rs. 55,073 and tissue culture banana was Rs. 57,561.30. The gross returns realized were Rs. 1,70,596.56 and Rs. 1,85,953.07, respectively and the net returns were Rs. 1,15,523.56 and Rs.1,28,391.77, respectively. In sucker banana cultivation, regression coefficient of plant nutrients (0.35) was significant at five per cent and that of plant protection chemicals and bullock labor were non-significant.

Haque (1983) conducted a research on some technological aspects for the commercial production of banana during the period from 1981 to 1983 at

Bangladesh Agricultural University (BAU), Mymensingh, he reported that the best period of banana plantation was September to November. In another study by him reported that intercropping of banana were practiced during of period September to April, as the weather of this period remain favorable for large number of vegetables, oilseed and pulse crops.

Haque (1988) conducted a research at Bangladesh Agricultural University Mymensingh during October 1987 to November 1988. He examined the economic performance of Banana production. He found that per hectare costs and net returns of Banana production were Tk. 103,614.88 and Tk. 161,386.12 respectively. According to Haque, net return from banana cultivation was much higher than any other field crops.

Hossain (2000) conducted a study to determine the relative profitability of Meher Sagar, Amrit Sagar varieties of banana in Mymensingh and Tangail district. His survey period was April to May 2000 and sample (20 farmer's growing Amrit Sagar and 40 farmers growing Meher Sagar) were selected randomly for this study. The researcher mainly used tabular analysis to achieve the objectives and Cob-Doglus production model was also estimated to determine the contribution of some important inputs to banana production. He found that Amrit Sagar banana was more profitable than Meher Sagar banana production. Per hectare gross returns, net returns above cash cost and net return above full cost of Amrit Sagar banana production were Tk. 206782, Tk. 127516 and Tk. 91793 respectively, while the corresponding returns for Meher Sagar banana production were Tk. 182505.59, Tk. 106821.73 and Tk. 72167.55 respectively.

Islam *et al.* (2013) conducted a study on an analysis of cost of production of banana and profitability at Narsingdi and Gazipur district in Bangladesh. Study was based on data collected from 40 farmers from two districts namely Gazipur

and Narsingdi of Bangladesh. Most of farmer faced problems on lack of fertilizer, insufficient labor and lack of subsidy. Despite of some limitations, the findings of the study confirmed that the farmers could obtain positive net return from cultivation of banana. In the context of income generation and poverty alleviation, production of crop like banana might play a crucial role in meeting the cash needs of the farmers. The findings of the study also revealed that the trading of banana is a profitable venture to different intermediaries. The profit of the retailer was higher than that of other intermediaries and the profit was found reasonable. However, the marketing efficiency was not good in the study area. The gap between the producer's price and consumer's price was huge and the producers do not get their reasonable price for their product. For this reason, the government should take an effective step to control the price system and price spread of the market and make sure that the producers can get their reasonable price and the consumer can get the product in a reasonable price. Banana is not only an important source of nutrition but also an important source of cash income to growers and traders. Moreover, a large number of people were involved in the production and marketing of banana. So the farmers and intermediaries could be more benefited financially if production and marketing of banana are to be well expanded.

Islam *et al.* (2018) conducted a study on profitability of banana cultivation under agricultural credit in Narsingdi district of Bangladesh. The study analyzed the adequacy, utilization patterns and repayment status of credit, the profitability and show the relationship between profitability and loan size of Banana cultivation in sadar upazila of Narsingdi district of Bangladesh. Primary data were collected from randomly selected 60 borrowers of the different NGOs who cultivated banana in the study area. Data were collected through direct interviewing using pre-tested semi-structure interview schedule. The overall benefit-cost ratio of Banana cultivation was 1.67. The relationship between loan size and profitability of Banana cultivation indicated that medium size loan receiver farmers were

more profitable compare to the small and large amount of loan receiver farmers. The findings of the study indicated that reasonable amount of credit ensures farmers to profitable farming activities.

Jaffar and Namasivayam (2004) remarked that the average net profit per acre on banana cultivation was high in the case of medium size growers and medium to large size growers and low in the case of small size growers. Country capitalizes the opportunity in increasing the production of banana and productivity of banana can also be enhanced with scientific production technique.

Kamal *et al.* (2014a) conducted a study on cost and return analysis of banana cultivation under institutional loan in Bogura, Bangladesh. The study was aimed at assessing the loan use, repayment and profitability of banana cultivation under bank loan. For this purpose, 60 loanee farmers were selected from four villages of Shibgong upazila in Bogura district. The major findings of this study revealed that banana cultivation under the institutional loan was a profitable business. The overall benefit cost ratio of banana farming came out to 3.69 indicating that one Taka investment resulted in a net benefit of Tk. 2.69. The findings also showed that scientific use of inputs had increased the production of bananas. The credit aspects of the study indicated that Rajshahi Krishi Unnayan Bank (RAKUB) had greater contribution as financing agency to banana production than other institutional sources of credit. But it was clear that the banana producers got credit as a part of operating capital which was not sufficient to them. Most of the credit amount (78.22%) was utilized for farming purposes. Rate of repayment was fully satisfactory (100%). RAKUB credit programme benefited the credit receivers in respect of increasing income, spending capacity decision-making power and social status.

Kathirvel (2008) analyzed the economic factors limiting to banana production with the help of Garrett Ranking Technique. He pointed out that credit inadequacy was the major problem (Rank 1) in the production of banana. High Fertilizer cost was the next important problem (Rank 2). The small size of farm holdings, the lack of technical guidance was the least important problems.

Kayat *et al.* (2016) the findings indicate that there is a relationship between farmers' knowledge, attitude and practices with their farm production. Knowledge on specific agrochemicals and practices allow farmers to supply their cultivate with proper nutrient and nursery management to improve their banana production. Farmers' attitude in adopting knowledge and technology in their cultivation process also become the main factor to improve the fruit quality and quantity produce. Furthermore, agricultural practices on the farm also indicate the farmers' knowledge on how importance those practices will affect their production. In addition, the right practices and at the right time implemented on the farm will improve the production and hence increase their profit.

Manojkumar *et al.*, (2006) concluded that the majority of the farmers cultivating banana had agriculture as their main source of income. The reason stated for non-enrolment in insurance was not lack of awareness or high premium rate but cumbersome administrative procedures and financial difficulty to pay premium at the pre-gestation stages of cultivation. Even the farmers who had adequate financial resources were reluctant to pay premium in bulk, out of their own sources. Linking of a credit facility with crop insurance program was found to be an inevitable condition for its success. The crop insurance scheme should be made viable by spreading the risk horizontally by enrolling all the farmers in a locality in the scheme. The scheme should be attractive, credit-linked, and should have support facilities like a reinsurance package. Majority of farmers were not willing to leave banana cultivation in future even if it involves high

risk. Therefore, a package that covers a longer period (for example a three-year package) with a premium that considers the cost of cultivation for the period as a whole has to be thought of. This will help to bring down premium rates, by saving on cost of land preparation, especially in reclaimed lands.

Mpawenimana (2005) in his study analyzed the socio-economic factors influencing the production of bananas in Kanama District in Rwanada.After estimating the relationship between the output of bananas and various socio-economic factors, the findings showed that various socio-economic factors have to be reviewed in order to improve the production of bananas in the country. The results described that acreage (land), physical capital, fertilizer and price, have positive relationship with the banana output. These are the factors on which the government should give emphasis in order to increase the production of bananas. There are other factors such as education has shown a positive coefficient, but explained an insignificant relationship to the banana output. One of the reasons is that educated people run away from rural areas to towns. Labor was another factor which has shown a negative effect. However based on the above findings, he concluded that land, physical capital, fertilizer, and price are the important socio-economic factors that have effect on the production of bananas in Rwanda.

Mudyazvivi and Maunze (2007) conducted a study to evaluate the banana industry in Zimbabwe focusing on postharvest losses along the value chain (VC). Total postharvest losses for 2011-2012 were estimated to be 24-27 per cent of total production with a minimum economic loss of USD 69,983/annum/firm, and a total loss of more than USD 500,000/annum between the VCs analyzed. The bulk of the losses occurred at farm level during handling and transportation. The major factors contributing to banana postharvest losses were: unreliable transport, poor communication and coordination between producers and processors; lack of or inefficient temperature management and poor sanitation.

Mukul and Rahman (2013) conducted a study on production and profitability of banana in Bangladesh-an economic analysis. The study was to determine relative profitability of banana in Narsingdhi during the period January to March, 2013. In this study they investigated total cost, profit and benefit cost ratio for different marketing channel like banana producers, wholesalers and retailers. Profit for producer, wholesaler and retailer in banana production were Tk. 55002.8 per Hectare, Tk. 59.08 per Chari, and Tk. 122.67 per Chari respectively and benefit cost ratio for producers, wholesalers and retailers were 1.40, 1.30 and 1.41 respectively. They had also followed Cobb-Douglas production model was used to determine the contribution of some important inputs like land preparation, fertilizer, irrigation, insecticides, sucker and labor cost to production of banana. We also investigate to explore the problems of producing banana and offer suggestion for possible improvement in the existing marketing system.

Munia *et al.* (2019) conducted a study on economics of small scale commercial banana farming in Tangail district of Bangladesh. This study was conducted to analyze the profitability of banana farming in some selected areas of Tangail district of Bangladesh during 2015. A total of 60 samples (16 small, 19 medium and 25 large farmers) were directly interviewed using a structured questionnaire for achieving the purpose. Apart from the descriptive analysis of the socio-economic variables of the selected respondents, the benefit-cost and functional profitability analysis of banana farming were also performed. The Cobb-Douglas production function was chosen to determine the effects of various inputs on the profitability of banana. The finding of cost-benefit analysis reveals that banana farming is a profitable activity in Bangladesh as the estimated cost of production was lower than the return in the selected study areas. However, the profitability differs among different farmers' group and large farmers are more profitable in banana farming than small and medium farmers. In addition, the functional analysis identifies four inputs such as the cost of human labor, manure, fertilizer and irrigation as the significant determinants of profitability of banana farming

in the study area. In this study, resource use efficiency was also measured to show the efficient resource allocation to attain the goal of profit maximization, which showed that human labor, seedling, manure, fertilizer, insecticides, irrigation and bamboo has inefficient use of the resources, and farmers should limit the use of these inputs. The researcher suggested some recommendations to improve the present production situation so that banana farming could be more viable and attractive commercial enterprise.

Murry and Das (2019) conducted a study on economics of banana cultivation in Wokha district of Nagaland, it was found out that, the per hectare cost of banana cultivation for the sample farmer Rs. 59041.30. It was concluded that, the inputs cost is found to be highest for family labor which accounts for Rs. 24670.41 (41.79%), followed by hired human labor Rs. 17640.01(29.88%), interest on working capital Rs. 5044.89 (8.54%), marketing cost Rs. 5681.35(9.62%) etc. The fact that the contribution of human labor encompasses the highest percentage which accounts for almost fifty per cent of the total cost is because in tribal society like Nagaland farming is not depending on external inputs and make use of available natural resources and intensive use of family labor. The average yield of banana farm in the study area was found to be 121.52 q/ha. Considering the prevailing price of banana in the study area, which was Rs. 1300.00 per quintal, the gross income was found to be Rs. 157980.33 with an average net return of Rs. 101819.82. From the analysis, it was also concluded that the benefit cost ratio over variable cost was 2.85 and the benefit cost ratio over total cost was found to 2.68. The result from the finding of benefit cost ratio analysis implies that cultivation of banana is profitable in the study area.

Mustaffa and Kumar (2012) recorded wide variation in production and productivity in most of the banana growing regions. This is attributed mainly to the variety, type of planting material used, season and method of planting besides management techniques such as water and nutrients.

Muthupandi (2009) analyzed the production problems of banana growers by using Garret Ranking Technique Severity of wind which was the major problem with a mean score of 61.64. Severity of disease is the next important problem with a mean score of 58.81. The third important problem faced by the growers was severity of rain, which had a mean score of 45.18. Soil condition was the fourth problem, which has a mean score of 35.63.

