ECONOMIC STUDY ON LENTIL AND MUNG BEAN PRODUCTION IN SELECTED DISTRICTS OF BANGLADESH

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ECONOMIC STUDY ON LENTIL AND MUNG BEAN PRODUCTION IN SELECTED DISTRICTS OF BANGLADESH

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This is to certify that the thesis entitled **'ECONOMIC STUDY ON LENTIL AND MUNG BEAN PRODUCTION IN SELECTED DISTRICTS OF BANGLADESH'** submitted to the, Department of Agricultural Economics, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **Master of Science (MS) in Agricultural Economics** embodies the result of a piece of *bona fide* research work carried out by **MONIRA SULTANA, Registration No. 15-06783** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

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

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Dedicated To

My Beloved Family Members

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Monira Sultana

December, 2021

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LIST OF ACCRONYMS AND ABBREVIATIONS

%	=	Percentage
>	=	More than
≤	=	Less or equals to
AEO	=	Agriculture Extension Officer
BARC	=	Bangladesh Agricultural Research Council
BARI	=	Bangladesh Agricultural Research Institute
BBS	=	Bangladesh Bureau of Statistics
BCR	=	Benefit Cost Ratio
BER	=	Bangladesh Economic Review
BINA	=	Bangladesh Institute of Nuclear Agriculture
BRAC	=	Bangladesh Rural Advancement Committee
CIF	=	Cost, Insurance and Freight
DAE	=	Department of Agricultural Extension
DRC	=	Domestic Resource Cost
e.g.	=	exempli gratia (L), for example
EPC	=	Effective Protection Coefficient
et al.,	=	and others
etc.	=	Etcetera
FAO	=	Food and Agricultural Organization
FOB	=	Free on Board
FY	=	Financial year
g	=	Gram (s)
GDP	=	Gross Domestic Product
gm	=	Gram (s)
GR	=	Gross Return
ha	=	Hectare
HIES	=	Household Income and Expenditure Survey
HYV	=	High Yielding Variety
i.e.	=	id est (L), that is
Int.	=	International
IU	=	International Unit

LIST OF ACCRONYMS AND ABBREVIATIONS (Continued)

j	=	Journal
Kcal	=	Kilo calorie (s)
Kg	=	Kilogram (s)
kg	=	Kilogram (s)
Kg/ha	=	Kg per hectare
Km	=	Kilometer
MS	=	Master of Science
MoP	=	Muriate of Potash
MoYS	=	Ministry of Youth and Sports
MT	=	Metric ton
NGO	=	Non-Government Organization
No.	=	Number
NPCI	=	Nominal Protection Coefficient on Input
NPCO	=	Nominal Protection Coefficient on Output
P	=	Probability
PAM	=	Policy Analysis Matrix
PCR	=	Private Cost Ratio
PhD	=	Doctor of Philosophy
Res.	=	Research
SAAO	=	Sub Assistant Agricultural Officers
SAU	=	Sher-e-Bangla Agricultural University
Sci.	=	Science
SD	=	Standard Deviation
sq.	=	Square
TC	=	Total cost
Tk.	=	Taka
TSP	=	Triple Super Phosphate
TVC	=	Total Variable Cost
USD	=	United States Dollar
VC	=	Variable cost

Abstract

Lentil and mung bean have been playing very crucial role to ensure food and nutrition security in Bangladesh. Presently, more than two-third of its annual demand are fulfilled by overseas imports. Besides proper utilization of domestic resources, to achieve self-sufficiency, national production enhancement of these pulses has been emphasized. This study was conducted in Madaripur and Faridpur district of Bangladesh to estimate the financial and economic profitability of lentil and mung bean cultivation and to assess its comparative advantage in domestic production. Required primary data for this study were collected from 120 respondents during March to April, 2021. To analyze data, descriptive statistics and policy analysis matrix (PAM) were applied. Findings of the study reveals that per hectare yield of lentil and mung bean were 1.22 and 0.81 metric ton (MT), respectively. Financial analysis shows that the net return of lentil and mung bean production were Tk. 41497 and Tk. 24626 per hectare with a benefit cost ratio (BCR) of 1.66 and 1.63, respectively. The economic profitability of lentil and mung bean production were Tk. 17001/MT and Tk. 13396/MT, respectively. Domestic resource cost (DRC) analysis reveals that both the lentil (DRC = 0.66) and mung bean (DRC = 0.72) had a comparative advantage in domestic production for import substitution. Policy analysis matrix under import parity price suggests also that government policies were favourable to the domestic producers. Findings of the ratio indicators under import parity condition (NPCO, NPCI, EPC and PCR) further show that existing policy environment tends to protect the interest of the lentil and mung bean producers at production level. So, numerous policy supports are there for the producers. For further achievement, government should strengthen the ongoing input and output supports. Input market monitoring, farmers awareness rising, technology oriented training and further research for successful adoption of pulse crops in between the rice based cropping patterns are also warranted.

CHAPTER I

INTRODUCTION

Bangladesh is now emphasizing more on diversified crop production for achieving food and nutrition security. Among several other important crops pulse is considered one of the best options as it is a source of protein for all classes of people especially for the poor who have lesser access to animal proteins. Pulse crops such as lentils, mung beans and peas are important source of plant-based proteins and amino acids for human and animals. Food and Agricultural Organization (FAO) recommended consumption of pulse amounting to 45gm/head/day for fulfilling protein requirements for an adult (FAO, 2011). Presently, per capita availability of pulses in Bangladesh is about 17gm, which is far below the actual requirement (Rashid and Matin, 2018). It is considered as the major cheap source of vegetable protein. Besides these factors, the ability to fix nitrogen and the addition of organic matter to the soil are important factor in maintaining soil fertility. Furthermore, pulse fit well in the existing cropping pattern, due to their short duration, low input requirement and higher yield generating capacity.

1.1. Background

Pulses are considered as a food crop in Bangladesh. It plays a significant role in rain fed agriculture of Bangladesh. On an average about 4 lakh tons of pulses are produced in Bangladesh every year (BBS, 2021). Among different pulses, lentil, mung bean, grass pea, black gram etc. are the major pulse crops grown well in Bangladesh. However, the area and production of almost all the legumes have been vacillated over the time. The acreage of pulses production was at the nadir point in 2007-08. To halt the declining trend in area and production, research program was launched by BRAC during the year 2000 and seed production as well as variety development program was initiated to augment the pulse production of Bangladesh (Biswas, 2013). Some positive outcome of those programme is seen in recent statistics of productivity. Total production and productivity of major pulses like lentil and mung bean has been raising since the year of 2008-09. Some analysis on the acreage, production and productivity of pulses as well as lentil and mung bean are presented on the following pages. Data for these figure and tables were accumulated from various issues of Bangladesh Bureau of Statistics (BBS) and other researchers.

1.1.1. Acreage and Production Trend of Pulse Crops in Bangladesh

A time series data from 1990-91 to 2020-21 (31 years) regarding the area, production and yield of pulse crops were collected from the above-mentioned source. To generate meaningful inference those data were converted to trend line, table or other forms where necessary.

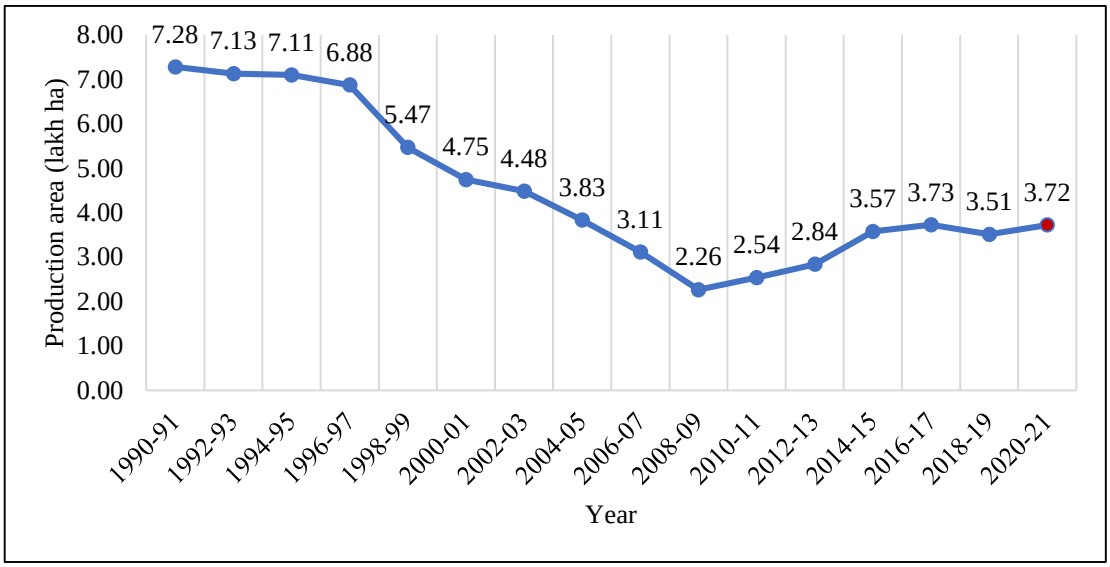


Figure 1.1. Trend in Acreage of Pulse Production in Bangladesh

Data source: Rahman et al. (2012) and BBS (2021)

Figure 1.1 indicates that during 1990-91, the area under pulse crop production in Bangladesh was 7.28 lakh hectares as compared to 3.72 lakh hectares sown during 2020-21. The figure also shows that the area under pulse crop production has been decreased to all time low 2.26 lakh hectare in 2008-09. However, the acreage of pulse production in Bangladesh has been raising from 2008-09 and presently 3.72 lakh hectares of land are used to produce different pulse crops.

The production of pulses during 1990-91 to 2020-21 was also vacillated with the corresponding changes in area of production (Figure 1.2). In 1990-91, the overall production of pulse crops was 5.23 lakh metric tonnes which decreased to the lowest yearly production of 1.96 lakh metric tonnes in 2008-09. After falling to that nadir point the production of pulses followed an increasing trend till now and raised up to 4.25 lakh metric tonnes in 2020-21. With the increment of additional land under pulse crop production some governmental efforts like providing input subsidy, agricultural credit etc. might be responsible for that increment of pulse production.

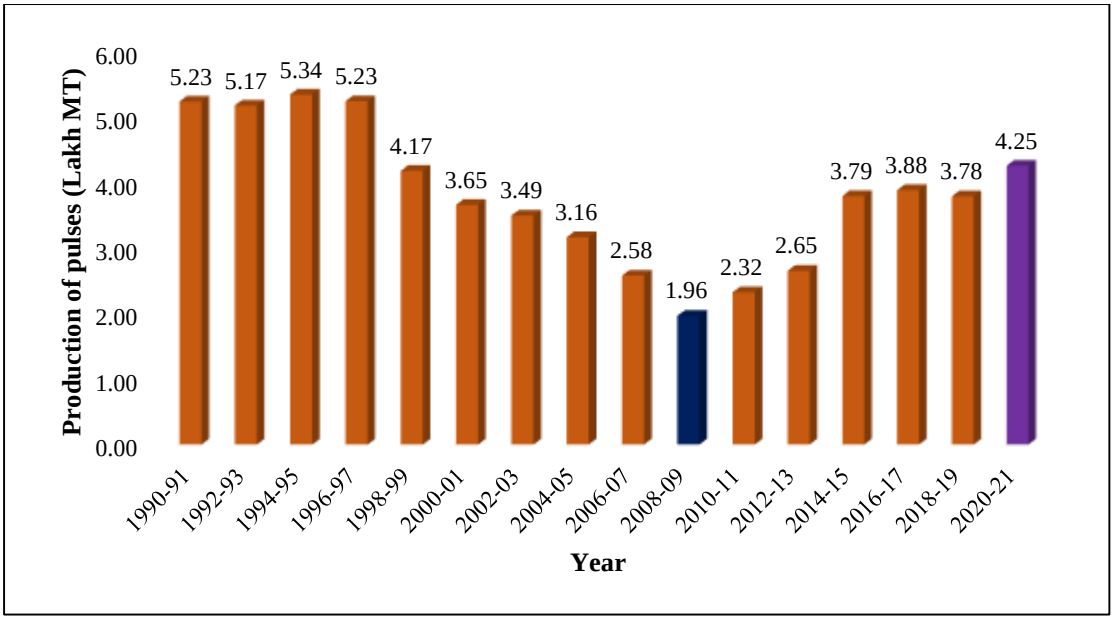


Figure 1.2. Production of Pulse Crops in Bangladesh

Data source: Rahman et al. (2012) and BBS (2021)

Over the years, an interesting picture of pulse productivity in Bangladesh is found from the statistics. Figure 1.3 reveals an all-time increasing pulse productivity trend in Bangladesh which starts from 0.72 metric tonnes per hectare in 1990-91 and raised up to 1.14 metric tonnes per hectare in 2020-21. For getting land coverage to produce, pulses had to compete with boro rice and other cash crops. That is why, productivity of pulse crops needed to raise as an obvious option. Major pulse growing areas are also shown on Figure 1.4.