Nargis (1997) conducted a study on "The comparative economic analysis of growing banana and banana with other vegetables in some selected areas of Muktagacha thana". Her study period was September to December, 1996 and mainly tabular analysis was used for this study. Besides, undiscounted benefit-cost ratios were calculated for evaluating the relative profitability of growing sole banana and banana with other selected vegetables. The major findings of the study were that per hectare costs of production of sole banana were Tk. 121438 and Tk. 92011, respectively considering full cost and cash cost. Per hectare cost of production of banana with cucumber, banana with Indian spinach and banana with lady's finger based on full cost were Tk. 122896, Tk. 123328 and Tk. 123544 respectively. Per hectare net return of growing sole banana was Tk. 90032 and Tk. 11944459 considering full cost and cash cost, respectively. Per hectare net return of growing banana with cucumber, banana with Indian spinach and banana with lady's finger were Tk. 137974, Tk. 142482 and Tk. 149676 respectively on the basis of full cost. Per hectare net return from banana with cucumber, banana with Indian spinach and banana with lady's finger were Tk. 167909, Tk. 172499 and Tk. 179859 respectively considering cash cost.

Nessa (1998) conducted a study to determine the relative profitability of banana and sugarcane in Mymensingh district during the period of July-September, 1997. She followed mainly tubular method and Cob- Doglus production model was used to determine the contribution of some important inputs to banana production. She found that banana production was more profitable than

sugarcane production. Per hectare gross return, net return over full-cost of banana were Tk. 113295.08, Tk.70432.19 and Tk.43899.05 respectively, while the per hectare gross return, net return above cash-cost and net return above full-cost of sugarcane were Tk. 67505.81, Tk. 41807.75 and Tk 14539.30 respectively.

Nzioka (2009) in his article disclosed that approximately 80% of Kenya's population lives in rural areas and derives its livelihood largely from agriculture. Agriculture makes up about 26% of Kenya's gross domestic product, and banana production occupies 2% of Kenya's arable land. A structured questionnaire was given to farmers in three Divisions of Kiambu East District: Githunguri, Municipality and Kiambaa. A frontier production function was established, and results indicated that farmers operated at about 60 per cent of the optimum production level because of technical inefficiency, resulting in low levels of production by individual farmers. If farmers received training on how to manage their traditional bananas and organized into marketing groups, they could improve their bargaining power and increase household income to as much as 3 times the current level. Farmers therefore should form production and marketing groups to grow and market their bananas collectively. Farmers also need to be given management training and financial assistance to grow their yielding varieties of bananas (e.g., Tissue Culture Bananas). In addition, farmers need to be trained on indigenous post-harvest technology to realize increased household incomes.

Patel (1996) conducted a case study of banana in Gujarat to identify the emerging problems of marketing new crops with added focus on impact supply and to offer suggestion for possible improvement in the existing marketing, processing and impact supply system based on the findings of the study. The problems and prospects relating to banana marketing functions such as picking, grading, assembling, packing, transport etc., price received for product, supply

of key inputs, were reported from a sample survey of banana growers.

Patil *et al.*, (1987) examined the trends and growth rates in area, production and productivity of banana Crop. They found that the area under banana cultivation increased from 6,600 hectares to 34,400 hectares and production also increased sharply by almost 68.9 percent. Famers were responsible for banana prices.

Peter (1974) studied the input-output ratios of banana plantation in Kanyakumari District of Tamil Nadu. Cobb-Douglas production function had been used. The study illustrated that a shifting of resources from the total per day units of labor to total expenditure incurred for manuring was necessary to maximize the gross income at the existing level of expenditure. There was a highly significant positive response in the gross income to the positive changes in the expenses on manure.

Rahman (2000) carried out a research on the relative profitability of banana in comparison with alternative dominant cropping patterns in some selected areas of Jamalpur district. His survey period was January to February 2000 and mainly tabular analysis was used in this study. He found that banana production was more profitable than any other dominant cropping patterns in the study area. The per hectare gross return, total cost, gross margin and net return of banana production were Tk. 1,86,356.89, Tk. 90,7771.35, Tk. 1,08,383.20 and Tk. 91,461.38 respectively. Analysis of dominant cropping patterns showed that per hectare gross return, total cost, gross margin and net return of the cropping pattern P2 (HYV Banana- T. Aman- Potato) were the highest and the corresponding figures were Tk. 1,23,032.11, Tk. 81,607.75 Tk. 56,413.66 and Tk. 41,424.36 respectively. The lowest gross return, total cost, gross margin, and net return per hectare were obtained by farmers following cropping pattern P4 (Fallow-Jute-T. Aman) and the corresponding figures were Tk. 54,110.77, Tk 39,615.66, Tk. 24,928.48 and Tk. 14,495.12 respectively.

Rahman and Akbar (1989) conducted a study on Banana marketing in Narsingdi District. They reported that the farmer's share of the consumer's taka spent on bananas varied between 42 to 62%. The intermediaries appropriated a marketing margin of 38 to 56% from marketing cost and profit.

Rahman *et al.* (2020) conducted a study on farmer's profitability of banana cultivation at Narsingdi district. The study was designed to measure production profitability of banana in selected area of Narsingdi district. Primary data were collected from the banana growing area of Shibpur and Manohordi under Narsingdi district. Thirty farmers were selected through convenience sampling procedure. Simple descriptive methods were used to analyze the data. Among many cultivars Champa (Apple Banana) had been selected for this research work. The major findings of the study revealed that banana production was profitable. In this study, it was found that young and illiterate farmers were mostly engaged in banana cultivation. Farming experience of Banana farmers ranged from 2 to above 20 years. It was seen that gross return per bunch of banana was Tk. 450. Gross margin per Chari of banana was Tk. 387.65. Net return per Chari of banana was Tk. 334.65. The undiscounted benefit cost ratio (BCR) was 3.90. The major problems faced by farmers included lack of availability of adequate input, higher input cost; lack of subsidy, inadequate capital, Lack of quality sucker was a major problem for banana cultivation. The Government should provide credit facilities through Bangladesh Krishi Bank (BKB) and other commercial banks.

Roy (1996) conducted a study "Comparative economic analysis of banana and their crops production in Mymensingh district" to determine the costs and return as well as the relative profitability of banana growers. For this study, sixty farmers were selected randomly. He observed that per hectare gross expense of banana production with intercrops was Tk. 65,583.13, while the per hectare gross return, net return above gross expenses stood at Tk. 91297.24 and 12514.11,

respectively. Per hectare gross expenses for producing banana without intercrops was Tk. 48503.70, while per hectare gross return and net return above gross expense were Tk. 149234.80 and 100731.10 respectively. Gross expenses for gross return, net return above gross expenses were Tk. 81394.22 and Tk. 35557.90, respectively.

Thomas and Gupta (1987) have explained that the main items of expenditure in working out the cost of cultivation of banana per hectare in Kottayam District of Kerala were the expenditures on manures and fertilizers and on labor. An encouraging point noted in their study is the significant contribution of family labor, which absorbs about 30 per cent of the total labor cost in small size holdings.

Tita (2006) conducted a study, which gave an in-depth knowledge of the social and environmental problems that exist in CDC and which could be documented to help future researchers. Social and environmental issues is a new concept but researchers think it would ensure better future for banana growers through recommending social life cycle assessment.

Wahome *et al.* (2021) indicated that banana productivity is affected by key factors which have the potential to significantly lower their productivity in the study areas. The major factors included a limited supply of input ranging from planting materials, agrochemicals, as well as limited knowledge associated with good banana farming management practices. There was potential in enhancing banana production in the three counties; unfortunately, the knowledge gap among the residents and inaccessibility to important inputs in the three study areas was a hindrance. Although tissue culture was essential in increasing agricultural productivity and achieving sustainability in banana production, its adoption rates were very low, thus calling for a need to its promotion.

A general survey of the relevant literature reveals that a few studies on banana production had been conducted in different areas of Bangladesh. Therefore, the present study attempts to analyze the profitability of banana production in some selected areas of Narsingdi district.

CHAPTER THREE
METHODOLOGY

3.1 Introduction

The validity of farm management research is contingent upon the study's approach. Appropriate technique is a precondition for doing sound research. The design of every survey is largely governed by the study's nature, purpose, and goals. Additionally, it is contingent upon the availability of required resources, supplies, and time. There are several data collection techniques available for farm management studies. A farm business research often entails the gathering of data from individual farmers; data collection for farm business analysis requires the analyst to use judgment in selecting data collecting techniques within the constraints given by the available resources for the assignment (Dillon and Hardaker, 1993). The "survey approach" was used in this research primarily for two reasons:

i. It permits rapid analysis of a large number of instances; and
ii. Its conclusions have a broader application.

The primary drawback of this strategy is that the investigator must depend on the farmers' recollection. To address this issue, frequent trips to the research region were conducted to gather data, and in the event of any omission or contradiction, farmers were contacted to get the missing and/or correct information. The following stages were used in designing the survey for this investigation.

3.2 Selection of the Study Area

Selection of the study area is a crucial stage for farm management research. The area chosen suited both the study's specific objective and the possibility of cooperating with the farmer. This research was undertaken in certain chosen regions of Narsingdi district to analyze the banana production. Although bananas are cultivated across Bangladesh, Narsingdi district is one of the country's main banana producing areas. Narsingdi district is divided into six upazilas. Three upazilas *i.e.* Monohardi, Shibpur and Palash of Narsingdi district were purposively selected for the study.

The following were the primary reasons for choosing the research area:

a) Availability of a large number of banana growers in the study area.

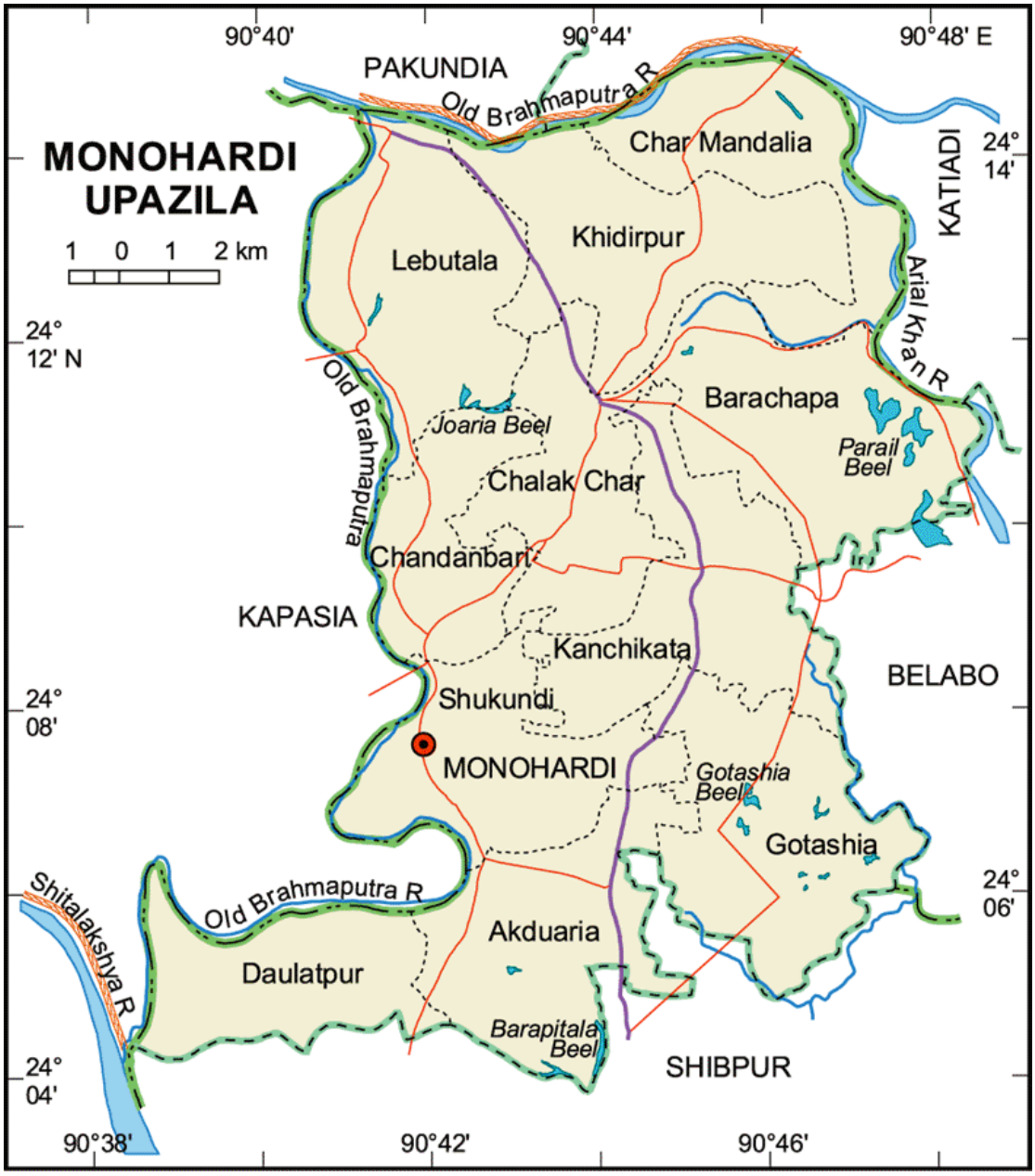
b) These upazilas had some physical traits, such as topography, soil composition, and climate conditions conducive to banana cultivation.

c) Access to these settlements was anticipated to be easy, as were communication facilities; and

d) Cooperation from the respondents was expected to be strong, in order to acquire trustworthy data.