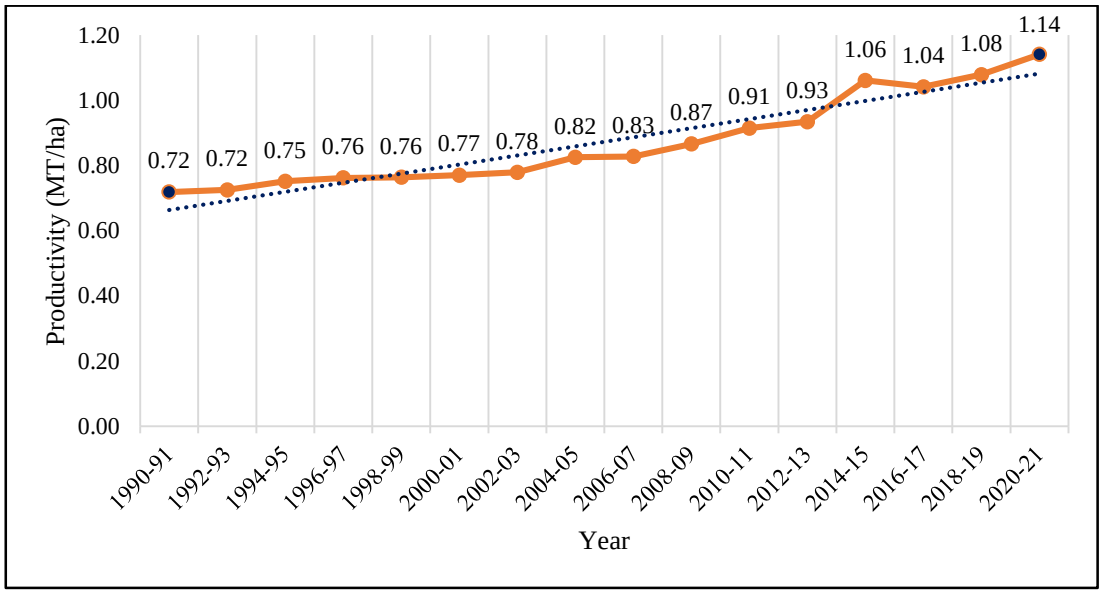


Figure 1.3. Trend of Productivity of Pulse Crops in Bangladesh

Data source: Rahman et al. (2012) and BBS (2021)

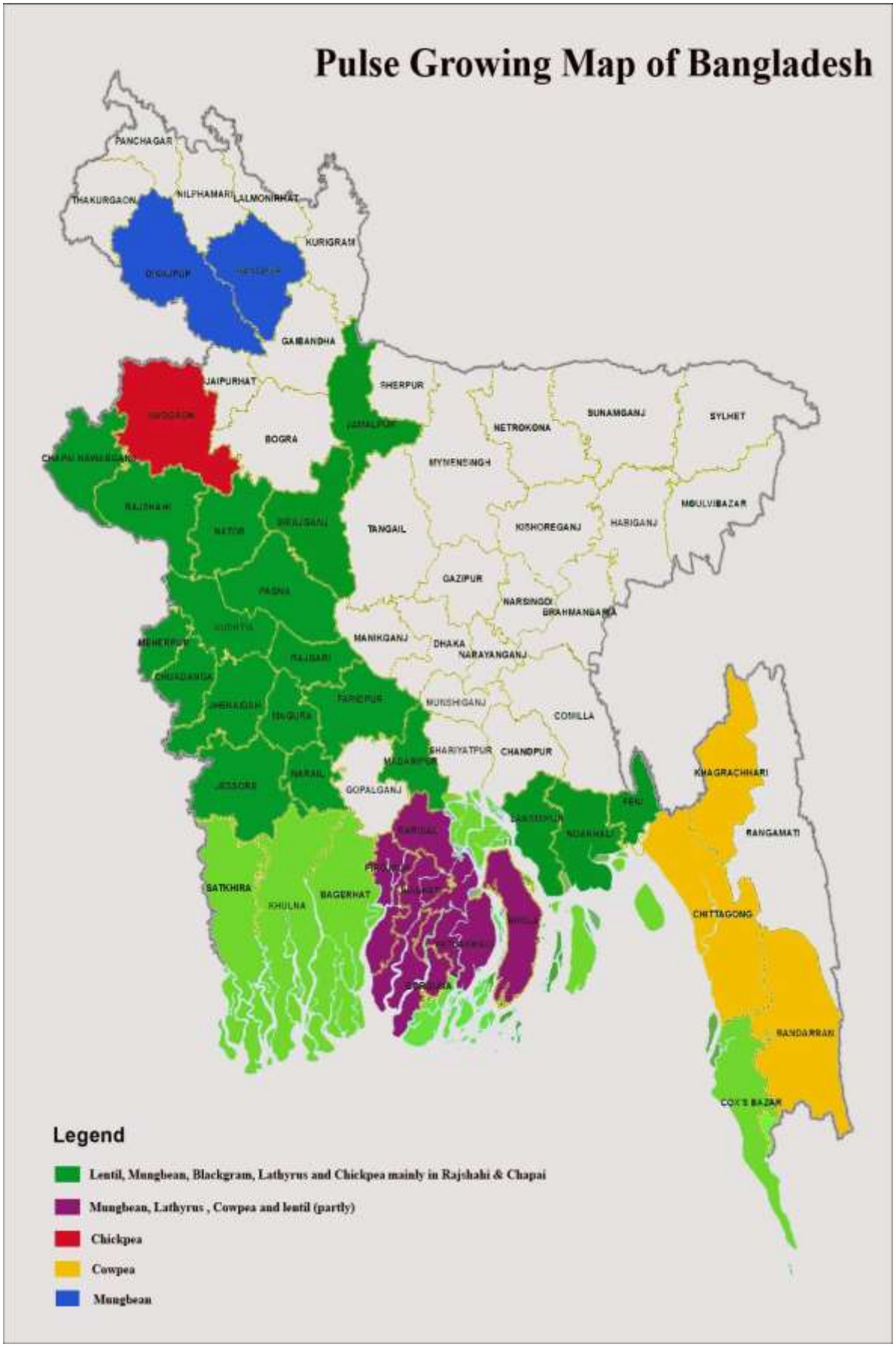


Figure 1.4. Pulse Growing Area of Bangladesh (Source: Hossain, 2016)

1.1.2. The Area Under Lentil, Mung bean and Other Pulses in Bangladesh

Different major pulses like lentil, mung bean, grass pea, chick pea, black gram have different land coverage, production and productivity. Purpose of cultivation of these pulses are also different. Different pulses have different consumption demand too. The overall cultivation area, production and productivity of the major pulse crops in Bangladesh were as presented in Figure 1.5.

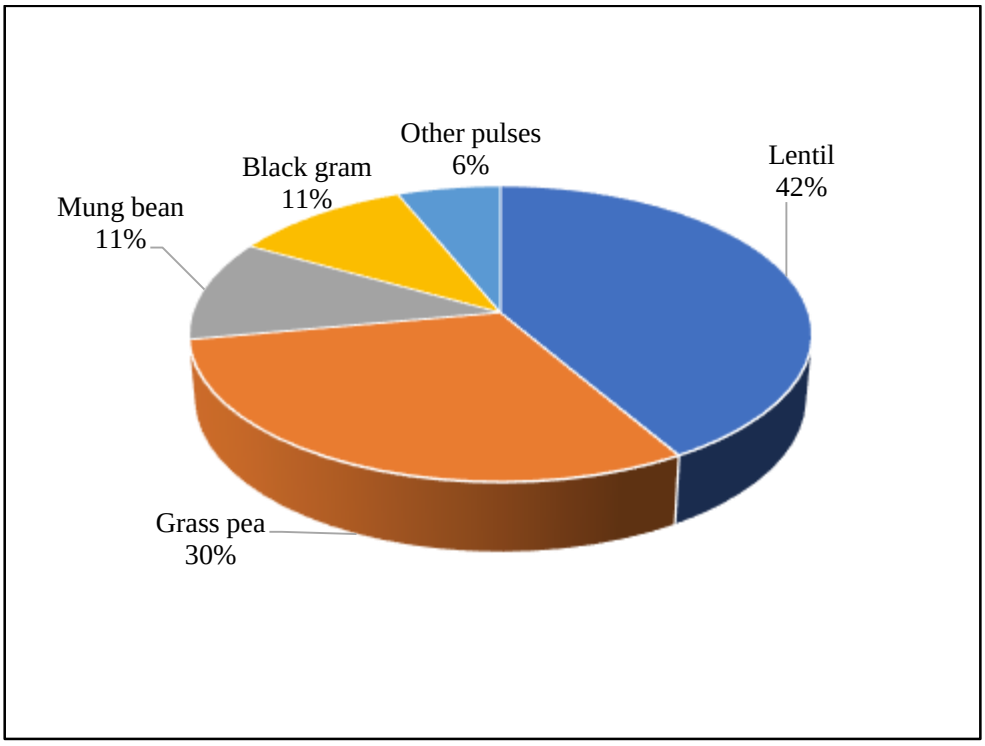


Figure 1.5. The Area Under Lentil, Mung bean and Other Pulses in Bangladesh

Data source: BBS (2020)

Presently, most of the pulse crops cultivated area are occupied by lentil, grass pea and mung bean production. The land coverage under lentil, grass pea and mung bean cultivation were about 42%, 30% and 11%, respectively (Figure 1.5). However, this study was conducted in Madaripur and Faridpur districts of Bangladesh. Lentil and mung bean are grown well in these two districts (BBS, 2021). Pulse growing map of Bangladesh (Figure 1.4) also shows that along with the other pulse crops, lentil and mung bean are grown well in the selected districts of the study.

1.1.3. Acreage, Production and Productivity of Lentil and Mung bean in Bangladesh

In Bangladesh, lentil placed first position among the pulses according to area of production and also stand first in terms of consumption (BBS, 2021). It is the principal and popular edible crop among pulses. Lentil grain contains about 25% protein, 0.70% fat, and 59% carbohydrate (Afzal et al., 1999). Table 1.1 indicates that during 1996-97, the area under lentil production in Bangladesh was 2.06 lakh hectares as compared to 1.46 lakh hectares during 2020-21. The table also shows that the acreage of lentil production in Bangladesh has been raising since 2008-09. The production of lentil during 1996-97 to 2020-21 was also changed with their respective changes in area of production. In 1996-97, the overall production of lentil was 1.71 lakh metric tonnes which decreased to the lowest production of 61 thousand metric tonnes in 2008-09. After reaching that lowest point the production of lentil followed an increasing trend and raised up to 1.86 lakh metric tonnes in 2020-21. Summery presented at Table 1.1 is also shows that the annual growth rates of lentil cultivation area and production decreased significantly till 2008-09, while the rate of yield increased in all periods. The introduction of improved/HYV seed of lentil might be responsible for that.

Table 1.1. Acreage, Production and Productivity of Lentil and Mung bean in Bangladesh

Year	Lentil			Mung bean		
	Acreage of cultivation (lakh ha)	Production (lakh MT)	Productivity (MT/Ha)	Acreage of cultivation (lakh ha)	Production (lakh MT)	Productivity (MT/Ha)
1996-97	2.06	1.71	0.83	0.55	0.34	0.62
1998-99	2.06	1.65	0.80	0.55	0.34	0.61
2000-01	1.64	1.26	0.77	0.53	0.34	0.65
2002-03	1.54	1.16	0.75	0.44	0.30	0.68
2004-05	1.54	1.21	0.79	0.24	0.18	0.74
2006-07	1.38	1.17	0.85	0.24	0.19	0.78
2008-09	0.71	0.61	0.86	0.22	0.18	0.82
2010-11	0.83	0.80	0.96	0.28	0.19	0.69
2012-13	0.90	0.93	1.03	0.35	0.25	0.71
2014-15	1.45	1.67	1.15	0.39	0.33	0.85
2016-17	1.55	1.69	1.09	0.41	0.35	0.85
2018-19	1.40	1.61	1.15	0.41	0.34	0.82
2020-21	1.46	1.86	1.27	0.44	0.41	0.93

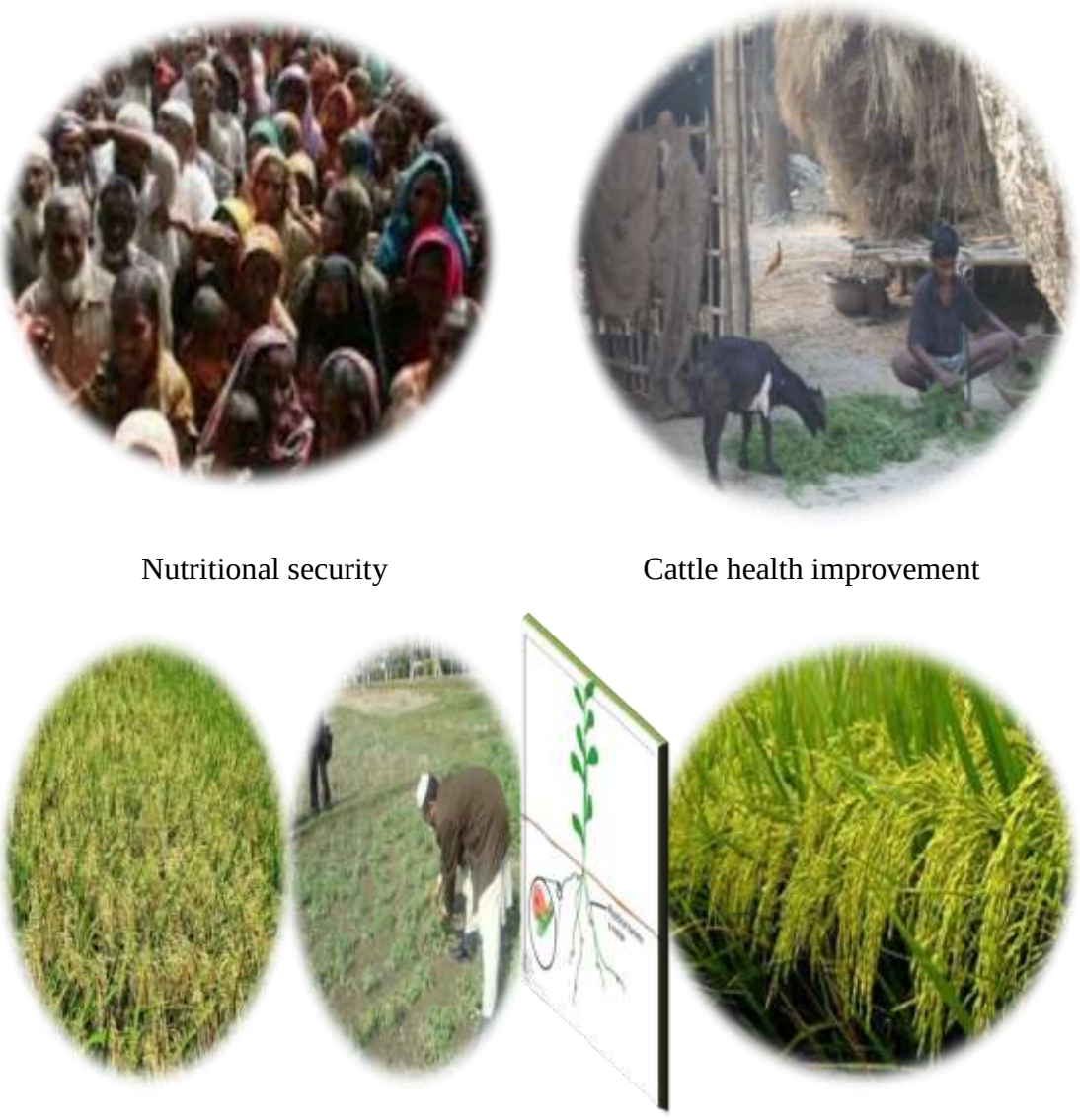
Data source: Rahman et al. (2012) and BBS (2021)

Table 1.1 also indicates that during 1996-97, mung bean production area in Bangladesh was about 55 thousand hectares as compared to about 44 thousand hectares in 2020-21. The table also shows that like lentil production area, the acreage of mung bean production in Bangladesh has been following an increasing trend, since 2008-09. The production of mung bean was 34 thousand metric tonnes in 1996-97 which raised up to 41 thousand metric tonnes in 2020-21 (Table 1.1). Besides, the productivity of mung bean has also improved over the times. Bangladesh's mung bean imports are on the rise due to increased consumption amid inadequate domestic production.

1.2. Importance of Pulse Crops to Ensure Food and Nutrition Security

Pulses are the essential components of the daily diets of the people of Bangladesh, and supplies of pulses are met by importing and local production in the country. Pulses are considered as the protein of the poor. Pulses are being treated as important legume crops in Bangladesh because of their contribution in food, feed, and cropping systems (Figure

1.6). It contains about twice as much protein as cereals. It also contains amino acid lysine which is generally deficient in food grains. Pulses have played an important role in sustaining the productivity of soils in Bangladesh for centuries. They are generally grown without fertilizer since they can meet their nitrogen requirement by symbiotic fixation of atmospheric nitrogen in the soil.



Nutritional security

Cattle health improvement

Soil health improvement

Figure 1.6. Diagrams Showing Different Contribution of Pulse Crops

(**Source:** Hossain, 2016)

1.2.1. The Contribution of Pulses towards Food and Nutrition Security

Pulses have intrinsic value being packed with nutrients, high protein content, low fat and high fiber, which keeps cholesterol and blood sugar under control. Pulses contain

more than 20% protein, 50-60% carbohydrate, more than 1% fat and 3.25% fiber (Table 1.2). It also contains various types of vitamin such as vitamin A, vitamin C and also some minerals like phosphorus, Iron and calcium.

Table 1.2. Food and Nutrition Value of Pulses

Constituents	**Magnitudes**
Protein	> 20 %
Carbohydrate	55 – 60 %
Fat	> 1.0 %
Fibre	3.2 %
Phosphorus	300 – 500 mg / 100 g
Iron	7 – 10 mg / 100 g
Vitamin C	10 – 15 mg / 100 g
Calcium	69 – 75 mg / 100 g
Vitamin A	430 - 489 IU

Source: Singh et al. (2015)

1.3. Current Production Consumption and Import Status of Lentil in Bangladesh

At present the production of pulses like lentil, mung bean etc. in the country is much less than the demand. For this, the country have to import a lot of pulses from abroad. Among all the pulses, lentils are the most consumed in Bangladesh. Due to the inadequate domestic production, lentil imports from Australia, Turkey, Canada and Nepal are on the rise due to increased consumption. Presently, farmers in Bangladesh are producing 1.86 lakh tonnes of lentils annually (BBS, 2021) while the annual requirement of the country is about 6 lakh tonnes. Between July and September 2020, lentil imports reached 5.21 lakh tonnes, an increase of 58 per cent over the same period last year (BBS, 2021). To meet up the growing demand, steps need to be taken to enhance the domestic production of lentil, mung bean and other major pulses which in turn will contribute to reduce over-reliance on imports.

1.4. Rationale of the Study

In spite of having immense importance of producing lentil and mung bean to ensure food and nutrition security, very few researches were conducted to explore the prospects and challenges of its production in Bangladesh. The productivity of these

pulses in Bangladesh has been following an increasing trend since 2008. The development of short duration and high yielding varieties of pulses mostly mung bean, black gram (mashkalai), and lentil (musur) by different research institutions has opened up a great opportunity to increase the internal production by introducing one leguminous crop between rice and the rice based cropping pattern and contributed to conserve the soil fertility (Das and Kabir, 2016). In the recent times, providing input subsidy has taken as a policy intervention to enhance the domestic production. Several researchers argued that existing policy regarding pulse crops production should be reshuffled (Rashid and Hasan, 2012; Rashid and Matin, 2018). Various explorative and explanatory researches are required to find out the appropriate policy interventions to enhance internal production substituting the imports. This great importance motivated me for taking an endeavour to explore the import parity of the major pulses i.e. lentil and mung bean produced in Bangladesh. Therefore, the present research titled 'Economic Study on Lentil and Mung bean Production in Selected Districts of Bangladesh' has been taken to estimate the comparative profitability of lentil and mung bean cultivation and to assess the import substitution status of lentil and mung bean in Bangladesh. This study will generate a sound knowledge on the scenario of pulse production, import parity and consumption status of Bangladesh and will generate aspiration to conduct study on formulating policy interventions to enhance the domestic production of pulses.

1.5. Objectives

The broad objective of the study was to estimate the import parity of lentil and mung bean production in Bangladesh. However, some specific objectives were also added while studying these major pulse crops production and import in Bangladesh. The specific objectives of the study were as follows:

a) To delineate the socio-economic profile of the lentil and mung bean growers;
b) To estimate the financial and economic profitability of lentil and mung bean cultivation in selected areas of Bangladesh;
c) To assess the import substitution status of lentil and mung bean production in Bangladesh; and
d) To derive the policy implications from the study.

1.6. Key Research Questions of the Study

a) What are the demographic characteristics of lentil and mung bean cultivators?
b) What is the socio-economic status of the lentil and mung bean farmers?
c) What are the patterns of input usage for lentil and mung bean production?
d) How much cost incurred during lentil and mung bean cultivation?
e) How much gross margin obtained by lentil and mung bean farmers?
f) What is the profit margin of lentil and mung bean production?
g) What was the shadow prices of different inputs used for production of lentil and mung bean?
h) What was the domestic resource cost (DRC)/import parity for lentil and mung bean production in Bangladesh?
i) What are the constraints faced by the lentil and mung bean farmers during cultivation?

1.7. Organization of the Report

Chapter one describes the background and importance of lentil and mung bean production in Bangladesh, rationale of the study and objectives of the study. The second chapter comprises the review of literature. The third chapter covers of the research methodology. Chapter four describes the socio-economic profile of lentil and mung bean cultivators. Chapter five has discussed about the comparative profitability of lentil and mung bean cultivation in Bangladesh. Chapter six consists of import substitution status of lentil and mung bean cultivation. Chapter seven depicts the constraints faced by lentil and mung bean cultivators during their cultivation practices and Chapter eight contains summary, conclusion and recommendations.

CHAPTER II

REVIEW OF LITERATURE

To find out the specific gap in literature, a rigorous study of previous researches is very much crucial. Review of literature is an attempt to examine the previous findings in order to generate proper guidelines in designing current and future researches. It helps to the successful completion of a research work by providing relevant knowledge and information about the proposed study. It also helps to validate the findings of new researches. In connection with the present study, the literature and research findings of major previous works were searched. In this chapter, the review the past research works which are relevant to the objectives of this study are presented in chronological order. This review work was mainly concerned with the findings of financial and economic profitability of lentil and mung bean cultivation in Bangladesh. Further emphasis was given to review the findings relevant to analyze the comparative advantage and competitiveness of lentil and mung bean cultivation in Bangladesh. In some review, focus was given to highlight the use of policy analysis matrix (PAM) in different crops cultivated in Bangladesh.

2.1. Review of Literatures on Lentil and Mung bean Production

Islam et al. (2008) conducted a study to estimate the profitability and resource use efficiency of mung bean cultivation in Barisal and Jhalokati districts of Bangladesh. They estimated the benefit cost ratio (BCR) of mung bean production as 2.53 and 3.56 on variable and cash cost basis and opined that the production was profitable to the farmers. Functional analysis of their result also shows that human labour, urea and insecticides had positive significant contribution to mung bean cultivation.

Rashid et al. (2009) conducted a study to determine financial profitability of selected crops in the different locations in the country and to examine the implications of Bangladesh's trade policies and comparative advantages of selected agricultural commodities including lentil. Their estimated DRC shows that Bangladesh had comparative advantage in lentil production as the estimates of DRC were less than one. Thus, they opined that the production of lentil would be highly efficient for import substitution.