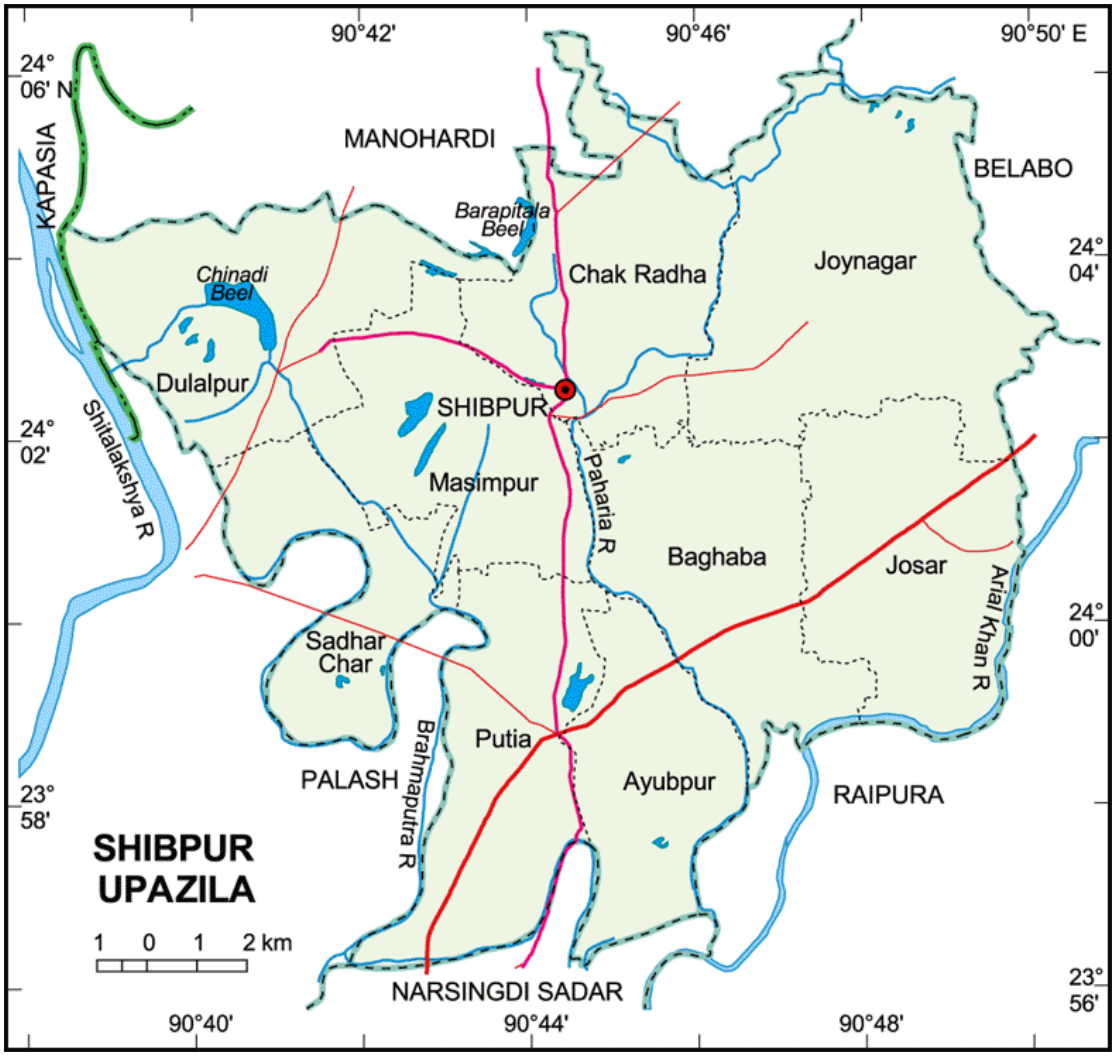
Source: www.google.com

Figure 3.1: Map of Narsingdi District



Source: www.google.com

Figure 3.2: Map of Monohardi Upazila



Source: www.google.com

Figure 3.3: Map of Shibpur Upazila

Source: www.google.com

Figure 3.4: Map of Palash Upazila

3.3 Sampling Technique and Sample Size

There are two major criteria, which should be considered while choosing samples for a research. The sample size should be as big as possible while yet providing sufficient degrees of freedom for statistical analysis. On the other hand, field research administration, data processing, and analysis should be feasible within the constraints of physical, human, and financial resources

(Mannan, 2001). However, due to variation of the technological and human environments, it is required to sample several numbers of the population before drawing any conclusion. Thus, sampling's objective is to choose a subset of the population that is representative of the whole population (Rahman, 2000). Due to limitation of time, funding, and manpower, it was not feasible to enroll all of the study area's farmers. A total of 100 farmers (40, 30 and 30 from Monohardi, Shibpur and Palash upazila, respectively) cultivating ‘Sagor’ variety were chosen at random. A purposeful random sample strategy was used to save costs and time and to accomplish the study's final aims.

3.4 Data Collection

As data collection has enormous influence on the quality of survey findings, it is recognized as a crucial component of a survey. Considering its significance, the following procedures were taken during developing of the questionnaire used to gather data.

3.4.1 Questionnaire Design

A questionnaire is a very effective assessment instrument that enables collection of data through multi-dimensional questions. A questionnaire created without a clear objective and intention would always ignore critical topics and waste the time of both researcher and respondents by asking and responding to irrelevant questions, respectively. All of these points were considered to the degree practicable while constructing the survey questionnaire.

3.4.2 Pre-testing the Questionnaire

The questionnaire was pre-tested to determine the length of time required to finish the interview, its reliability, *i.e.* if it caught the needed information, and also its consistency, i.e. whether the information acquired by it was connected to the survey's overall aim. Additionally, the test was designed to validate the logistics necessary for the survey's proper operation. To verify the questionnaire's optimal performance in terms of data collecting, processing, and

analysis, pre-testing was conducted prior to the survey in the research region during the period of February to April 2020. A few farmers was picked randomly to be responders.

3.4.3 Finalization of the Questionnaire and Method of Data Collection

After resolving all of the adjustments suggested by the pre-test, the questionnaire was delivered to the supervisor. The questionnaire was the modified and finalized according to the suggestions of the supervisor. Eventually, the questionnaire received permission. A face-to-face interview was conducted in response to the questionnaire.

3.4.4 Data Editing and Coding

Other critical aspects of the survey included data editing and coding, which were required for data processing. It should be performed prior to the processing of data. Coding was completed concurrently with questionnaire creation in order for the enumerator to simply and properly mark the correct responses. The term "data editing" refers to the process of verifying and cleansing previously acquired data from the field.

3.5 Data Processing

Data processing included several procedures that were critical since they had an effect on the survey's findings. The following actions were conducted during data processing.

- ➢ Data entry
- ➢ Appending and Merging files
- ➢ Data validation (further computer checking, editing, and imputation)
- ➢ Final decision on errors
- ➢ Completion of data processing and generation of data files
- ➢ Final documentations
- ➢ Conversion of data files to another software.
- ➢ Storage of all files.

3.6. Processing, Tabulation and Analysis of Data

After manual editing and coding of the gathered data, the acquired data was meticulously compiled and analyzed. Additionally, data input was performed electronically, and analyses were conducted using the appropriate tools, Microsoft Excel and STATA. It was kept in mind that information was first gathered in local units. After required checks, it was converted to international standard units.

3.7 Problems Faced During Data Collection

The researcher encountered a few difficulties when gathering data. These issues are summarized below:

i. The majority of respondents expressed hesitation in responding to the question, since they had never encountered this form of questioning before. To resolve this issue, much effort was spent establishing rapport.

ii. It was difficult to persuade respondents of the study's use due to the fact that the majority of respondents were illiterate and uninformed.

iii. The respondents did not keep track of their business's financial transactions. As a result, it was rather difficult for individuals to recollect pertinent information from their memory using the recall technique.

iv. The respondents consistently refrained from providing accurate information about the extent of their holdings and revenue from bananas, believing that providing accurate information would result in increased taxes being imposed on them.

v. Occasionally, farmers were unavailable at home, and the researcher had to exert more effort and time to obtain information from them.

3.8 Procedure for Computation of Cost and Returns

Input costs are critical in every organization. When estimating profit or loss, the cost elements must be clarified. To estimate the relative profitability of various crops, however, all cost elements must be computed. Which are subtracted from the result value. Farmers growing bananas have to pay for a variety of inputs.

Some of these inputs were bought, while others were contributed by the user. Purchased inputs necessitated out-of-pocket or direct expenditures, and calculating the prices of these inputs was relatively uncomplicated. However, no financial payment was provided for the inputs given by the homeowner. The opportunity cost principle was used to estimate that a significant amount of the overall cost of manufacturing was obtained from locally provided inputs. When estimating gross expenditures, the primary components, such as human labor, input costs, and so on, were taken into account. These cost components are outlined briefly below:

3.8.1 Cost of Mechanical power

Mechanical power was mostly employed for land preparation, but also for transporting fertilizer. Land preparation was carried out by all groups of farmers using power tillers. Mechanical power, such as the usage of a power tiller, has increased significantly in the study region, and farmers have increasingly relied on mechanical power to prepare their land. The owner of the power tiller provides gasoline and a driver for land preparation. The power tiller and driver's labor costs were comparable. It was quite difficult to disentangle the cost of the power tiller from the cost of driver labor.

3.8.2 Human Labor Cost

Human labor is a significant element into banana production. There were two distinct forms of human work: (a) family labor that did not need payment in cash and (b) hired labor that required payment in cash. Family work consists of the operator's personal labor plus that of his family members, such as his brother, children, and so forth. Women's and children's work has been converted to man equivalent hours using the following formula: 2 child hours = 1.5 woman hours = 1 adult male equivalent hour. The opportunity cost idea was utilized to calculate the cost of family labor. In the past, the opportunity cost of family labor was determined by the market pay rate, that is, the wage rate that farmers actually

paid hired labor. On the other hand, in computing the cost of hired labor actual wages paid are considered.

Human labor was quantified in this research in terms of man-days, which typically equaled eight hours of work by an adult man. The wage rate per man day ranged between 350 and 500 tk. depending on the season and the availability of day labor in the research region. Thus, the average computed wage rate was 400 tk. per man day, which was used to determine the human labor cost excluding the monetary value of kind payment such as meal, tobacco etc. To perform the following task human labor was utilized throughout the banana production process:

1. Land preparation.
2. Transplanting
3. Fertilizer application.
4. Intercultural operation.
5. Harvesting, carrying and grading.

3.8.3 Material Input Cost

Material input cost was also an important cost item, which included the cost of suckers, fertilizers, manure, irrigation water, insecticides, land use cost and interest on operating capital.

Cost of Sucker

Although bananas come in a number of types, practically all of the farmers in the study region produced mostly the "Sagor" variety. Farmers in the research region mostly utilized bought suckers to produce bananas. Farmers were required to purchase suckers in cash at a cost of Tk.6-8.00 per piece, which was prevalent in the region throughout the study period.

Cost of Manure

Banana farmers employed two types of manures: cow dung and oil cakes. Farmers mostly bought cow dung. However, a little proportion is consumed by

farmers, which is essentially non-existent in the research region. However, if they utilized manure such as cow dung, it was collected mostly from domestic animals engaged in the agriculture process and milk production.

Cost of Chemical Fertilizer

Farmers in the research region used four different types of fertilizers: Urea, Triple Super Phosphate (TSP) and Muriate of Potassium (MoP). The costs of these fertilizers were evaluated using market prices in effect throughout the research period. The average market price per kilogram of urea, TSP and MoP was tk. 16, tk. 22 and tk. 15, respectively.