Islam et al. (2010) conducted a study to assess the cost and return of lentil and mustard cultivation in Pabna and Jashore districts of Bangladesh. Findings of their study reveals that lentil cultivation in the study areas were highly profitable as it generates a gross margin of Tk. 26616/ha with a benefit cost ratio of 3.02. From that comparative study they also opined that lentil production required fewer inputs like urea, TSP, MoP, irrigation etc. than the requirement for mustard.

Islam et al. (2011) studied the economics of mung bean cultivation in two coastal districts, Noakhali and Patuakhali, of Bangladesh. They found that the mung bean production was profitable in their study areas as the BCR was 2.22 on full cost basis. Their estimated result shows that the average level of technical efficiency among the sampled farmer was 89%. They also identified the farmer's education and experience having positive significant effect on mung bean production.

Rahman et al. (2012) conducted a study to investigate the adoption and profitability of BARI lentil varieties in Jhenaidah and Jashore district of Bangladesh. Results of their study reveals that the cultivation of BARI lentil was profitable to the farmers since the per hectare total cost, gross return and net return of BARI lentil cultivation were Tk. 52,734, Tk. 80,572 and Tk. 27,838, respectively. Functional analysis of their study reveals that seed, urea, mechanical power cost and pesticides had positive effect on the yield of lentil production.

Kazal et al. (2013) conducted a study to estimate the financial and economic profitability of selected agricultural crops in Bangladesh where they found that lentil production was financially profitable based on positive net return and BCR in the north-western region of Bangladesh. They analyze policy analysis matrix (PAM) to measure the economic profitability, efficiency and policy incentives for lentil (import parity price). They also found less than one (0.62) DRC value for lentil cultivation indicating the crop's efficiency in domestic production.

Matin et al. (2018) conducted a study in Jashore, Meherpur and Natore district of Bangladesh to estimate the profitability and farm specific technical efficiency of lentil growers. In their study they found that HYV lentil was more profitable than local variety. Besides, they also found that cost of human labour, organic fertilizer, TSP,

MoP and irrigation contributed significantly in the efficiency of lentil farmers. They further identified 64% of lentil growers of Bangladesh as technically efficient.

Rashid and Matin (2018) conducted a study to examine the relative efficiency of selected pulse crops in Bangladesh and their comparative advantage in international trade. Findings of their study reveals that pulse crops cultivation at farm level was very much remunerative to its growers. The border price of selected pulse crops at producer level was mostly higher than the domestic producer price. In their study, Policy Analysis Matrix (PAM) for selected pulse crops under import parity prices showed that revenue transfer and input transfer were negative but the domestic factor transfer was positive. They also found the net profit/net policy transfer as negative. Finally, domestic resource cost (DRC) result of their study indicates that production of pulse crops would be highly efficient for import substitution in Bangladesh.

Tithi and Barmon (2018) conducted a study to estimate the profitability and comparative advantage of lentil and mustard production in Bangladesh. They found the BCR of lentil and mustard production as 2.32 and 1.73, respectively. They estimated the DRC of lentil and mustard production as 0.39 and 0.55, respectively implying that Bangladesh had comparative advantage in producing both lentil and mustard. They also found farm area, irrigation, pesticides and chemical fertilizers as the significant factors affecting lentil production having increasing returns to scale whereas farm area, irrigation and manure as the statistically significant factors affecting mustard production with constant return to scale.

Hajong et al. (2020) conducted a study to assess the value chain of lentil in Jashore, Jhenaidah and Kushtia district of Bangladesh. They estimated the total production cost of lentil as Tk. 66374/ha with a BCR of 1.75 implying the profitability of lentil production. However, the average yield of lentil cultivation was found to be 1.63 ton/ha.

Islam et al. (2020a) conducted a study to assess the technology adoption and profitability of BINA released lentil variety Binamasur-5 in five districts namely Magura, Pabna, Jashore, Kushtia and Faridpur of Bangladesh. They found the average net return as Tk. 52405 per hectare with an average BCR of 1.86. However, they also found varied BCR for different districts. The highest BCR was found in Magura district

(1.96) which was followed by Jashore (1.91), Faridpur (1.88), Pabna (1.84) and Kushtia (1.73) districts, respectively.

Sarkar et al. (2020) estimated the financial profitability of Binamasur-8 producing farmers in Magura, Faridpur, Pabna and Chapai Nawabganj districts of Bangladesh. They found the average gross margin as Tk. 56564/ha with a net return of Tk. 38536/ha. The benefit cost ratio was estimated at 1.66 and 2.40 on full cost and variable cost basis implying that the Binamasur-8 cultivation at farm level was highly profitable.

Miah et al. (2021) conducted a study to estimate the profitability and comparative advantage of lentil production in six lentil growing districts namely Faridpur, Magura, Kushtia, Jhenaidah, Manikganj and Sirajganj of Bangladesh. Comparing with local variety they concluded that cultivation of improved variety was profitable from the financial point of view (Tk. 48,165/ha) and an economic perspective (Tk. 15,083/ha). They also found that domestic production of improved lentils had a comparative advantage (DRC = 0.72).

Molla et al. (2021) reported that a study was conducted to estimate the economic returns and competitiveness of some selected crops including lentil in Bangladesh. Findings of that study reveals that the net returns of lentil and mung bean production were Tk. 33409 and Tk. 26144 with a BCR of 1.63 and 1.56, respectively on a total cost basis. Results of the study also shows that DRC values were less than one for both crops (0.62 for lentil and 0.63 for mung bean) implying that the country had a comparative advantage in production of these crops for import substitution.

2.2. Specific Research Gap

Over the time, several research works have been conducted to assess the variety development (Afzal et al., 1999), adoption status (Miah et al., 2004; Rahman et al., 2012), acreage under production (Das et al., 2016), profitability (Islam et al., 2008), and performance of different cultivars (Islam et al., 2020a) in Bangladesh. However, there remains a serious dearth of literature which had been taken to generate policy interventions in the production of lentil and mung bean in Bangladesh which may substitute the overseas imports. This study was taken to investigate the hypothesis "existing policy interventions are not enough to achieve highest production which may compensate the imports of lentil and mung bean" and generate better options to

implements. Therefore, the present study has been carried out to estimate the financial and economic profitability as well as import parity of lentil and mung bean production in Madaripur and Faridpur district of Bangladesh. The outcomes of this research will be helpful to the planners, policy makers and extension workers for better understanding the current scenarios and for making effective policy interventions to accelerate the production of lentil and mung bean as well as the development of agriculture.

CHAPTER III

METHODOLOGY

Research methodology is a way of explaining how researchers intends to carry out their research. It is a logical and systematic plan to resolve a research problem. It gives research legality and provide scientifically sound findings. A sound research methodology guide researcher to follow a specific plan of action throughout his/her research. While formulating research methods and procedure to conduct a research, a researcher should be very careful to select the correct method for fulfilling the objectives. The purpose of this chapter is to describe the study area, research design and the process to collect and analyze the data for answering the research questions. The method of data collection depends on the purpose of the study. This study is conducted mainly based on primary data. The study is, therefore, followed the farm survey method. Survey method is preferred as it has advantages over other methods. The limitation of the method however, is that the investigator has to rely upon the memory of respondents. In order to overcome this drawback, survey schedules were set in a systematic way and the questions were asked in such a manner that it cover all the required opinion in a complete way.

3.1. Locale of the Study

Locale of the research is intricately related with the fulfilment of a study. Pulses i.e. lentil and mung bean are cultivated all over the country. However, greater cultivation is done in greater Dhaka, Faridpur, Jashore, Kushtia, Rajshahi, Cumilla, Noakhali and Barisal districts[1]. To serve the purpose of the study Shibchar upazila[2] of Madaripur district and Sadarpur upazila of Faridpur district were selected purposively. The map of Madaripur and Faridpur district has shown in Figure 3.1 and the specific study locations namely Shibchar and Sadarpur upazila have also been presented in Figure 3.2 and Figure 3.3.

[1] Administrative unit of Bangladesh
[2] Sub-district

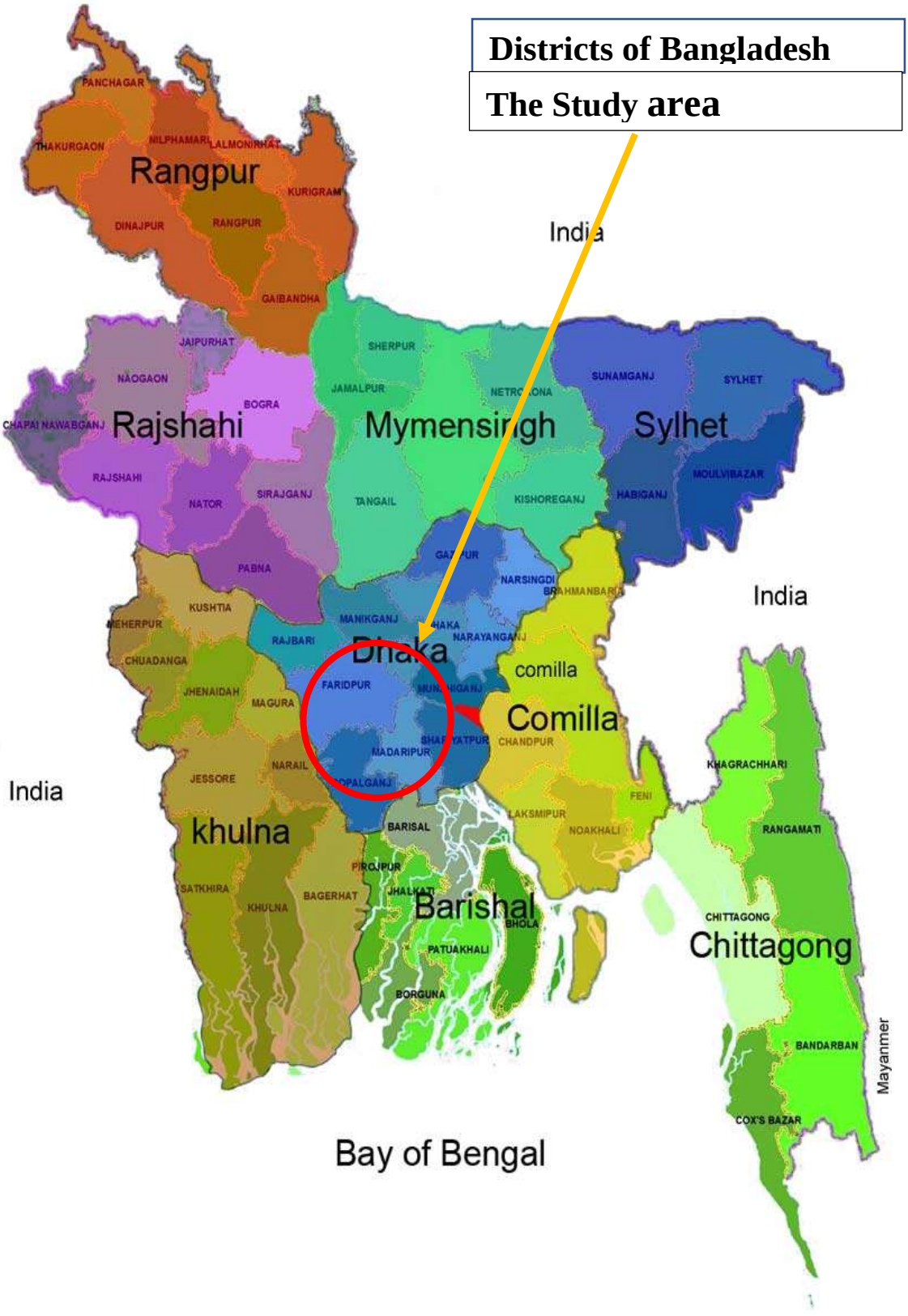


Figure 3.1. Map of Bangladesh Showing Study Areas

(**Sources:** Maps were edited after collecting from internet)

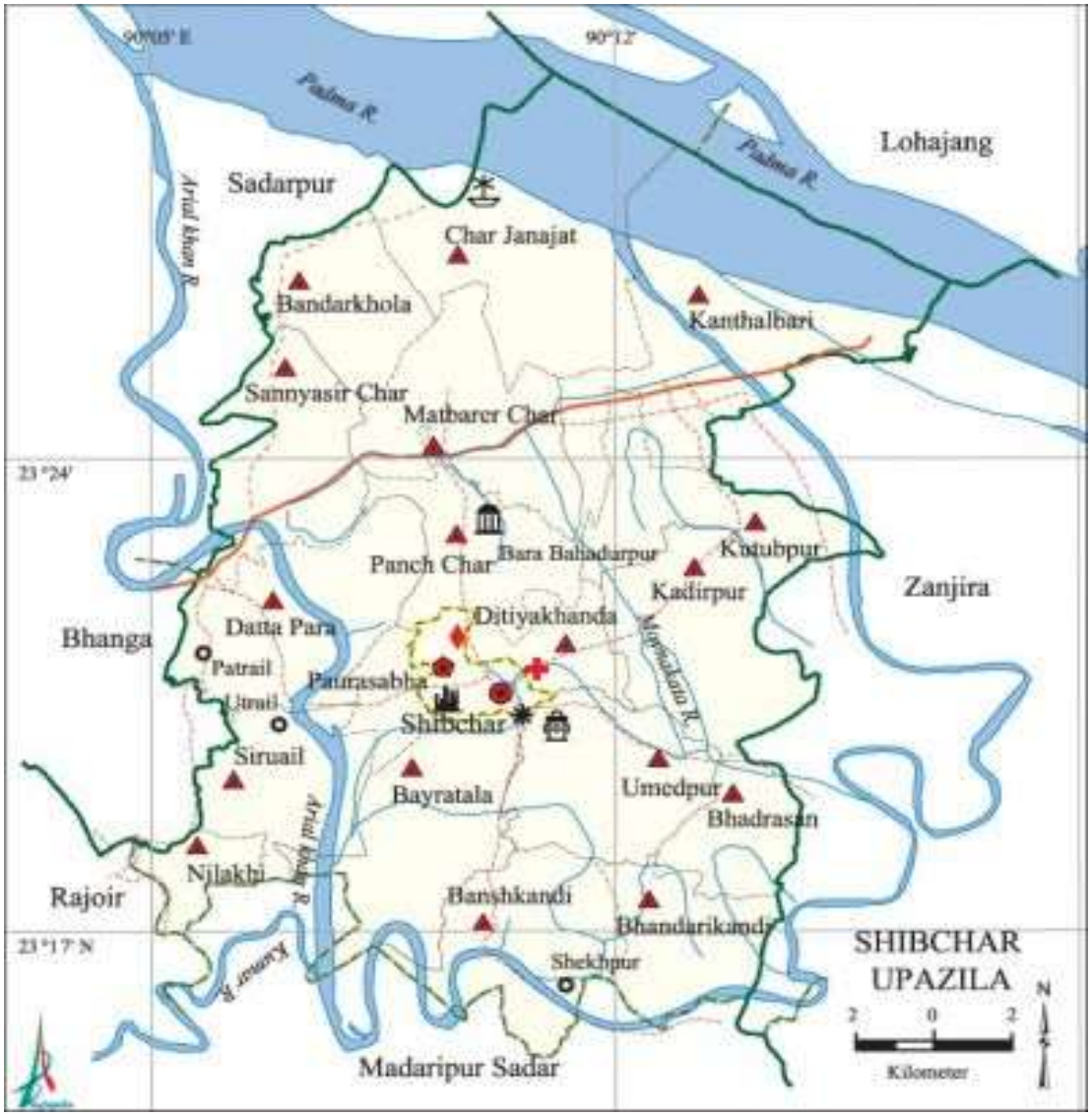


Figure 3.2. Map of Shibchar Upazila of Madaripur District Showing a Part of the Study Area (**Source:** Banglapedia)

3.2. Description of the Study Area

3.2.1. Shibchar Upazila

According to Banglapedia, the area of Shibchar upazila (Madaripur district) is 321.88 sq km, located in between 23°15' and 23°30' north latitudes and in between 90°05' and 90°17' east longitudes. It is bounded by Padma river, Lohajang and Sadarpur upazilas on the north, Rajoir and Madaripur sadar upazilas on the south, Zanjira upazila on the east, Bhanga upazila on the west. Notable water bodies are Padma, Kumar, Arial khan and Moynakata rivers.

According to Banglapedia, the features of the farmers and agriculture at Shibchar upazila are as follows:

a) Main sources of income: Agriculture 63.95%, Non-agricultural labourer 2.16%, Commerce 14.57%, Transport and communication 2.18%, Service 6.16%, and Others 10.98%.
b) Ownership of agricultural land: Landowner 65.77%, Landless 34.23%.
c) Main crops: Paddy, Jute, Pulse, Onion, Garlic, Mustard, Sugarcane, Wheat, Betel leaf, Ground nut, etc.

Figure 3.3. Map of Sadarpur Upazila of Faridpur District Showing a Part of the Study Area (**Source:** Banglapedia)

3.2.2. Sadarpur Upazila

According to Banglapedia, the area of Sadarpur upazila (Faridpur district) is 290.20 sq km, located in between 23°24' and 23°34' north latitudes and in between 89°57' and 90°11' east longitudes. It is bounded by Char bhadrasan and Dohar upazilas on the north, Bhanga upazila on the south, Shibchar and Sreenagar upazilas on the east, Nagarkanda upazila on the west. Notable water bodies: Padma, Arial khan and Bhubaneshwar. According to Banglapedia, the features of the farmers and agriculture at the Sadarpur upazila are as follows:

a) Main sources of income: Agriculture 67.79%, Non-agricultural labourer 2.33%, Commerce 11.41%, Transport and communication 2.42%, Service 5.68%, and Others 10.37%.
b) Ownership of agricultural land: Landowner 66.33%, landless 33.67%
c) Main crops: Paddy, Pulse, Jute, Oil-seed, Vegetables, etc.

3.3. Population of the Study

All the farmers who cultivate lentil and mung bean at Madaripur and Faridpur districts constituted the population of the study. To attain the objectives of the study, an approximate number of lentil and mung bean farmers were estimated with the help of agriculture extension officer (AEO), field level assistant, sub assistant agricultural officers (SAAO) of the Department of Agricultural Extension (DAE) and the local farmers. The approximate number of farmers helped to get an idea about the sample size of the study.

3.4. Sample, Sample Size and Sampling Procedure

Farm level survey was carried out for collecting data on lentil and mung bean cultivation applying the multistage stratified random sampling technique for selecting the farmers. At the first stage, the 2 districts[3], Madaripur and Faridpur, were selected based on the suitability of lentil and mung bean cultivation. So, all the lentil and mung bean farmers of these two districts constituted the population for this study. At stage two, an upazila[4] from each district were selected based on higher production. Finally, the lentil and mung bean farmers were selected randomly from the specified population

[3] Administrative unit of Bangladesh
[4] Sub-district

to administer primary survey. Sample size of the study was determined by applying the following formula (Arkin and Colton, 1963):

$$n = \frac{Nz^2p(1-p)}{Nd^2+z^2p(1-P)} \quad 3.1$$

Where: n = Sample size

N = Total number of lentil/mung bean farmers

z = Confidence level (at 95% level z = 1.96)

p = Estimated population proportion (0.5, this maximizes the sample size)

d = Error limit of 5% (0.05)

Equation (3.1) suggest that a sample of above 94 respondents would be representative for the population. However, a total of 120 households, 60 from each district were randomly selected from the population (Table 3.1). The selected lentil and mung bean farming households were surveyed with structured survey schedule to gather the required information for the study.

Table 3.1. Sample of the Study

Name of the crops	Name of the district	Name of the upazila	Sample size
Lentil	Madaripur	Shibchar	60
Mung bean	Faridpur	Sadarpur	60
Total			120

3.5. Data Collection Methods and Tools

3.5.1. Data Collection Methods

Various types of data and information are needed to complete a meaningful study. For this reason, primary data were collected from field survey and secondary information were collected through rigorous searching.

3.5.1.1. Primary Data Collection

Primary data refers to the first-hand data gathered by the researcher himself/herself. Sources of primary data can be surveys, observations, questionnaires, and interviews etc. Researcher herself conducted face-to-face interview of the selected respondents

with a structured and pre-tested questionnaire for collecting primary data. Interviews were conducted in respondent's house.

3.5.1.2. Secondary Data Collection

To conduct a worthy research, an extensive study for all the necessary information of a research topic is very crucial. To enrich the quality of the research and enhance the depth of study, secondary data were collected from different agricultural universities, research institutions, libraries, proceedings, articles, and reports such as:

- Different books, journals, publications, etc.
- Libraries of -
  - Sher-e-Bangla Agricultural University (SAU)
  - Bangladesh Agricultural University (BAU)
  - Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU)
- Bangladesh Agricultural Research Council (BARC)
- Bangladesh Agriculture Research Institute (BARI)
- Bangladesh Bank
- MS and PhD thesis papers
- Internet browsing, etc.

3.5.1.3. Specific Sources of Secondary Data

The data of Free on Board (FOB) and Cost, Insurance and Freight (CIF) price of lentil and mung bean were collected and adjusted following Kazal et al. (2013, Rashid and Matin (2018) and Molla et al. (2021). Further, the necessary data on urea, TSP, and MoP were collected from different sources following Islam et al. (2021). A brief of these data sources has been presented on Table 3.2. Data modification and filtering were performed to ensure that each variable's measurement was consistent with the objectives of the study. Mung bean production in Bangladesh is mainly done on two distinct seasons. For this study, lentil and mung bean cultivating farm of winter season were considered to achieve the objectives. Different methods are useful in estimating the economic profitability of specific crops. In this study, the domestic resource cost (DRC) ratio was used to measure the comparative advantage of lentil and mung bean production in Bangladesh at import substitution.

Table 3.2. Sources of FOB and CIF Prices

Commodity	FOB/CIF	Sources
Lentil	FOB	FAOStat, Kazal et al. (2013)
Mung bean	FOB	Molla et al. (2021) and Kazal et al. (2013)
Urea (Ukraine)	FOB	Economic trend, Bangladesh Bank, 2020
TSP (US Gulf port)	FOB	Economic trend, Bangladesh Bank, 2020
MoP (Morocco)	FOB	Economic trend, Bangladesh Bank, 2020

3.5.1.4. Secondary Data Required to Calculate Economic Profitability and DRC

A comprehensive dataset is required to estimate the economic profitability and comparative advantage or DRC. The desired information required for constructing the DRC includes inputs, outputs, market, and social prices. The inputs used to produce lentil and mung bean are divided into two categories: a) traded intermediate inputs, and b) non-traded intermediate inputs.

a) Traded Intermediate Inputs

Traded intermediate inputs are either imported or exported. In Bangladesh, different fertilizers i.e., urea, TSP, MoP etc. are usually used for lentil and mung bean production. In this study, these inputs were considered as traded intermediate inputs. The costs of tradable inputs are measured by border/import parity price.

b) Non-traded Intermediate Inputs

Unskilled agricultural labour, land rent and interest on operating capital (IOC) are considered as non-traded intermediate inputs and domestic resources because these components of production do not usually enter the international market. Following Islam et al. (2021) a specific conversion factor was used for the social valuation of the costs and prices of non-tradable inputs. In this study, a particular conversion factor of 0.75 for human labour charges was applied to construct the social budget. However, land rent cost was used as full social cost in this study following Kazal et al. (2013). The opportunity cost of operating capital was calculated at 10% annual interest rate for fourth months of production period. It was taken following rule of thumb. The payments for non-traded intermediate inputs and domestic resources are converted from a measurement of "per unit of the land" to "per unit of output." Methodologically, these

items are valued considering their opportunity costs. In Bangladesh, factor markets are reasonably competitive, and thus, payment for non-traded intermediate inputs and domestic resources represent the opportunity costs of these resources.

3.5.2. Primary Data Collection Tools

A structured interview schedule was prepared earlier to attain the objectives of the study. The prepared schedule embodied with both open and closed ended questions. The questions of the schedule were formulated in a simple and unambiguous way and arranged in a logical order to make it more attractive. The survey tools were initially constructed based on an extensive literature review. The schedule was pre-tested with 10 randomly selected lentil and mung bean farmers in the study area. The pre-test was helpful in identifying the incomplete/inappropriate questions in the draft schedule. Thus, necessary additions, deletions, modifications and adjustments were made in the schedule on the basis of experiences gained from pre-test. The questionnaires were also checked for validity by supervisor and educational experts at Sher-e-Bangla Agricultural University, Dhaka. Finally, based on background information, expert's appraisal and the pre-test the questionnaire was finalized.