Cost of Pesticides

The majority of banana producers in the research region utilized pesticides such as Diazinon, Shobicron, Tilt and Oczim, as well as liquid insecticides. The cost of pesticides is calculated according to the quantity of bottles/packets used by farmers. Sometimes the rates vary according to the quantity of bottle/packet utilized by farmers. Prices range from Tk. 170 to Tk. 200.

Cost of Irrigation

Irrigation is a significant component in banana production. In the research region, farmers uses machine for irrigation. Costs associated with irrigation included gasoline and fees for the usage of the equipment. Irrigation was provided on average twice or thrice in their land, with an estimated cost of Tk.1960.67.

Cost of Tools and Equipment

All of the farmers in the research region employed conventional tools and equipment in various activities of the banana producing process. Farmers employed basic agricultural equipment such as a plough, yoke, ladder, spade, khupri, and sickle to cultivate bananas. The time-consuming task of calculating tool and equipment expenses was omitted since this item accounts for less than 1% of overall cost.

Cost of Bamboo

The use of bamboo is a traditional practice during the maturity stage of banana cultivation. Farmers were required to purchase bamboo in cash at a cost of Tk.

15.00-20.00 per piece, which was prevalent in the region throughout the study period.

3.8.4 Land Use Cost

The cost of land use for different plots was different depending on the location, topography and fertility of the plots. Cost of land use estimated in one of the following three alternatives

i) Foreign incomes from alternative use.

ii) Interest on the value of land and

iii) Valuation of land as its rental price.

For this study, the third method was used for finding the cost of land, *i.e.*, by taking into account the rental value of land. Land use cost for banana cultivation was assessed considering land use over a production period for one year.

3.8.5 Interest on Operating Capital

The amount of money required to satisfy the demand on rented or bought inputs was considered an operational expense in the research. The average annual interest rate in the research region was 9% for the duration of the banana production period. This annual interest rate was determined by Bangladesh Krishi Bank's local branch office. It was expected that if farmers obtained loans from a bank, they would be required to pay the above-mentioned rate of interest. All expenditures were not incurred at the start of the manufacturing process; rather, they were incurred over the duration of the production. As a result, Interest on operating capital was calculated by using the following formula.

Interest on operating capital (IOC) = Alit

Where,

Al = Total operating capital/2.

i = Interest rate per annum.

t = Length of crop period.

This really reflected the average operational cost for the period, since investment in terms of operating capital was not made in one go; rather, it was spread out

across the crop season, with producers getting no return until the crops were harvested.

3.9 Profitability Analysis

Cost and return calculations were conducted using enterprise costing. The economic performance of bananas, as well as their relative profitability, were determined using gross margin and net return analysis.

3.9.1 Gross Return Analysis

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

Gross Return= Quantity of the product x Average price of the product + Value of byproduct

3.9.2 Gross Margin Analysis

The research was conducted because Bangladeshi farmers are very curious about their return on total variable cost. Gross margin was calculated on TVC basis. Gross margin is calculated by subtracting variable costs from gross return.

That is, **Gross margin** = Gross return – Variable cost

3.9.3 Net Return Analysis

The net return on a per-hectare basis was calculated by deducting the entire production cost (variable cost + fixed cost) from the total return on banana output. **Net return** = Total return – Total production cost.

3.9.4 Benefit Cost Ratio (BCR)

Benefit cost ratio (BCR) of banana was estimated as a ratio of gross return to total cost.

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

3.10 Technical Efficiency Analysis

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 production function. Given the stated relationship, the firm is technically efficient if it produces on its outer-bound production 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.

3.10.1 The 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 production 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.

3.10.2 The Stochastic Frontier with Cobb-Douglas Production Function

The Cobb-Douglas production function is probably the most widely used form for fitting agricultural production 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 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 production 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 production frontier model may be written as

$Yi = f(Xi,\beta) \exp.(Vi-Ui)$ i = 1, 2, 3, ……., N

Where the stochastic production frontier is $f(Xi,\beta)\exp.(Vi)$, Vi having some symmetric distribution to capture the random effects of measurement error and exogenous shocks which cause the placement of the deterministic kernel $f(Xi,\beta)$ to vary across firms.

The technical inefficiency relative to the stochastic production frontier is then captured by the one-sided error component $Ui > 0$.

3.10.3 Specification of Production Model

There is no single function that can be used to describe agricultural productivity under all environmental situations. The algebraic shape and magnitude of the function will change depending on the soil, the kind and variety of crops, the size of other inputs in 'fixed quantities' for the farm, and so on. As a result, a challenge in each investigation is determining the right algebraic form of the function. This is compatible with the observed occurrences. To assess the influence of major factors on banana manufacturing processes, the Cobb-Douglas production function was employed. The Cobb-Douglas model's double log form was shown to be the better choice on theoretical and econometric grounds.

The Cobb-Douglas Stochastic Frontier Production Function have been specified in order to estimate the level of technical efficiency. The functional form of stochastic frontier is as follows:

$$Yi = \beta_0 X_1^{\beta 1} X_2^{\beta 2} \ldots\ldots\ldots X_8^{\beta 8} e^{Vi-Ui}$$

The above function is linearized double-log form:

$$\text{In } Y = \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + \beta_5 \ln X_5 + \beta_6 \ln X_6 + \beta_7 \ln X_7 + \beta_8 \ln X_8 + U_i$$

Where,

Y = Gross return (Tk./ha)

X_1 = Cost of Mechanical power (Tk./ha)

X_2 = Cost of Human Labor (Tk./ha)

X_3 = Cost of Sucker (Tk./ha)

X_4 = Cost of Fertilizer (Tk./ha)

X_5 = Cost of Manure (Tk./ha)

X_6 = Cost of Irrigation (Tk./ha)

X_7 = Cost of Insecticide (Tk./ha)

X_8 = Cost of Bamboo (Tk./ha)

β_1,β_2.....β_8 = Coefficients of respective variables

a = Intercept

i= No. of variable

ln = Natural logarithm.

The model of the technical inefficiency effects in the stochastic production frontier equation is defined by

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

Where,

Z_1 to Z_5 are explanatory variable

The equation can be written as:

$U_i = \delta_0 + \delta_1$ Banana farming experience + δ_2 Farm size + δ_3 Extension service + δ_4 Training + δ_5 Taking loan + W_i

V is two-sided uniform random variable beyond the control of farmer having N (0, σ 2) distribution, U is one-sided technical inefficiency effect under the control of farmer having a positive half normal distribution $\{U_i \sim |N (0, \sigma u 2)|\}$ and W_i is two-sided uniform random variable. W is unobservable random variable having a positive half-normal distribution. The model was estimated simultaneously using STATA.

CHAPTER FOUR
RESULTS AND DISCISSION

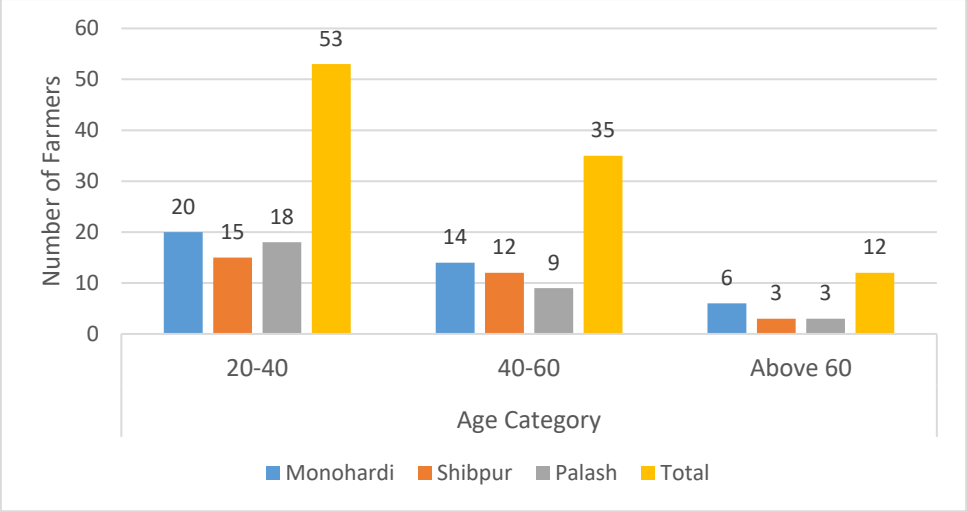
4.1 Socio-demographic Profile of Household Population

4.1.1 Introduction

The purpose of this section is to provide a quick overview of the sociodemographic profile of banana producers. The sociodemographic status of farmers may be interpreted in a variety of ways, depending on aspects such as their standard of living, the financial situation in which they live, and the type and extent of the grower's support for national progress initiatives. Due to time and asset constraints, it was difficult to collect full data on the financial characteristics of the sample farmers. The financial situation of the example farmers is critical in the event of study planning, as there are several connected and component aspects that identify a person and have a substantial influence on the development of his/her behavior and character. Individuals differ in their financial viewpoints. Nonetheless, for the sake of this study, a few of the financial characteristics have been considered for exchange.

4.1.2 Age

Forty, thirty and thirty samples were taken from each of the three Upazilas named as Monohardi, Shibpur, and Palash respectively, which represented the whole population. In Monohrdi upazila, 50% of the sample population was between the ages of 20 and 40, 35% were between the ages of 40 and 60, and 15% were beyond 60. In Shibpur upazila, 50% of the sample population was between the ages of 20 and 40, 40% were between the ages of 40 and 60, and 10% were beyond the age of 60. In Palash upazila, 60% of the sample population was between the ages of 20 and 40, 30% were between the ages of 40 and 60, and 10% were beyond the age of 60. (Figure 4.1). It was observed that majority of persons in each community were between the ages of 20 and 40.



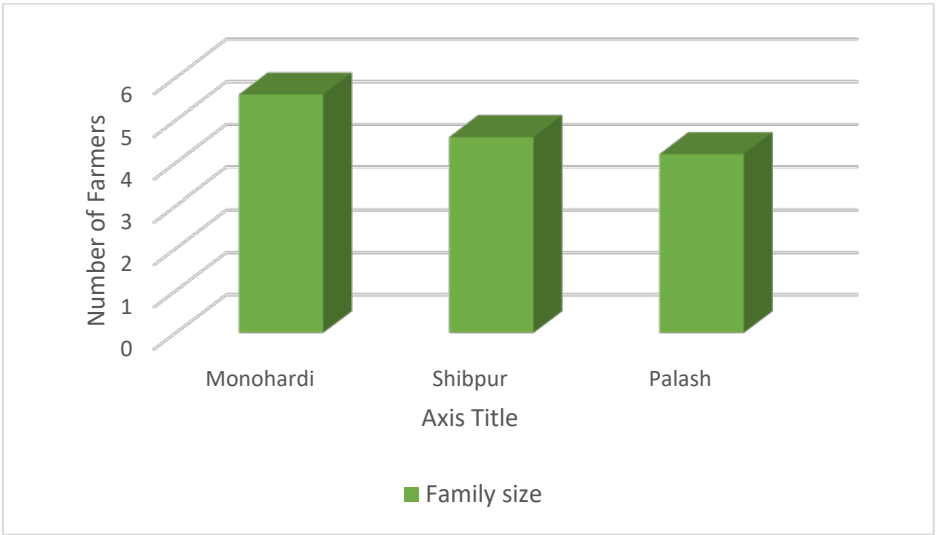
Source: Field Survey, 2020

Figure 4.1: Age of the Respondent by Study Area

4.1.3 Composition of the Family Size

Family size is critical in terms of producing adequate nourishing grain for the ranch family. In this research, family was defined as the total number of persons living in a same kitchen and eating meals under the influence of a single family leader. The term "relatives" refers to the husband, children, unmarried little girl, father, mother, sister, and several other relatives who reside in the family permanently.