3.5.3. Data Collection Period

At the time of data collection, overwhelming co-operation was experienced from field staff of different GOs, NGOs, local leader and obviously from the lentil and mung bean farmers. Before going to the respondent's house for interviewing they were informed verbally to ensure their availability at home as per schedule date and time. From the field survey, it is evident that the respondents felt hesitate to give answer at some aspect of questioning. The primary data were collected during the month of March and April 2021.

3.6. Data Processing

Bogdan and Biklen (2006) opined that data analysis and processing is also an on-going part of data collection. Initially, all collected data were carefully entered in to Microsoft Excel. Then, the entered data were checked randomly against original completed interview schedule. All the collected data were summarized and scrutinized carefully

to eliminate maximum possible errors. If errors were detected, necessary corrections were made accordingly.

3.7. Data Analysis and Analytical Techniques

Primary data on lentil and mung bean production were entered into a database system using Microsoft office software package. Both descriptive and analytical methods were employed in order to analyze the data. Descriptive techniques were used to illustrate the socio-economic status of the respondents. These techniques included: frequency distribution, percentage, range, mean and standard deviation etc. Analytical technique was applied to measure the financial and economic profitability of lentil and mung bean cultivation in the study areas. Then, the policy analysis matrix (PAM) was also applied to analyze the import parity of lentil and mung bean production in Bangladesh.

3.7.1. Analysis of Financial Profitability

In this study, different parameters of costs and return were analyzed to measure the profitability of lentil and mung bean cultivation in the study areas. As used by Rashid and Matin (2018), the following algebraic equation (3.2) was used to estimate the financial profitability of lentil and mung bean:

$$\pi_i = \sum_{i=1}^{n} P_i Q_i - TC_i = \sum_{i=1}^{n} P_i Q_i - (VC_i + FC_i) \quad (3.2)$$

Where,

π_i = Profit (Tk./ha)
Q_i = Quantity of i^{th} farmers (kg/ha)
P_i = Price of i^{th} farmers (Tk./kg)
TC_i = Total cost (Tk./ha)
VC_i = Variable cost (Tk./ha)
FC_i = Fixed cost (Tk./ha)
i = Number of farmers (1,2,3 …….. n)

Per hectare profitability of cultivating lentil and/or mung bean from the viewpoints of individual farmers was measured in terms of gross return, gross margin and net return.

Gross return: Gross return was calculated by simply multiplying the total volume of output with its per unit of price in the harvesting period.

Gross margin: Gross margin calculation was done to have an estimate of the difference between gross return and variable costs. The argument for using the gross margin analysis is that the farmers of Bangladesh are more interested to know their return over variable costs.

Net return: The analysis considered fixed cost (which included land rent and interest on operating capital). Net margin was calculated by deducting all costs (Variable and Fixed) from gross return.

3.7.2. Policy Analysis Matrix (PAM) Framework

Policy Analysis Matrix (PAM) framework was utilized to measure competitiveness, economic efficiency and effects of policy interventions on the production of lentil and mung bean. This framework was developed first by Monke and Pearson (1989), and augmented by recent developments in price distortion analysis by Masters and Winter-Nelson (1995). PAM is a tool that allows us to examine the impact of policy by constructing two enterprise budgets, one valued at market prices and the other valued at social prices. The PAM, once assembled, provides a convenient method of calculating the measure of policy effects and measures of competitiveness and economic efficiency/comparative advantage. This framework is also useful in identifying the appropriate direction of change in policy and has been applied by many researchers (e.g., Khan, 2001; Kazal et al., 2013; Rashid and Matin, 2018; Molla et al., 2021). In the present study, particular attention is given to competitiveness and economic efficiency in domestic resources by using a PAM framework. The assessment of competitiveness and economic efficiency of lentil and mung bean production at the farmgate level in central region (Madaripur and Faridpur district) of Bangladesh were undertaken and the necessary indicators were derived to explain the private profitability, social profitability and divergence.

Table 3.3. Framework of Policy Analysis Matrix (PAM)

Items	Revenue	Cost		Profit
		Tradable inputs	Domestic factors	
Private prices	A	B	C	D
Social prices	E	F	G	H
Divergences	I	J	K	L

Source: Monke and Pearson (1989)

Private profit (D) = A-(B+C), Social profit (H) = E-(F+G), Output transfer (I) = A-E, Input transfer (J) = B-F, Factor transfer (K) = C-G, Net transfer (L) = D-H or I-J-K

Valued at Private prices $A = P_id * Qi$, $B = P_jd * Q_j$, $C = P_nd * Q_n$

Valued at Social prices $E = P_ib * Qi$, $F = P_jb * Q_j$, $G = P_ns * Q_n$

Where: P_id = domestic price of output i

P_jd = domestic price of tradable input j

P_ib = international price of output i

P_jb = international price of tradable input j

P_nd = market price of non-tradable input n

P_ns = shadow price of non-tradable input n

Q_i = quantity of output

Q_j = quantity of tradable input.

Q_n = quantity of non-tradable input.

The indicators in the first row of Table 3.3 provide a measure of private profitability (D), or competitiveness, and are defined as the difference between observed revenue (A) and costs (B+C). Private profitability demonstrates the competitiveness of the agricultural system, given current technologies, prices for inputs and outputs, and policy interventions and market failures. The second row of the matrix calculates the measure of social profitability (H) defined as the difference between social revenue (E) and costs (F+G). Social profitability measures economic efficiency/comparative advantage of the agricultural system.

3.7.3. Ratio Indicators

The PAM framework can also be used to calculate important indicators for policy analysis. The computations of the following measures were established based on Appleyard (1987):

a) Nominal Protection Coefficient on Output (NPCO)

This ratio shows that the extent to which domestic prices for output differ from international reference prices. If NPCO is greater than one, the domestic farm gate price is greater than the international price of output and thus the system receives protection. On the contrary, if NPCO is less than one, the system is disprotected by policy. NPCO is expressed as:

$$NPCO = (A)/(E) = (P_id * Q_i) / (P_ib * Q_i) \quad (3.3)$$

b) Nominal Protection Coefficient on Input (NPCI)

This ratio shows how much domestic prices for tradable inputs differ from their social prices. If NPCI exceeds one, the domestic input cost is greater than the comparable world prices and thus the system is taxed by policy. If NPCI is less than one, the system is subsidized by policy. Using the PAM framework, NPCI is derived as:

$$NPCI = (B)/(F) = (P_jd * Q_j) / (P_jb * Q_j) \quad (3.4)$$

c) Effective Protection Coefficient (EPC)

EPC is the ratio of value added in private prices (A-B) to value added in social prices (E-F). An EPC value of greater than one suggests that government policy protects the producers, while values less than one indicate that producers are disprotected through policy interventions. EPC is expressed as:

$$EPC = (A-B)/(E-F) = \{(P_id * Q_i) - (P_jd * Q_j)\} / \{(P_ib * Q_i) - (P_jb * Q_j)\} \quad (3.5)$$

d) Domestic Resource Cost (DRC)

Comparative advantage in the production of a given crop for a particular country is measured by comparing its border price with the social or economic opportunity costs of producing, processing, transporting, handling and marketing an incremental unit of commodity. The domestic resource cost (DRC) provides a measure of efficiency, with implications for the level of incentives offered to producers. Whether it is efficient for

a country to produce a commodity as opposed to importing it, depends on the opportunity cost of domestic production relative to the value added it creates in foreign currency. The DRC was brought into common use by Bruno (1972) specifically for the purpose of measuring comparative advantage. The DRC is the ratio of the cost in domestic resources and non-traded inputs (valued at their shadow prices) of producing the commodity domestically to the net foreign exchange earned or saved by producing the good domestically. In this study DRC was calculated applying the following formula as used by (Rashid and Matin, 2018):

$$\text{DRC} = \frac{\text{Cost of domestic resource and non-traded inputs for producing per unit of output}}{\text{Value of tradable output} - \text{Value of tradable inputs}}$$

$$\text{DRC} = \frac{\sum f_{ij} P_j^d}{U_i - \sum a_{ik} P_k^b} \qquad (3.6)$$

Where,

f_{ij} = Domestic resource and non-traded inputs j used for producing per unit commodity i

P^d_j = Price of non-traded intermediate inputs and domestic resource

U_i = Border price of output i

a_{ik}= Amount of traded intermediate inputs for unit production of i

P^b_k = Border price of traded intermediate input

If DRC < 1, the economy saves foreign exchange by producing the good domestically either for export or for imports substitution. This is because the opportunity cost of domestic resources and non-traded factors used in producing the good is less than the foreign exchange earned or saved. In contrast, if DRC > 1, domestic costs are in excess of foreign exchange costs or savings, indicating that the good should not be produced domestically and should be imported instead.

e) Private Cost Ratio (PCR)

PCR is the ratio of factor costs (C) to value added in private prices (A-B). This ratio measures the competitiveness of a commodity system at the farm level. The system is competitive if the PCR is less than one. Using the PAM framework, the PCR can be expressed as:

$$\text{PCR} = (C)/(A\text{-}B) = (P_n d * Q_n) / \{(P_i d * Q_i) - (P_j d * Q_j)\} \qquad (3.7)$$

3.7.4. Shadow Pricing of Inputs for PAM Analysis

- Land – Rental value of per unit of land is applied for calculating the shadow price of land
- Labour – Market wage rate is considered for shadow pricing because no substantial market imperfection exists in agricultural labour market. However, in this study, a particular conversion factor of 0.75 for human labour charges was applied to construct the social budget.
- Working capital – Interest rate for working capital were used
- Fertilizers– International prices are used to calculate the import parity prices
- Seed – Actual market price were used

CHAPTER IV

SOCIOECONOMIC PROFILE OF THE LENTIL AND MUNG BEAN GROWERS

Introduction

Different characteristics of the respondents might have significant influence to their agricultural practices as well as lentil and mung bean cultivation. Many of those traits can be discussed to explain the socio-economic profile of the lentil and mung bean growers in middle part of Bangladesh. In this report, nine characteristics of the respondents were selected including their age, level of education, agricultural farming experience, lentil or mung bean farming experience, household size, household farm size, lentil or mung bean growing farm size, annual household income and household poverty status that might have great influence to their crop cultivation practices. Similar attributes were also studied by Molla et al. (2009) and Sujan (2018) in their study. The above-mentioned characteristics are explained in this section of the report.

4.1. Age Distribution of the Respondents

Age of the responded lentil and mung bean growers varied from 21 to 75 years with an average of 49.61 years. Considering the recorded age, lentil and mung bean growers were classified into three categories ‘young’, ‘middle’ and ‘old’ aged as classified by MoYS (2012). The distribution of the respondents in accordance of their age is presented in Table 4.1.

Table 4.1. Age Distribution of the Responded Lentil and Mung bean Growers

Category	Basis of categorization (years)	Lentil		Mung bean		Overall	
		Number	Percent	Number	Percent	Number	Percent
Young	≤ 35	11	18.33	4	6.67	15	12.50
Middle	36 - 50	21	35.00	29	48.33	50	41.67
Old	> 50	28	46.67	27	45.00	55	45.83
Total		60	100.00	60	100.00	120	100.00
Observed range (years)		21 - 75		30 - 72		21 - 75	
Average age (years)		49.18		50.03		49.61	

Source: Field survey, 2021

Results reveal that the old-aged growers comprised the highest proportion (45.83%) followed by middle (41.67%) and young (12.50%) aged category. Findings of the study indicate that people are remaining more involved with pulse crops cultivation with the increment of their age. However, in case of lentil cultivators, 18.33%, 35.00 % and 46.67% respondents fall under young, middle and old aged category, respectively whereas these percentage were 6.67%, 48.33% and 45.00 % for mung bean cultivators (Table 4.1). This result implicates that middle and old aged farmers are more likely to cultivate mung bean rather lentil and this finding is also justified in the averages of lentil and mung bean cultivators.

4.2. Educational Status of the Respondents

The level of education of the responded lentil and mung bean growers ranged from 0 to 17 years with an average of 4.58 years. Based on education years, the growers were grouped into four categories as classified by Rahman (2020). The distribution of growers according to their level of education is presented in Table 4.2. The result shows that more than one-third portion of the lentil and mung bean growers were illiterate. However, the growers under secondary education category constitute the second highest proportion (30.00%) followed by primary (27.50%) and above secondary (5.83%) education category. Findings of the study reveal that 63.33% of the lentil and mung bean growers were literate which is lower than the average literacy rate (74.40%) of Bangladesh (BER, 2020).

Table 4.2. Educational Status of the Responded Lentil and Mung bean Growers

Category	Basis of categorization (years)	Lentil		Mung bean		Overall	
		Number	Percent	Number	Percent	Number	Percent
Illiterate	0	20	33.33	24	40.00	44	36.67
Primary education	1 - 5	10	16.67	23	38.33	33	27.50
Secondary education	6 - 10	24	40.00	12	20.00	36	30.00
Above secondary	> 10	6	10.00	1	1.67	7	5.83
Total		60	100.00	60	100.00	120	100.00
Observed range (years)		0-13		0-17		0-17	
Average education (years)		5.35		3.82		4.58	

Source: Field survey, 2021

The average years of education for lentil farmers were higher (5.35 years) than the mung bean farmers (3.82 years). However, literacy rate for lentil and mung bean farmers were 66.67% and 60.00%, respectively (Table 4.2). Besides, percentage of growers in secondary and above secondary category of lentil cultivators was higher than that of mung bean.

4.3. Agricultural Farming Experience of the Respondents

Agricultural farming experience of the respondents ranged from 4 to 55 years with an average and standard deviation of 30.98 and 12.21, respectively. Following Islam (2016), the lentil and mung bean grower's agricultural farming experience were classified into three categories by adding and subtracting standard deviation with the average experiences as 'low', 'medium' and 'higher' experience. The distribution of the lentil and mung bean growers according to their agricultural farming experience is presented in Table 4.3.

Table 4.3. Distribution of the Respondents According to Their Agricultural Farming Experiences

Category	Basis of categorization (year)	Lentil		Mung bean		Overall	
		Number	Percent	Number	Percent	Number	Percent
Low experience	≤ 19 (Mean - 1SD)	14	23.33	3	5.00	17	14.17
Medium experience	20-42 (Mean ± 1SD)	34	56.67	47	78.33	81	67.50
Higher experience	> 42 (Mean + 1SD)	12	20.00	10	16.67	22	18.33
Total		60	100.00	60	100.00	120	100.00
Observed range (year)		4-50		12-55		4-55	
Average agricultural farming experience (year)		29.40		32.55		30.98	

Note: Overall standard deviation (SD) was 12.21.

Source: Field survey, 2021

Result indicates that the medium experience category constitutes the highest proportion (67.50%) followed by the higher experience (18.33%) category. Only 14.17% of the respondents had lower experience. Findings of the study also indicate that average agricultural farming experience of the mung bean farmers (32.55) was higher than that of lentil farmers (29.40).

4.4. Lentil or Mung bean Farming Experience of the Respondents

Lentil or mung bean farming experience of the respondents ranged from 2 to 50 years with an average and standard deviation of 23.21 and 11.24, respectively. Following Islam (2016), respondent's lentil and/or mung bean farming experience were classified into three categories by adding and subtracting standard deviation with the average experiences as 'low', 'medium' and 'higher' experience. The distribution of the lentil and mung bean growers according to their lentil or mung bean farming experience is presented in Table 4.4.

Table 4.4. Distribution of the Respondents According to Their Lentil or Mung bean Farming Experiences

Category	Basis of categorization (year)	Lentil		Mung bean		Overall	
		Number	Percent	Number	Percent	Number	Percent
Low experience	≤ 12 (Mean - 1SD)	15	25.00	8	13.33	23	19.17
Medium experience	13-34 (Mean ± 1SD)	30	50.00	46	76.67	76	63.33
Higher experience	> 34 (Mean + 1SD)	15	25.00	6	10.00	21	17.50
Total		60	100.00	60	100.00	120	100.00
Observed range (year)		2-50		5-50		2-50	
Average lentil/mung bean farming experience (year)		23.90		22.52		23.21	

Note: Overall standard deviation (SD) was 11.24.

Source: Field survey, 2021

Result indicates that the medium-term lentil or mung bean farming experience category constitutes the highest proportion (63.33%) followed by the lower experience (19.17%) category. Only 17.50% of the respondents had higher lentil or mung bean farming experience. Findings of the study also indicate that average farming experience of the lentil farmers (23.90 years) was higher than that of mung bean farmers (22.52 years).

4.5. Household Size of the Responded Lentil or Mung bean Growers

Family size of the respondents ranged from 2 to 13 members with an average and standard deviation of 5.33 and 1.80, respectively. Following Islam (2016), the lentil and mung bean grower's household size were classified into three categories by adding and subtracting standard deviation with the average household size as 'small', 'medium' and 'large' family. The distribution of the lentil and mung bean growers according to their family size is presented in Table 4.5. Result indicates that the medium size family constitute the highest proportion (70.00%) followed by the large (16.67%) sized family. Only 13.33% of the respondents had small family. Such finding is quite normal as per the situation of Bangladesh. However, results of the study indicate that average family size of the study area (5.33) was higher than the national average of 4.06 (HIES, 2016). Average family size of the lentil farmers (5.42) was higher than the mung bean farmers (5.23).

Table 4.5. Distribution of the Respondents According to Their Household Size

Category	Basis of categorization (number)	Lentil		Mung bean		Overall	
		Number	Percent	Number	Percent	Number	Percent
Small family	≤ 3 (Mean - 1SD)	8	13.33	8	13.33	16	13.33
Medium family	4-7 (Mean ± 1SD)	40	66.67	44	73.34	84	70.00
Large family	> 7 (Mean + 1SD)	12	20.00	8	13.33	20	16.67
Total		60	100.00	60	100.00	120	100.00
Observed range (numbers)		2-13		2-11		2-13	
Average family size (numbers)		5.42		5.23		5.33	

Note: Overall standard deviation (SD) was 1.80.

Source: Field survey, 2021

4.6. Household Farm Size in the Study Area

In the study area, household farm size of the lentil and mung bean growers ranged from 0.04 to 4.05 hectares with an average of 1.17 hectares. Based on the farm size, lentil and mung bean growers were classified into five categories following the categorization of DAE (1999). The distribution of the lentil and mung bean growers according to their household farm size is presented in Table 4.6. Results indicate that the small farm

holder constituted the highest proportion (47.50%) of the respondents. Another 41.67% of the lentil and mung bean growers were medium farm holder. The findings of the study reveal that majority (89.17%) of the lentil and mung bean growers were small to medium sized farm holder. Average household farm size of the study area (1.17 hectare) was higher than that of national average (0.60 hectare) of Bangladesh (BBS, 2014). Covering char land areas might be the reason behind this finding. However, average farm size of the landless, small, medium and large farm was 0.11, 0.57, 1.66 and 3.49 hectare, respectively. It is worth to mention that, overall average farm size of the mung bean farmers (1.50 hectare) was higher than that of lentil farmers (0.84 hectares).

Table 4.6. Distribution of the Respondents Based on Their Farm Size

Category	Basis of categorization (hectare)	Category-wise Average farm size	Lentil		Mung bean		Overall	
			Number	Percent	Number	Percent	Number	Percent
Landless	< 0.20	0.11	5	8.33	1	1.67	6	5.00
Small	0.20 - 1.00	0.57	40	66.67	17	28.33	57	47.50
Medium	1.01 - 3.00	1.66	13	21.67	37	61.67	50	41.67
Large	> 3.00	3.49	2	3.33	5	8.33	7	5.83
Total		-	60	100.00	60	100.00	120	100.00
Observed range (hectare)		-	0.06 – 4.05		0.04 – 4.05		0.04 - 4.05	
Average agricultural farm size (hectares)		-	0.84		1.50		1.17	

Source: Field survey, 2021

Note: Landless is with < 0.20 hectares of land, small is with 0.20 - 1.00, medium is with 1.01 - 3.00 and large is above 3.00 hectares of land (DAE, 1999).

4.7. Lentil or Mung bean Cultivating Farm Size in the Study Area

Lentil and mung bean cultivating farm size of the study area was ranged from 0.06 to 1.30 hectares with an average of 0.22 hectares. Lentil and mung bean growing farm sizes were also classified into five categories following the categorization of DAE (1999). Distribution of the growers according to their lentil and mung bean farm size is presented in Table 4.7. Results also indicate that the small sized lentil and mung bean farm holders constituted the highest proportion (62.50%) of the respondents. Average lentil and mung bean farm size of the landless, small and medium farm was 0.11, 0.39 and 1.30 hectare, respectively. However, average farm size of the mung bean farmers (0.29 hectare) was higher than that of lentil farmers (0.15 hectares).

Table 4.7. Distribution of the Respondents According to Their Lentil and Mung bean Growing Farm Size

Category	Basis of categorization (hectare)	Category-wise Average farm size	Lentil		Mung bean		Overall	
			Number	Percent	Number	Percent	Number	Percent
Landless	< 0.20	0.11	48	80.00	27	45.00	75	62.50
Small	0.20 - 1.00	0.39	12	20.00	32	53.33	44	36.67
Medium	1.01 - 3.00	1.30	0	0.00	1	1.67	1	0.83
Large	> 3.00	0.00	0	0.00	0	0.00	0	0.00
Total		-	60	100.00	60	100.00	120	100.00
Observed range (hectare)		-	0.06 – 0.54		0.06 – 1.30		0.06 – 1.30	
Average lentil/mung bean farm size (hectares)		-	0.15		0.29		0.22	

Source: Field survey, 2021

Note: Landless is with < 0.20 hectares of land, small is with 0.20 - 1.00, medium is with 1.01 - 3.00 and large is above 3.00 hectares of land (DAE, 1999).

4.8. Annual Household Income of the Respondents

Annual household income of the respondents included all the incomes of the lentil or mung bean growers and his/her family members from different income source i. e. field crops, livestock rearing, fisheries, business, services, foreign remittance and others. In the study area, annual household income of the respondents ranged from 0.75 to 7.00 lakh taka with an average of 3.24 lakh taka. Findings of the study show that average monthly household income of the respondents (Tk. 26,969) were well above the national average of Tk. 15,988 (HIES, 2016). Following Islam (2016) and Sujan (2018), the lentil and mung bean growers were classified based on their annual household income into three categories arbitrarily as ‘low’, ‘medium’ and ‘high’ annual income category. The distribution of the lentil and mung bean growers according to their income is presented in Table 4.8. Result shows that the lentil and mung bean growers having annual income lower than 3 lakh taka constituted the highest proportion (45.00%), while 30.83% of the growers had annual household income higher than 4 lakh taka. However, a majority (69.17%) of the lentil and mung bean growers had low to medium annual household income.

Table 4.8. Distribution of the Respondents According to Their Annual Household Income

Category	Basis of categorization (lakh Tk.)	Category-wise Average income (lakh Tk.)	Lentil		Mung bean		Overall	
			Number	Percent	Number	Percent	Number	Percent
Low income	< 3.00	1.92	22	36.67	32	53.33	54	45.00
Medium income	3.00 – 4.00	3.54	18	30.00	11	18.34	29	24.17
High income	> 4.00	4.94	20	33.33	17	28.33	37	30.83
Total		-	60	100.00	60	100.00	120	100.00
Observed range (lakh Tk.)		-	0.75 – 6.30		0.80 – 7.00		0.75 – 7.00	
Average income (lakh Tk.)		-	3.38		3.09		3.24	

Source: Field survey, 2021

Average annual household income of the lentil farmers (Tk. 3.38 lakh) was higher than that of mung bean farmers (Tk. 3.09 lakh). Higher percentage of the farmers in the high- and medium-income category of lentil farmers than the mung bean farmers also signify the above statement (Table 4.8).

4.9. Poverty Status of the Responded Households

Based on the household income, respondents were also categorized into two categories namely poor (spending < USD 1.90 per capita per day) and non-poor (spending ≥ USD 1.90 per capita per day). The poverty line was estimated through multiplying USD 1.90 with average household size of the study area 5.33. Then, the threshold level was converted to yearly annual income by multiplying with 365. Thus, the minimum income requirement to escape from poverty was determined as 1.90*5.33*365*84.78 taka or 3.13 lakh taka per year. Distribution of the lentil and mung bean growers according to their household poverty status is presented in Table 4.9. Findings of the study show a disappointing picture that is 48.33% of the lentil or mung bean growers fall under the poor household category. That means, only 51.67% of the respondents were no-poor household.