The average family size of Monohardi, Shibpur and Palash upazila was 5.6, 4.6 and 4.2, respectively. (Figure 4.2)

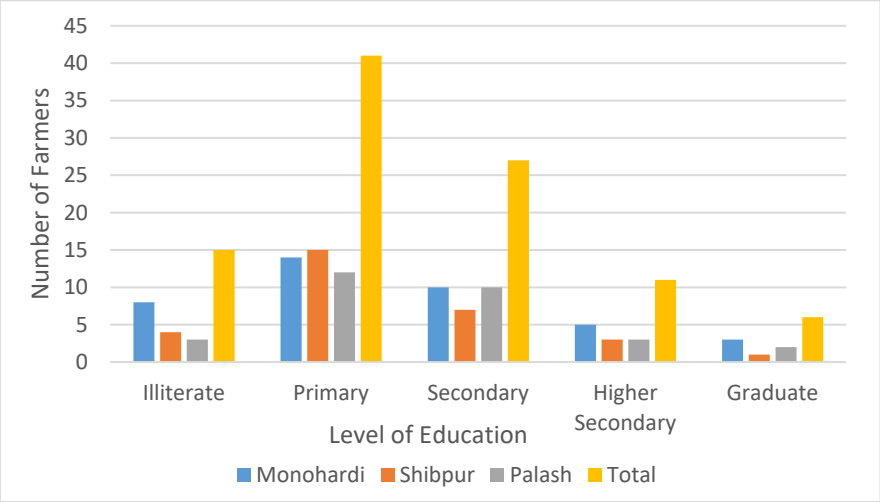


Source: Field Survey, 2020

Figure 4.2: Family Size of the Respondent by Study Area

4.1.4 Education

According to Figure 4.3, approximately 15% of the study population aged 5 years or more were deprived of education and/or were unable to read or write, approximately 41% obtained primary level education, approximately 27% achieved secondary level education, approximately 27% attained higher secondary level education, and approximately 6% completed graduation level education. In Monohardi upazila, approximately 20% of the population aged 5 years or more lacked education and/or were unable to read or write, approximately 35% achieved primary level education, approximately 25% obtained secondary and approximately 12.5% attained higher secondary level education, and approximately 7.5% completed graduation level education. In Shibpur upazila, approximately 13.33% of the population aged 5 years or more lacked education and/or were unable to read or write, approximately 50% achieved primary level education, approximately 23.34% obtained secondary and approximately 10% attained higher secondary level education, and approximately 3.33% completed graduation level education. In Palash upazila, approximately 10% of the population aged 5 years or more lacked education and/or were unable to read or write, approximately 40% achieved primary level education, approximately 33.33% obtained secondary and approximately 10% attained higher secondary level education, and approximately 6.67% completed graduation level education.



Source: Field Survey, 2020

Figure 4.3: Education of the Household Members by Study Area

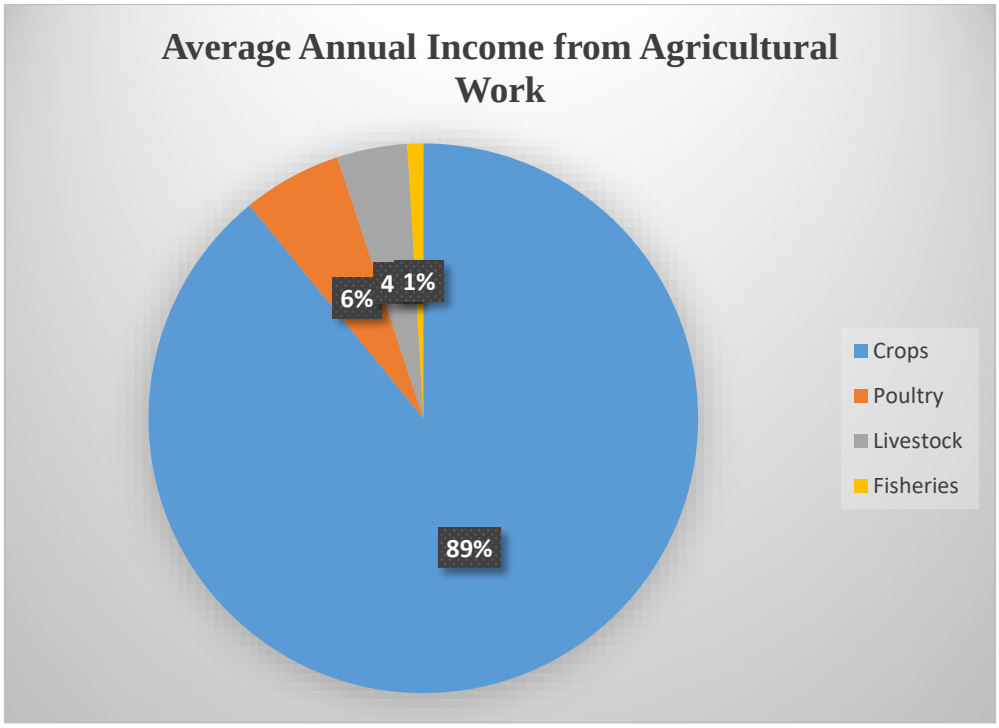
4.1.5 Annual Family Income

a) Agricultural Work

Crops, poultry, livestock, and fisheries are the sample's primary agricultural revenue sources. The majority of framers earn their living through agriculture. Crop cultivation was the primary source of income for these individuals, with an average annual revenue from crop production of Tk. 490582. Farmers get Tk. 32100 and Tk. 22771 per year from poultry and livestock, respectively. Farmers also earn an average of Tk. 5137 per year from fisheries. Agriculture generated a total yearly household income of Tk. 550590.

b) Non-Agriculture Work

Non-agricultural activities included day labor, auto and truck driving, domestic labor, small business, overseas remittance, and services. Tk. 25429 was reported to be the annual average revenue from non-agriculture sources. The overall yearly average income was determined to be Tk. 576019.



Source: Field Survey, 2020

Figure 4.4: Average Annual Income of the Household Members from Agricultural Work

4.1.6 Annual Family Expenditure

The average yearly spending of a sample farmer was determined to be Tk. 312283.40. The majority of household expenditure was used for food consumption. Other significant costs were those associated with a child's education, clothes, medication, transportation, festival attendance, and entrainment. Tk. 263735.60 was determined to be the average yearly household savings.

Table 4.1 Annual Family Income and Expenditure by Study Area

Agricultural Income (Tk.)	Non-agricultural Income (Tk.)	Total Income (Tk.)	Total Family Expenditure (Tk.)	Savings (Tk.)
550590.00	25429.00	576019.00	312283.40	263735.60

Source: Field Survey, 2020

4.1.7 Agricultural Training

Only 30% of responding farmers in Monohardi upazila received training in banana growing, compared to 33.33% in Shibpur upazila and 30% in Palash upazila (Table 4.2). These training sessions enhanced their perspectives of proper sucker handling, the use of resistant cultivars, the administration of insecticides and herbicides, and proper water management, among other topics. The majority of DAE's Integrated Pest Management training (IPM).

Table 4.2 Agricultural Training of the Respondent by Study Area

Training Received	Monohardi Upazila		Shibpur Upazila		Palash Upazila	
	No. of Farmers	%	No. of Farmers	%	No. of Farmers	%
Yes	12	30	10	33.33	9	30
No	28	70	20	67.66	21	70
Total	40	100	30	100	30	100

Source: Field Survey, 2020

4.1.8 Membership of Any Social Organization

In Monohardi upazila, 50% of banana farmers were found to be members of various NGOs and/or farmers' organizations, whereas in Shibpur upazila, 60% of banana farmers were found to be members of various NGOs and/or farmers' organizations, and 70% of banana farmers were found to be members of various social organizations in Palash upazila (Table 4.3).

Table 4.3 Membership in Any Organization of the Respondent by Study Area

Membership	**Monohardi Upazila**		**Shibpur Upazila**		**Palash Upazila**	
	No. of Farmers	%	**No. of Farmers**	%	**No. of Farmers**	%
Yes	20	50	18	60	21	70
No	20	50	12	40	9	30
Total	40	100	30	100	30	100

Source: Field Survey, 2020

4.2 Profitability of Banana Production

4.2.1 Introduction

The primary objective of this chapter is to evaluate the costs, returns, and profitability of banana cultivation. Profitability is a critical factor in determining whether to produce any crop at the farm level. It may be quantified in terms of net return, gross margin, and return on total cost. The overall cost of production was determined by adding the expenses of all products. The crop returns have been approximated using the values of the primary products and by-products.

4.2.2 Variable Costs

4.2.2.1 Cost of Mechanical Power During Land Preparation

The preparation of the land is the most critical step in the production process. Land preparation efforts included plowing, laddering, and other tasks necessary to prepare the land for banana agriculture. Thus, the average cost of mechanical power during land preparation for banana production was Tk. 4540 per hectare, or 2.34% of the overall cost (Table 4.4).

4.2.2.2 Cost of Hired Human Labor

Human labor is a significant cost component for the cost of cultivation of banana. It is a critical and widely utilized input in the production of Banana. It is often needed for a variety of tasks including land preparation, seeding, weeding, fertilizer and pesticide treatment, irrigation, harvesting and hauling, threshing, cleaning, drying, and storage. The average amount of hired human labor utilized in banana production was 60 man-days per hectare, with an average wage of Tk. 400 per man-day. As a result, the cost incurred for human labor was Tk. 42076.37, accounts 21.69% of the overall cost (Table 4.4).

4.2.2.3 Cost of Sucker

Sucker prices vary significantly according on its quality and availability. Farmers used an average of 2520 sucker per hectare. The overall cost of sucker per hectare for banana cultivation was calculated to be Tk. 18900, accounts 9.74% of the total cost (Table 4.4).

4.2.2.4 Cost of Urea

In the study area, farmers used different types of fertilizers. On an average, farmers used urea 212 kg per hectare. Per hectare cost of urea was Tk. 3392, which represents 1.74% of the total cost (Table 4.4).

4.2.2.5 Cost of TSP

Among the different kinds of fertilizers used, the rate of application of TSP per hectare was 170kg. The average cost of TSP was Tk. 3740 which depicts 1.93% of the total cost (Table 4.4).

4.2.2.6 Cost of MoP

The application of MoP per hectare was 150 kg. Per hectare cost of MoP was Tk. 2250, which accounts 1.16% of the total cost (Table 4.4).

4.2.2.7 Cost of Manure

Farmers in the study area employed cow dung for banana cultivation. They purchased a substantial amount of cow excrement from milk producers. It was discovered that the cost per hectare is around Tk. 11700, which accounts 6.03% of the overall cost (4.4)

4.2.2.8 Cost of Irrigation

Irrigation is one of the most significant expenditures associated with banana cultivation. Irrigation water used in the proper dosages aids in the growth of bulb diameter, clove number, leaf number, and plant height. As a consequence, the yield per hectare increases. Irrigation costs for banana cultivation was Tk. 1960.67 per hectare, accounting for 1.01% of the overall cost (Table 4.4).

4.2.2.9 Cost of Insecticides

Farmers used different kinds of insecticides to keep their crop free from pests and diseases. The average cost of insecticides for banana production was Tk. 2188.23, which was 1.13% of the total cost (Table 4.4).

4.2.2.10 Cost of Bamboo

The use of bamboo is a traditional practice during the maturity stage of banana cultivation to protect the fruit bearing plants from falling off. The average cost of bamboo for banana production was Tk. 31875.65, which was 16.43% of the total cost (Table 4.4).

4.2.2.11 Interest on Operating Capital

Interest on operating capital was determined by factoring in all operational expenditures incurred throughout Banana's production period. Interest on operating capital for banana production was approximated at 9% and Tk. 11036.00 per hectare was computed, which accounts 5.69% of the total cost (Table 4.4).

4.2.2.12 Total Variable Cost

Therefore, from the above different cost items it was clear that the total variable cost of Banana production was Tk. 133658.27 per hectare, which accounts 68.90% of the total cost (Table 4.4).

Table 4.4: Per Hectare Costs of Banana Production

Cost Items	Costs/Returns (Tk/ha)	% of total
A. Gross Return		
Main product (Banana)	476532.00	99.16
By-product (Sucker)	4050.00	0.84
Total return	**480582.00**	100
B. Gross Cost		
Variable Cost		
Mechanical Power	4540.00	2.34
Labor Cost	42076.37	21.69
Sucker	18900.00	9.74
Urea	3392.00	1.74
TSP	3740.00	1.93
MOP	2250.00	1.16
Total Fertilizers cost	**9382.00**	4.83
Manure (Cowdung)	11700.00	6.03
Irrigation	1960.67	1.01
Insecticides	2188.23	1.13
Bamboo cost	31875.65	16.43
C. Total operating cost (TOC)	**122622.27**	63.21
Interest on operating capital @ 9%	11036.00	5.69
D. Total variable cost (TVC)	**133658.27**	68.90
Land use cost	60320.33	31.10
E. Total Fixed cost (TFC)	**60320.33**	31.10
F. Total costs (D+E)	**193978.60**	100

Source: Field Survey, 2020

4.2.3 Fixed Cost

4.2.3.1 Land Use Cost

The rental value of land was determined using the opportunity cost of land usage per hectare during a four-month cropping cycle. The rental value of land was used to calculate the cost of land usage. Land usage cost was determined to be Tk. 60320.33 per hectare using data acquired from banana producers, accounting for 31.10% of the overall cost (Table 4.4).

4.2.4 Total Cost (TC) of Banana Production

Total cost was calculated by adding all the cost of variable and fixed inputs. In the present study per hectare total cost of producing Banana was Tk. 193978.60 (Table 4.4).

4.2.5 Return of Banana Production

4.2.5.1 Gross Return

The return on banana production per hectare is given in Table 4.5. The gross return per hectare was computed by multiplying the total quantity of product by the per-unit price. As a result, the total return from main product (banana) was determined to be Tk. 476532 per hectare (Table 4.5). Additionally, the product (sucker) has an estimated value of Tk. 4050 per hectare for banana cultivation. The total return or gross margin per hectare was determined to be Tk. 480582.

4.2.5.2 Gross Margin

Gross margin is the gross return over variable cost. Gross margin was calculated by deducting the total variable cost from the gross return. The gross margin was estimated to be Tk. 346923.73 per hectare (Table 4.5).

Table 4.5: Per Hectare Cost and Return of Banana Production

Cost Item	Cost/Returns (Tk./ha)
A. Gross Return	480582.00
B. Variable Cost	133658.27
C. Fixed Cost	60320.33
D. Total costs	193978.60
E. Gross Margin (A-B)	346923.73
F. Net Return (A-D)	286603.40
G. Undiscounted BCR (A/D)	2.48

Source: Field Survey, 2020

4.2.5.3 Net Return

Net return or profit was calculated by deducting the total production cost from the gross return. The study resulted that net return was Tk. 286603.40 per hectare (Table 4.5).

4.2.6 Benefit Cost Ratio (Undiscounted)

Benefit Cost Ratio (BCR) is a relative measure, which is used to compare benefit per unit of cost. Benefit Cost Ratio (BCR) was 2.48 which implies that one-taka investment in banana production generated profit of Tk. 1.48 (Table 4.5). The study revealed that banana cultivation is profitable in the study area.

4.3 Major Factors Affecting in Banana Production

The principal inputs used in the research region for banana production were primarily human labor, mechanical power, sucker, urea, TSP, MoP, and irrigation. These inputs were used as explanatory variables in the study of the banana production function. As a result, these inputs are theorized to account for the diversity in banana output. As a result, a Cobb-Douglus production function was applied to ascertain plausible correlations between banana production and inputs.

4.3.1 Interpretation of ML Estimates of the Stochastic Frontier Production Function

Maximum likelihood estimation starts with the formulation of a mathematical equation for the sample data known as the Likelihood Function. The likelihood of acquiring a piece of data can be defined as the probability of receiving that collection of data given the probability distribution model selected. This phrase comprises the model parameters that are unknown. Maximum Likelihood Estimates, or MLE's, are the values of these parameters that maximize the sample likelihood. Maximum Likelihood Estimates (MLE) for the Cobb-Douglas stochastic frontier production function model for banana production for all farmers are represented in table 4.6.

Table 4.6: Estimated Values of the Co-efficient and Related Statistics of Cobb-Douglas Production Model

Variables	Parameter	Coefficients	T-ratio
Stochastic Frontier:			
Intercept	β_0	13.827***	3.78
Mechanical Power cost (X1)	β_1	0.2261***	2.58
Labor Cost (X2)	β_2	-0.0642	-1.35
Cost of Sucker (X3)	β_3	0.1242*	1.69
Cost of Fertilizer (X4)	β_4	0.6004***	3.79
Cost of Manure (X5)	β_5	-0. 0639	-1.26
Cost of Irrigation (X6)	β_6	0.0357***	3.39
Cost of Insecticide (X7)	β_7	0.0507*	1.92
Cost of Bamboo (X8)	β_8	0.0067**	2.31
R^2	0.73		
F-Value	57.29***		
Returns to scale($\sum \beta i$)	0.9157		
Inefficiency Model			
Constant	δ_0	0.7286	0.63
Experience (Z1)	δ_1	-0.0629*	1.90
Farm size (Z2)	δ_2	-0.1450***	-2.58
Extension service (Z3)	δ_3	-0.0297	-0.23
Training (Z4)	δ_4	0.7346	-0.67
Credit service (Z5)	δ_5	-0.8330	-0.80
Log-likelihood Function	-51.481		

Source: Field Survey, 2020

Note: *** = Significant at 1% level
** = Significant at 5% level
* = Significant at 10% level

As evidenced by the F-values and R-square, the Cobb-Douglas model matched the data rather well. For banana farmers, the coefficient of multiple determinations (R-square) was 0.73. The R-square result indicates that the explanatory factors accounted for 73% of the variation in banana production. The influence of specified variables influencing banana productivity may be noticed in the regression equation estimates. In the instance of banana growers, the results indicate that the co-efficient of mechanical power, cost of fertilizer and irrigation were significant at 1% level, co-efficient of cost of bamboo was

significant at 5% level, cost of insecticide and cost of sucker were significant at 10% level but the co-efficient of labor cost and cost of manure did not have the predicted sign. Additionally, the F-value of the equation was significant at 1% level of significance. This means that the variation in banana production is mostly determined by the model's explanatory factors.

Mechanical Power Cost (X1)

The value of production co-efficient for mechanical power was 0.2261 for banana. The production co-efficient was positive. The positive sign indicates that return from banana can be increased by using mechanical power. The estimated co-efficient 0.2261 revealed that 1% increase in mechanical power during land preparation and intercultural operation with other factors remaining constant, would increase the gross return by 0.2261%.

Labor Cost (X2)

The value of the production co-efficient for human labor was -0.0642 for banana. The production co-efficient was negative and not significant.

Cost of Sucker (X3)

The value of production co-efficient for sucker was 0.1242 for banana. The production co-efficient was positive. The positive sign indicates that return from banana can be increased by increasing sucker cost. The estimated co-efficient 0.1242 revealed that 1% increase in sucker cost with other factors remaining constant, would increase the gross return by 0.1242%.

Cost of Fertilizer (X4)

The value of production co-efficient for fertilizer was 0.6004 for banana. The production co-efficient was positive. The estimated co-efficient 0.6004 revealed that 1% increase in fertilizer cost in the pre-harvesting period with other factors remaining constant, would increase the gross return by 0.6004%.

Cost of Manure (X5)

The value of production co-efficient for manure was -0.0639 for banana. The production co-efficient was negative and not significant.

Irrigation Cost (X6)

The value of production co-efficient for irrigation was 0.0357 for banana. The production co efficient was positive. Therefore, if irrigation can be applied timely during the dry spells then the production will be increased. The positive sign indicates that return from banana can be increased by timely application of irrigation. The estimated co-efficient 0.0357 revealed that 1% increase in irrigation in the pre-harvesting period with other factors remaining constant, would increase the gross return by 0.0357%.

Cost of Insecticide (X7)

The value of production co-efficient for insecticide was 0.0507 for banana. The production co-efficient was positive. The positive sign indicates that return from banana can be increased by timely application of insecticide. The estimated co-efficient 0.0507 revealed that 1% increase in insecticide cost in the pre-harvesting period with other factors remaining constant, would increase the gross return by 0.0507%.

Bamboo Cost (X8)

The use of bamboo is a crucial practice during the maturity stage of banana cultivation. The value of production co-efficient for bamboo cost was 0.0067 for banana. The production co efficient was positive. The positive sign indicates that return from banana can be increased with proper use of bamboo as a support for the plants. The estimated co-efficient 0.0067 revealed that 1% increase in bamboo cost in the pre-harvesting period with other factors remaining constant, would increase the gross return by 0.0067%.

Returns to Scale ($\sum \beta i$)

The total of all regression coefficients or production elasticity's of the estimated model provides information on the returns to scale, that is, the change in output in response to a proportionate change in all inputs. The total of all of the production coefficients in the equation for banana growing came to 0.9157. This

implies that the production function in banana (production/ha) exhibits diminishing returns to scale, which means that if all of the inputs listed in the function are raised by 1% then the return will grow by 0.9157%.

4.4 Interpretation of Technical Inefficiency Model

In the technical inefficiency effect model experience, farm size, extension service and credit service have expected (negative) coefficients. The negative and significant (1 percent) coefficient of experience implies that experienced farmers are technically more efficient than non-experienced farmers.

The negative coefficient and significant at 10 percent level of significance of farm size implies that if farm size increase efficiency ill also increase.

The negative coefficient of extension service is not statistically significant.
The negative coefficient of credit service is not statistically significant.

The coefficients of training 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 producing banana. (Table 4.6)

Concluding Remarks

From the above discussion, it is easy to comprehend about the different cost items, their application doses of farmers and yields and returns per hectare of banana production. Banana production is a labor-intensive enterprise. It is most essential to use modern inputs such as suckers, fertilizers, human labor, power tiller, strong bamboo, pesticides and irrigation efficiently. Timely and efficient use of these inputs are the most important to increase production and profitability. On the basis of above considerations, it could considerately be concluded here that production of banana is a profitable practice. Production of banana would help farmers to increase their income earnings.

4.5 Problems Faced by Farmers in Banana Production

There were numerous difficulties encountered by farmers and intermediaries in the production and marketing of bananas, similar to those encountered by farmers and intermediaries of other agricultural crops and in other areas of Bangladesh, even though Narsingdi (study area) was ideally suited for banana production and marketing, as reported by farmers and intermediaries in the study area.

4.5.1 Problems Faced by Farmers During Production

Bangladesh's economy is heavily reliant on agriculture. However, this agricultural industry remains insignificant at this moment. This industry is fraught with a variety of issues. Farmers in Bangladesh seldom get the requisite number of land, appropriate money, fertilizers, professional assistance, and lastly, a market price for their output. Farmers encountered a variety of issues throughout one-year banana production cycles, which are stated below:

Lack of Adequate Capital

The majority of farmers in the study region said that they lacked enough operational capital. The majority of them were deprived of institutional credit. Due to their financial incompetence and urgent need for cash, they are forced to borrow money from non-institutional sources, incurring hefty interest rates. In the research region, the first significant issue was a lack of appropriate money.

High Price of Inputs

Banana production required a variety of inputs, including labor, sucker, and fertilizer. Regrettably, the majority of farmers were enforced to pay a higher market price than was fair. In the research region, the second most serious issue faced the sample farmers was high input prices.

Lack of Quality Sucker

Due to natural adversity and a lack of adequate information, the majority of farmers in the study region were unable to gather excellent sucker from their own land. As a result, they were forced to rely on other suckers. Even they were forced

to pay an illogically high price. In the research region, the third most serious difficulty faced farmers was a scarcity of high-quality sucker.

Low Output Price

The majority of farmers were compelled to sell their crops immediately after harvesting at very cheap prices in order to cover home expenses, pay labor costs, and so on. Conscious farmers rated their goods' prices as very cheap in comparison to their production costs. Low output prices were the fourth most serious concern faced by farmers in the research region.

Lack of Technical Knowledge

The banana farmers lacked understanding of science and contemporary technologies. They also emphasized the lack of effective weeding and fertilizer application procedures, owing to the fact that these activities required a huge number of laborers. Low output prices were the fifth most serious concern faced by farmers in the research region.

Storage Problem

Banana storage issues were also noted in the research location. Due to a lack of adequate storage facilities, the majority of items were sold at a discount following harvest. Additionally, significant spoiling happens throughout the harvesting process. However, the issue was not discovered in the situation of small farmers, but was prevalent in the case of big and medium farms. It was the study area's sixth restriction issue.

Disease and Insects Infestation

This is one of the issues challenging banana growers. Production may be diminished as a result of disease and insect infestation. To address this issue, they sometimes apply insecticides and pesticides, which increased their manufacturing costs. Disease and insect infestation were the seventh limiting concern identified by farmers in the research region.