Table 4.9. Distribution of the Lentil and/or Mung bean Growers According to Their Household Poverty Status

Category	Lentil		Mung bean		Overall	
	Number	**Percent**	**Number**	**Percent**	**Number**	**Percent**
Poor (earning < Tk. 3.13 lakh/year)	25	41.67	33	55.00	58	48.33
Non-poor (earning ≥ Tk. 3.13 lakh/year)	35	58.33	27	45.00	62	51.67
Total	60	100.00	60	100.00	120	100.00

Source: Field survey, 2021

Note: Exchange rate for 1 USD was taken 84.78 taka at the study period.

CHAPTER V

FINANCIAL PROFITABILITY OF LENTIL AND MUNG BEAN CULTIVATION

Financial profitability of lentil and mung bean cultivation in the study area are discussed in this chapter. Before the presentation of comprehensive explanation on financial profitability, the input use pattern to produce lentil and mung bean were also discussed. Cost of producing lentil and mung bean in the study area were also discussed afterward. Finally, revenue as well as profitability of the practices were estimated and presented.

5.1. Input Use Pattern of Lentil and Mung bean Cultivation in the Study Area

For better presentation, all the variable inputs used to produce lentil and mung bean in the study area were grouped into six categories. These categories were human labour, land preparation, machinery inputs, seed, fertilizers and insecticides & pesticides, etc. More details about the input use patterns are presented in Table 5.1.

Table 5.1. Input Use Pattern of Lentil and Mung bean Cultivation

Sl. No.	Items	Lentil		Mung bean		Unit price (Tk.)
		Amount	%	Amount	%	
01.	Human labour (man-days/ha)	82	52.04	62	64.22	*
	Hired labour	29	-	14	-	-
	Family labour	53	-	48	-	-
02.	Land preparation cost (Tk./ha)	10613	20.76	4076	12.04	-
03.	Machinery inputs (harvesting, carrying, threshing) (Tk./ha)	1039	2.03	2134	6.30	-
04.	Seed (kg/ha)	71	13.94	16	4.81	100
05.	Fertilizers (kg/ha)	209	10.75	87	6.93	-
	Urea	57	-	57	-	17
	TSP	117	-	24	-	32
	MoP	35	-	7	-	16
	Others	4	-	10	-	-
06.	Insecticides & pesticides (Tk./ha)	241	0.47	1928	5.70	-

* varied between Tk. 300 to Tk. 400; Source: Field survey, 2021

Among the inputs used for lentil production, resource allocation for human labour comprises the highest (52.04%) position followed by land preparation (20.76%), seed (13.94%), fertilizers (10.75%), machinery inputs (2.03%) and insecticides & pesticides (0.47%) (Table 5.1). However, it is mentionable that in earlier studies (Rahman et al., 2012; Tithi and Barmon, 2018; Sarkar et al., 2020; Miah et al., 2021) the percent share of the cost of lentil production varied to a large extent for different inputs such as labour (27-41%), seed (5.4-8%), fertilizers (7-15%), land use (17-36%), and land preparation (10.6-16%). On the other hand, among the inputs used for mung bean production, resource required for labour input also holds the highest position (64.22%) and followed by land preparation (12.04%), fertilizers (6.93%), machinery inputs (4.81%), insecticides & pesticides (5.70%) and seed (4.81%). Wage rate of the labour in the study areas varied between Tk. 300 to Tk. 400. Farmers had to buy the fertilizers like Urea at Tk. 17, TSP at Tk. 32 and MoP at Tk. 16. Seasonal and timely unavailability of these fertilizers may force the farmers to buy at higher prices than the national declaration.

Fewer requirement of land preparation and intercultural operations like weeding and fertilization were responsible for the lower utilization of human labour in case of mung bean production. Farmers also used lower amount of fertilizer specially urea for mung bean cultivation which also depicted on Table 5.1. However, in case of lentil production, farmers hardly used any pesticides. They used pesticides in mung bean farming as it is susceptible to pest infestation. That is why, proportionate pesticide use for mung bean was higher than that of lentil production in the study area.

However, per hectare human labour input used for lentil and mung bean production was found lower than this research by Molla et al. (2021) and Miah et al. (2021). They also found higher use of inputs as insecticides & pesticides than this study. Farmers in the study area used human labour to control weeds instead of using weedicide or herbicides. That is why, the cost incurred for human labour is found higher in this study than that of Molla et al. (2021). In this study, data for mung bean cultivation was collected from the char land area which also responsible for lower requirement of land preparation and human labour costs (Table 5.1). Seed used for lentil production was also found higher than the findings of Matin et al. (2018). Lack of confidence on locally available seed and perceived relationship between seed rate and yield might influenced the farmers to use more seed in the study area.

5.2. Cost of Lentil and Mung bean Production in the Study Area

For determining the costs of lentil and mung bean production, all the variable costs like cost for land preparation, human labour, seed, machinery inputs, fertilizers, and insecticides & pesticides were calculated per hectare basis. The fixed costs of lentil and mung bean production consists of the cost incurred for land use and interest on operating capital. The cost of land use was calculated on the basis of per hectare lease value of land as calculated by Matin et al. (2018). The total cost included fixed cost and variable cost. Details of the cost of lentil and mung bean production is presented on Table 5.2.

Table 5.2. Cost of Lentil and Mung bean Production in the Study Area

Sl. No.	Items	Lentil		Mung bean	
		Amount (Tk./ha)	% of total cost	Amount (Tk./ha)	% of total cost
A.	Variable Cost	51110.70	81.63	33846.33	86.80
	Land preparation cost	10613.07	16.95	4075.93	10.45
	Human labour	26597.46	42.48	21734.61	55.74
	Machinery inputs	1039.27	1.66	2133.63	5.47
	Seed	7124.48	11.38	1627.33	4.17
	Fertilizers	5495.50	8.78	2346.40	6.02
	Urea	969.30	1.55	965.60	2.48
	TSP	3738.60	5.97	757.47	1.94
	MoP	567.57	0.91	107.03	0.27
	Others	220.04	0.35	516.30	1.32
	Insecticides and pesticides	240.92	0.38	1928.42	4.95
B.	Fixed cost	11504.98	18.37	5148.67	13.20
	Interest on operating capital	1703.69	2.72	1128.21	2.89
	Land use cost	9801.29	15.65	4020.46	10.31
	Total Cost (A+B)	62615.68	100.00	38995.00	100.00

Source: Field survey, 2021

The total cost of lentil and mung bean production were estimated to be Tk. 62616 and Tk. 38995 per hectare, respectively. The variable cost of lentil and mung bean production were Tk. 51111 and Tk. 33846 per hectare, respectively. The total cost and variable cost found in this study are higher than the findings of Rahman et al. (2012),

Matin et al. (2018) and Molla et al. (2021). Higher labour use might be a reasonable cause for this variation. Miah et al. (2021) estimated the total cost of improved lentil production higher than the findings of this study. More than two times cost for land use were mainly responsible for their different findings.

On the other hand, the total cost and variable cost found to produce mung bean in the study area are lower than the findings of Rashid and Matin (2018) and Molla et al. (2021). Fewer cost incurred for initial land preparation and lower use of fertilizer were the causes behind this variation. Besides, fewer land use cost in the char land area is also responsible for lowering the mung bean production cost in the study area. However, in both the cases, the major share in total cost was also incurred for human labour inputs, followed by land preparation costs and land use costs, etc. (Table 5.2). Although Rashid and Matin (2018) and Miah et al. (2021) found land use cost as the second highest cost of lentil production, in this study, land preparation cost has occupied that position as there involved few additional labour use.

5.3. Financial Profitability of Lentil and Mung bean Production

Farmers of the study area were cultivated local lentil variety. The average yield of lentil and mung bean production were about 1.22 t/ha and 0.81 t/ha, respectively which were slightly lower than the national average of 1.27 t/ha and 0.93 t/ha (BBS, 2021). The yield of a crop depends on many agro-economic and environmental factors (Miah et al., 2021). It may vary from variety to variety, location to location, and year to year. Molla et al. (2021) found slightly higher productivity of lentil (1.42 t/ha) in Natore, Jashore and Faridpur districts and mung bean (1.28 t/ha) in Natore, Patukhali and Bhola districts during 2018-19. In their study, they also found higher use of fertilizer, insecticide and pesticide to produce lentil and mung bean. That concentrated use of those inputs might be responsible for their exploration of higher productivity. However, Kazal et al. (2013) estimated much lower yield of lentil (1.16 t/ha) in Natore and Bogura districts during 2012. Miah et al. (2021) also recorded much lower productivity of local variety of lentil (1.08 t/ha) in Faridpur, Magura, Kushtia, Jhenaidah, Manikganj, and Sirajganj during 2021. It is worthy to mention that Rahman et al. (2012), Matin et al. (2018) and Miah et al. (2021) also found higher yield of lentil at the rate of 1.73 t/ha, 1.49 t/ha, and 1.66 t/ha, respectively by adopting high yielding varieties in different parts of the country.

Table 5.3. Financial Profitability Analysis of Lentil and Mung bean Production

Sl. No.	Items	Unit	Lentil	Mung bean
01.	Yield	MT/ha	1.22	0.81
02.	Farm gate Price	Tk./kg	77.08	71.58
03.	Return from by products	Tk./ha	9919.68	5684.98
04.	Gross return (GR)	Tk./ha	104113.05	63621.23
05.	Total variable cost (TVC)	Tk./ha	51110.70	33846.33
06.	Total cost (TC)	Tk./ha	62615.68	38995.00
07.	Gross margin (GR-TVC)	Tk./ha	53002.35	29774.90
08.	Net return (GR-TC)	Tk./ha	41497.38	24626.23
09.	Benefit cost ratio (BCR)		1.66	1.63

Source: Field survey, 2021

Gross return of lentil and mung bean production were found to be Tk. 104113 and Tk. 63621, respectively (Table 5.3). The per hectare gross margin of lentil and mung bean cultivation were Tk. 53002 and Tk. 29775, respectively. Again, the net return of lentil and mung bean production were Tk. 41497 and Tk. 24626 per hectare, respectively. Considering total cost of production, the undiscounted benefit cost ratio of lentil (1.66) was slightly higher than that of mung bean production (1.63). Molla et al. (2021), Miah et al. (2021) and Matin et al. (2018) also estimated the benefit cost ratio of local lentil production as 1.63, 1.30 and 1.22 on the basis of total cost. Besides, Matin et al. (2018), Hajong et al. (2020) and Miah et al. (2021) estimated BCR (1.81, 1.75 and 1.71) of improved variety lentils higher than the present result (1.66), but Rahman et al. (2012) estimated a BCR of 1.53 which was lower than the findings of this study. Besides, Molla et al. (2021) and Rashid and Matin (2018) estimated BCR of mung bean production 1.56 and 1.42 which was lower than the findings of this study. However, based on financial analysis, it can be interpreted that lentil and mung bean cultivation in the study area are profitable.

CHAPTER VI

ECONOMIC ANALYSIS OF LENTIL AND MUNG BEAN CULTIVATION

In this chapter of the thesis, findings of economic profitability and policy analysis matrix for lentil and mung bean production in Bangladesh are discussed. In this study, the farm gate price was used as domestic producer price, and the CIF (Cost, insurance, and freight is an international shipping agreement which represents the charges paid by a seller to cover the costs, insurance, and freight of a buyer's order while the cargo is in transit) import price was taken in terms of world price to measure the comparative advantage for lentil and mung bean production in the country.

6.1. Economic Profitability of Lentil and Mung bean Production in Bangladesh

An attempt was made to assess the profitability of lentil and mung bean cultivation from an economic point of view under the import parity level in Bangladesh. Border price of lentil Tk. 69777/MT and mung bean Tk. 58867/MT were estimated following the information of FAOSTAT (www.faostat.org), Kazal et al. (2013) and Molla et al. (2021). The average net returns were calculated for lentil and mung bean production at Tk. 17001/MT and Tk. 13396/MT, respectively. Molla et al. (2021) also found an economic profitability of lentil and mung bean production at Tk. 20031/MT and Tk. 20907/MT, respectively. However, Miah et al. (2021) also found an economic profitability of improved lentil production at