Table 4.7: Problems Faced by the Farmers in Banana Production

Nature of Problem	No. of Farmers	Percentage of Total No. of Farmers	Rank of the Problem
Lack of Adequate Capital	64	64	1st
High Price of Inputs	56	56	2nd
Lack of Quality Sucker	55	55	3rd
Low Output Price	50	50	4th
Lack of Technical Knowledge	47	47	5th
Storage Problem	43	43	6th
Disease and Insects Infestation	30	30	7th
Problems of Theft	28	28	8th
Problems of Natural Calamities	25	25	9th
Carrying Problem	20	20	10th
Lack of Fertilizer	16	16	11th

Source: Field survey, 2020

Problems of Theft

During the harvesting season, banana theft was a widespread occurrence, discouraging producers from growing this fruit crop. Around sixty percent of banana producers in the research region reported theft incidences that had a negative impact on banana output.

Problems of Natural Calamities

About eighty percent of banana growers claimed that natural calamity was also a major constraint to expansion of banana production.

Carrying Problem

It was one of the problems in the study area. To carry various inputs and outputs from market field and field to market has hampered greatly due to proper carrying.

Lack of Fertilizer

Fertilizer is the most critical component in banana production. They often use urea, TSP, and MoP. Farmers have applied fertilizer multiple times in their land to increase productivity. Fertilizer shortages are prevalent throughout our country's production era. Certain merchants created a fictitious fertilizer crisis in order to increase the price. The last issue in the research region was a shortage of fertilizer.

CHAPTER FIVE
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

In Bangladesh, banana is one of the most significant perishable multifunctional food crops. It is nutrient-dense, palatable, readily digested, high in carbohydrate and minerals, and has more calories. It has the potential to contribute to our people's nutritional food security. Banana cultivation may assist in achieving import substitution by lowering reliance on foreign goods. Additionally, it is critical for farmers' monetary demands. The crop is critical for nutrition, profitability, and revenue, particularly in the study area. Bananas are mostly consumed as fruits in Bangladesh. Occasionally, its residuals are utilized as cow fodder. Bananas are not just a source of nutrition; they also provide farmers with a source of monetary revenue. However, its output is heavily reliant on its marketing capabilities. If producers are unable to sell bananas at attractive rates and on schedule, they are likely to cease production. The marketing of bananas is critical in determining its profitability. In that regard, the current research was undertaken to ascertain the profitability of banana production, to ascertain the production area's difficulties, and to provide likely recommendations at those levels. The research area consisted of three upazilas. These are Monohardi, Shibpur and Palash upazilas. The population of the research was composed of banana producer-farmers in a chosen banana market. In terms of sample selection, a total of 100 banana producers were chosen for the research. Primary and secondary sources of data were taken into account. Primary data were collected from respondents through in-depth interviews. The survey was done by the researcher during February to April of 2020. Additionally, secondary data was required for the investigation. Secondary data sources included pertinent books, journals, and other Bangladesh Bureau of Statistics publications. The study's results were reported in uncomplicated language such as count, percentage, mean, and standard error of mean. The statistical approach STATA was utilized to determine the study's technical efficiency.

The costs of cultivation were calculated for analytical purposes using gross margin analysis. Analysis of net margins, benefit-cost ratios, and functional analysis. To assess the influence of major factors on banana cultivation, the Cobb-Douglas production function was employed. The Cobb-Douglas model's double log form was shown to be the better choice on theoretical and econometric grounds. To estimate technical efficiency, stochastic frontier production function was used. According to the socioeconomic study among the three upazilas, 53% of the sample population was between the ages of 20 and 40 years, 35% were between 40 and 60 years, and 12% were above 60 years. The average family size of Monohardi, Shibpur and Palash upazila was 5.6, 4.6 and 4.2, respectively. Approximately 15% of the study population aged 5 years or more were deprived of education and/or were unable to read or write, approximately 41% obtained primary level education, approximately 27% achieved secondary level education, approximately 27% attained higher secondary level education, and approximately 6% completed graduation level education. The average yearly income was determined to be Tk. 576019.00, the average annual expenditure was determined to be Tk. 312283.40, and the average annual family savings was determined to be Tk. 263735.60. Economic profitability is a critical factor in determining whether to produce any crop at the farm level. It may be quantified in terms of net return, gross margin, and return on total cost. The cost of land preparation for banana cultivation was estimated Tk. 4540 per hectare on average. The cost of contracted human labor was Tk. 42076, or 21.69% of the overall cost. Sucker cost per hectare was Tk. 18900 for banana cultivation. Farmers used chemical fertilizers and manure for banana cultivation. The average cost of fertilizer and manure was Tk. 9382 and Tk. 11700, respectively. Tk. 2188.33 was the average cost of pesticides used in banana cultivation. Whereas the average irrigation cost per hectare was Tk. 1960.67. The total variable cost was for banana cultivation Tk. 133658.27 per hectare, accounts 68.90% of the overall cost. The average gross return of banana production was Tk. 480582.00. The gross margin and net return per hectare were Tk. 346923.73 and Tk. 286603.40, respectively. The Benefit Cost Ratio (BCR)

was 2.48, implying that a single taka investment in banana production yielded Tk. 1.48. Technical efficiency measures a farmer's capacity to maximize output with a given amount of inputs and production technologies. Technical efficiency is thus defined as a farmer's divergence from the frontier of optimal practices. Mechanical Power cost (X1), Labor Cost (X2), Cost of Sucker (X3), Cost of Fertilizer (X4), Cost of Manure (X5), Cost of Irrigation (X6), Cost of Insecticide (X7) and Cost of Bamboo (X8) were the independent variables. While the regression coefficients for Mechanical Power cost (X1), Cost of Sucker (X3), Cost of Fertilizer (X4), Cost of Irrigation (X6), Cost of Insecticide (X7) and Cost of Bamboo (X8) were all positive and significant at various levels of significance. The regression coefficients for Labor Cost (X2) and Cost of Manure (X5) were determined to be negative and insignificant in relation to the return on banana production. The positive indication shows that the return on bananas can be enhanced by raising Cost of Mechanical Power, Sucker, fertilizer, Irrigation, Insecticide and Bamboo, while the negative sign suggests that the return on bananas may be decreased by investing more on labor and manure costs.

Farmers had several difficulties while growing bananas. The issues were social and cultural in nature, as well as financial and technological in nature. Inadequate capital was identified as one of the most significant constraints to producing Banana in the research. Farmers faced several challenges including high input costs, a scarcity of high-quality produce, poor output prices, a lack of technical expertise, storage issues, disease and insect infestation, theft issues, natural disaster issues, transportation issues, and a shortage of fertilizer. These are the primary restrictions for banana farmers in the research region. Public and commercial actions should be conducted to mitigate or remove these issues in order to improve banana output.

5.2 Conclusions

Despite certain restrictions, the study's results suggest that farmers may earn a good net return from banana farming. In terms of revenue creation and poverty reduction, the cultivation of bananas may be critical in addressing farmers' economic demands. The difference between the producer's and consumer's prices was enormous, and producers did not get a fair price for their goods. As a result, the government should take effective steps to manage the market's pricing system and price spread, ensuring that producers get an acceptable price and that consumers receive a decent price as well. Not only is banana a vital source of nourishment, it is also a significant source of financial gain for producers and dealers. Additionally, a considerable number of people were employed in the banana industry. Thus, growers may profit financially more if banana output is increased.

5.3 Recommendations

The institutional suggestions are made with the goal of enhancing banana production and the current banana marketing system in the research regions. In light of the study's research and observations, it was determined that the banana is a promising fruit, but some further effort is required to maximize its production and marketing potential. Measures should be taken to boost a farmer's awareness of contemporary agricultural techniques and to encourage them to use new technologies in order to increase yield.

REFERENCES

Aigner, D.J., Lovell, C.A.K. and Schmidt, P.J. (1977). Formulation and Establishment of Stochastic Frontier Production Function Models. *Journal of Econometrics*, 6:21-37.

Ahmad, K., Matin, M. A. and Quasem, M. A. (1973). Performance of some banana varieties when grown on damp land. Bangladesh Hort., 1: 70-72.

Ahmad, K., Hossain, A. K. M. A. and Hossain, B. (1974). A comparative study on four table varieties of banana. *Bangladesh Hort.*, 2: 5-11.

Ahmed, K. (1984). Gardener's Book on Production and Nutrition. 1st Edition. Mumtaj Kamal, Dhaka, Bangladesh. 448p.

Ara, N., Basher, M. K. and Hossain, M. F. (2011). Growth, yield and quality of banana (*Musa sapientum* L) influenced by different banana verities/lines and planting time. *Tropical Agric. Res. Extens.,* 14: 45-51.

Arputharaj and Nair, K.S. (1986). Economics of Banana Cultivation in Kerala. Himalaya Publications, New Delhi, pp. 25-37.

Assani, A. R., Haicour, G., Wenzel, F., Cote, F and Bakry, F. (2001). Plant regeneration from protoplasts of dessert banana cv. Grande Naine (*Musa* spp., Cavendish sub-group AAA) via somatic embryogenesis. *Plant Cell Rep.*, 20: 482-488. DOI: 10.1007/s002990100366

AtlasBig.com (2021). https://www.atlasbig.com/en-gb/countries-by-banana-production

Bairagi, P.C. (1990). An Economic Study of Banana Production in Some Selected Areas of Jhennidah District, M Sc Thesis, Department of Agricultural Economics, BAU, Mymensingh.

Bastine, L.C., and Radhakrishnan, V. (1988). Eonomics of Banana Cultivation in Irinjalakkuda Block in Trichur District of Kerala. *Indian Journal of Agricultural Economics*, 40(3): 154

BBS, (2019). Statistics Year Book of Bangladesh, Bangladesh Bureau of Statistics, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka.

Begum, N. (2001). An Economic Study on Production and Marketing of Banana of Three Union of Sirajgonj Upazila major Bogura district. An MS Thesis, Department of Agricultural Economics, BAU, Mymensingh.

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

BER (2017). Bangladesh Economic Review, Department of Finance, Ministry of Finance, Government of the People's Republic of Bangladesh, Dhaka.

Changadeya, W., Ambali, A.J.D. and Kambewa, D. (2012). Farmers' adoption potential of improved banana production techniques in Malawi. *International Journal of Physical and Social Sciences,* 2(4): 32-48.

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

Duraisingh, V., Pandian, H.S., and Immanuel, R. (2008). A Case Study of Agricultural Marketing in Nazareth, Thoothukudi District. *Voice of the Hindecon,* 14: 42-48.

Emaga, T.H., Andrianaivo, R.H., Wathelet, B., Tchango, J.T. and Paquot, M., (2008). Effects of the stage of maturation and varieties on the chemical composition of banana and plantain peels. *Food Chem.,* 103: 590-600.

FAO, (2009). Production Year Book. Food and Agriculture Organization of the United Nations, Rome, Italy.

Fonsah, E.G., Tertuliano, M., Manower, T., Chattapadhya, S., Hussain, A., Islam, S., Islam, M.S., Uddin, M.J., Amin, A.S. and Amin, B. (2018). A survey of Agricultural Value chain: A case study of Bangladesh banana industry. *Journal of Agriculture and Environmental Sciences,* 7(1): 141-148.

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

Geetha, P. and Meena, A. (2010) Problems in Production of Banana: An Analysis. *B-Research,* 7: 30-31.

Hanumantharaya, M.R., Kerutagi, M.G., Patil, B.L., Kanamadi, V.C. and Basavaraj, B. (2009). Comparative economic analysis of tissue culture banana and sucker propagated banana production in Karnataka. *Karnataka J. Agric. Sci*., 22(4): 810-815

Haque, M.A. (1983). Some Technological Aspects for the Commercial Production of Banana, National Symposium on Agricultural Research, 22-23 December, BARC, Dhaka.

Haque, M.A. (1984). Effect of planting time on the production of Banana in Bangladesh. *Bangladesh J. Agric. Res*., 9: 23-32.

Haque, M.A. (1988). The economic performance of Banana production. An MS Thesis, Department of Agricultural Economics, BAU, Mymensingh.

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

Hoque, M. A. (2006). Effect of planting time on yield and quality of Sabri banana. *Bangladesh J. Agric. Res*., 31: 323-330.

Hossain, M.K. (2000). The relative profitability of Meher Sagar, Amrit Sagar varieties of banana in Mymensingh and Tangail district. MS Thesis, Department of Agricultural Economics, Bangladesh Agricultural University, Mymensingh.

Hossain, M. F. (2014). A study of banana production in Bangladesh: Area, yield and major constraints. *ARPN J. Agric. Biol. Sci*., 9: 206-210.

Hossain, M. M., Alam, M.A. and Uddin, M.K. (2015). Application of stochastic frontier production function on small banana growers of Kushtia district in Bangladesh. *J. Stat. Applic. Probability*, 4: 337-342. DOI: 10.12785/jsap/040218

Hussain, K. (1994). Comparative Economics of Rice and Banana- A Study in a Selected Area of Bangladesh. MS. Thesis, Department of Agricultural Economics, BAU, Mymensingh.

Islam, S.M. and Hoque, M.A. (2005). Status of banana production in Bangladesh. Proceedings of the International Conference on Mechanical Engineering, (CME' 05), Dhaka, Bangladesh. pp. 33-41.

Islam, F., Parvin, M. M., Islam, M. N. and Habibullah, M. (2013). An analysis of cost of production of banana and profitability at Narsingdi and Gazipur district in Bangladesh. *International Journal of Research in Commerce, IT & Management,* 3(5): 113-118.

Islam, M.A., Rahman, M.A. and Saha, J.K. (2018). Profitability of Banana cultivation under agricultural credit in Narsingdi district of Bangladesh. *Fundam. Appl. Agric.* 3(3): 525-530. Doi: 10.5455/faa.296639

Jaffar, M.A., and Namasivayam. N. (2004) Different Size of Growers of Banana. *Kisan World,* 31(6): 57-58.

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.

Kamal, M.S., Ali, M.A. and Alam F.M. (2014a). Cost and Return Analysis of Banana Cultivation under Institutional Loan in Bogura, Bangladesh. *Int. J. Nat. Soc. Sci.,* 2(1): 19-27.

Kamal, M.S., Ali, M.A. and Alam F.M. (2014b). Socio-economic status and problems of banana growers in Bangladesh, *Int. J. Nat. Soc. Sci.,* 1(1): 91-99.

Kathirvel, N. (2008). Banana Production in Karur District. *Kisan World,* 35(3): 13-14.

Kayat, F., MohammadAmiziA, Idris, A.A., Ibrahim, M.F., Soon, J.M., Ahmad Yusuf, M.K.,Wong K.F. and Zulariff, A.L. (2016). Study of the Intention of Banana Growers in Improving the Production in Jeli, Kelantan. Second Asia Pacific Conference on Advanced Research. pp. 350-358.

Khanum, F., Swamy, M.S., Sudarshana, K.K.R., Santhanam, K. and Viswanathan, K.R. (2000). Dietary fiber content of commonly fresh and cooked vegetables consumed in India. *Plant Foods Human Nutrit.,* 55: 207-218.

Kumar, K.P.S., Bhowmik, D., Duraivel, S. and Umadevi, M. (2012). Traditional and medicinal uses of banana. *J. Pharmacognosy Phytochem.,* 1: 51-63.

Mannan, S.A. (2001). An analysis of agro-economic potentials of jute production in Bangladesh, Ph. D. thesis, Bangladesh Agricultural University, Mymensingh.

Manojkumar, K., Sreekumar, B. and Ajithkumar G.S. (2006). Crop Insurance Scheme: A Case Study of Banana Farmers in Wayanad District. Discussion Paper, Kerala Research Programme on Local Level Development Centre for development Studies, Thiruvananthapuram. p.49.

Mohapatra, D., Mishra, S. and Sutar, N. (2010). Banana and its by-product utilization: An overview. *J. Sci. Indus. Res.*, 69: 323-329.

Mohiuddin, A.K.M., Saha, M.K, Hossain, M.S. and Ferdoushi, A. (2014). Usefulness of banana (*Musa paradisiaca*) wastes in manufacturing of bio products: A review. *Agriculture,* 12: 148-158. DOI: 10.3329/agric.v12i1.19870

Mpawenimana, J. (2005). Analysis of Socio-Economic Factors Affecting the Production of Bananas in Rwanda: A Case Study of Kanama District. *Economic and Political Weekly*, 2(1): 33-34.

Mudyazvivi, E. and Maunze, S. (2007). Banana sub sector and value chain analysis for Zimbabwe. Study report, SNV Zimbabwe, Mutare.

Mukul, A.Z.A. and Rahman, M.A. (2013). Production and profitability of banana in Bangladesh-an economic analysis. *Int. J. Econom. Finance Manage. Sci.*, 1: 159-165. DOI: 10.11648/j.ijefm.20130103.15

Munia, Z.T., Islam, S., Akhi, K. and Islam, M.S. (2019). Economics of small scale commercial banana farming in Tangail district of Bangladesh. *Int. J. Agril. Res. Innov. Tech*. 9(2): 67-75. DOI: 10.3329/ijarit.v9i2.45413

Murry, N. and Das, S. (2019). An economic analysis of banana cultivation in Wokha district of Nagaland, India. *Ind. J. Pure App. Biosci.*7(6). 140-145. Doi: http://dx.doi.org/10.18782/2582-2845.7873

Mustaffa, M.M., and Kumar, V. (2012). Banana Production and Productivity Enhancement through Spatial, Water and Nutrient Management. *Journal of Horticultural Sciences*, *7*(1): 1-28.

Muthupandi, V. (2009). Cultivation and Marketing Problems of Banana in Tamil Nadu: A Study with Reference to Madurai District. Ph.D. Thesis, Madurai Kamaraj University, Madurai.

Nargis, K. (1997). A Comparative Economic Study of Banana and Sugarcane Production in a Selected Area of Meherpur District, MS Thesis, Department of Agricultural Economics, BAU, Mymensingh.

Nessa, A. (1998). A Comparative Economic Study of Banana and Sugarcane Production in a Selected Area of Meherpur District, MS Thesis, Department of Agricultural Economics, BAU, Mymensingh.

Nzioka, S.M. (2009). Economic Efficiency Analysis of Banana Farmers in Kiambu East District of Kenya: Technical Inefficiency and Marketing Efficiency. *Journal of Developments in Sustainable Agriculture.* 4: 118-127

Patel, V.M. (1996). Emerging Problems of Agricultural Marketing a Case Study of Banana in Gujrat, Research-Study- Agri-Economics Research Centre, Sardar Patel University.

Patil, B.N., Suryawanshi, S.D., and Desale, P.G. (1987). Acreage Response of Banana in Jalgaon District of Western Maharashtra. *Indian Journal of Agricultural Economics*. 42(3): 458-459

Parvin, M.M., Islam, M.N., Islam, F. and Habibullah, M. (2013). An Analysis of Cost of Production of Banana and Profitability at Narsingdi and Gazipur District in Bangladesh. *Int. J. Res. Comm. IT Manage.* 3(5): 113-118.

Peter, D. (1974). Input-output Relation of Banana Plantation in Kanyakumari District of Tamilnadu. *Indian Journal of Agricultural Economics,* 29(2): 59-65.

Prodhan, A.Z.M.S, Sarker, M.N.I, Sultana, A. and Islam, M.S. (2017). Knowledge, adoption and attitude on banana cultivation technology of the banana growers of Bangladesh. *Int. J. Hort. Sci. Orn. Plants.* 3(1): 47-52.

Rahman, L. and Akbar, A. (1989). Marketing of Banana in Some Selected Areas of Bangladesh, Research Report Submitted to the Bureau of Socio-Economic Research and Training, BAU, Mymensingh.

Rahman, M.W. (1995). Marketing of Banana in Some Selected Areas of Bogura district, An Unpublished Thesis Submitted to the Department of Cooperation and Marketing, BAU, Mymensingh.

Rahman, M. A. (2000). An Economic Study of Banana Production in Comparison with dominant Cropping Patterns in a selected Area of Jamalpur District.

Rahman, M.H. (2006). Constraints Faced by the Banana Growers of Sonarga0n Upazila under Narayanganj District. Department of Agricultural Extension & Information system, Sher-e-Bangla Agricultural University, Dhaka-1207.

Rahman, M., Mukta, F.A. and Islam, M.W. (2020). Farmer's Profitability of banana cultivation at Narsingdi District. *International Journal of Multidisciplinary Informative Research and Review*. 1(1):15-23

Rahman, M.Z. (2000), Effect of spacing on the growth, yield and storability of some garlic germplasm, M.S. in Horticulture thesis, Bangladesh Agricultural University, Mymensingh.

Roy, B. (1996). A Comparative Economic Analysis of Banana and Other Crop Production in an Area of Mymensingh District. An MS Thesis, Department of Agricultural Economics, BAU, Mymensingh.

Sharrock, S. and Lustry, C. (2000). Nutritive value of banana, in INIBAP. Annual Report, INIBAP, Montpellier, France.

Siti Hawa, J., (1998). Commercial exploitation of the banana diversity in Malaysia. Proceedings of the 1st National Banana Seminar in Malaysia, (BSM' 98), pp: 45-51.

Tabassum, P., Khan, S.A.K.U., Siddiqua, M. and Sultana, S. (2018). Effect of guava leaf and lemon extracts on postharvest quality and shelf life of banana cv. Sabri (*Musa sapientum* L.). *J. Bangladesh Agril. Univ*. 16(3): 337–342.

Thomas, E.C. and Gupta. (1987). Economics of Banana Cultivation: A Case Study in Kottayam District of Kerala. *Indian Journal of Agricultural Economics*, 42(3): 458.

Tita, J.A. (2006). Social and Environmental issues in Cameroonian Banana Production. MS Thesis, Chalmers University of Technology.

Tradingeconomics, (2021). https://tradingeconomics.com/bangladesh/gdp-from-agriculture.

USAID, (1969). Study of Perishable Food Marketing, East Pakistan, United States Agency for International Development.

Wahome, C., Maingi, J., Ombori, O., Kimiti, J. and Njeru, E. (2021). Banana Production Trends, Cultivar Diversity, and Tissue Culture Technologies Uptake in Kenya. *International Journal of Agronomy*, pp. 1-11. 10.1155/2021/6634046.

APPENDIX

An interview schedule for collection of data on

PROFITABILITY AND TECHNICAL EFFICIENCY ANALYSIS OF BANANA PRODUCTION IN SOME SELECTED AREAS OF NARSINGDI DISTRICT IN BANGLADESH

Serial no ……

Name of the respondent: ……

Upazila: ……...

(Please provide following information. Your information will be kept confidential and will be used for research purpose only)

Screening Question:

Part-A

1. Age: How old are you? ……..… Years.

2. Education

i. Can't read and write
ii. Can sign name only
iii. Have study up to class: ……

3. No. of family members: ……

4. Annual family income

Source of income		Income (Tk.)
A.	**Agricultural sources**	
Banana		
Other crops		
Livestock		
Poultry		
Fisheries		
B.	**Non-agricultural sources**	
Business		
Service		
Labor		
Remittance		
Others (please specify)……..…		
Total (A+B)=		

5. Annual Expenditure

Items of expenditure	**Amount (Tk.)**
Food	
Crop farming	
Children's education	
Health care	
Clothing	
House making/repairing	
Festivals	
Livestock rearing	
Poultry keeping	
Others	
Total	

6. Size of the farm: …… hectre/ Acre/ Bigha

7. Farming Experience: …… years

8. Received Agricultural training?

i) Yes
ii) No

9. Has membership of any social organization?

i) Yes
ii) No

Part-B

10. Cost of production:

Cost Items	**Costs/Returns (Tk/ha)**	**% of total**
A. Gross Return		
Main product (Banana)		
By-product (Sucker)		
Total return		
B. Gross Cost		
Variable Cost		
Mechanical Power		
Labor Cost		
Sucker		
Urea		
TSP		
MOP		
Total Fertilizers cost		
Manure (Cowdung)		
Irrigation		
Insecticides		
Bamboo cost		
C. Total operating cost (TOC)		
Interest on operating capital @ 12%		
D. Total variable cost (TVC)		
Land use cost		
E. Total Fixed cost (TFC)		
F. Total costs (D+E)		

11. Profitability of Banana Cultivation

Cost Item	Cost/Returns (Tk/ha)
A. Gross Return	
B. Variable Cost	
C. Fixed Cost	
D. Total costs	
E. Gross Margin (A-B)	
F. Net Return (A-D)	
G. Undiscounted BCR (A/D)	

Part-C

12. Problem faced by producers (Choose from the following):

Lack of adequate capital

High Price of Inputs

Lack of quality sucker

Low output price

Lack of technical knowledge

Storage problem

Disease and insects infestation

Problems of theft

Problems of natural calamities

Carrying Problem

Lack of Fertilizer

Others:……

Thank you.

Signature of the interviewer: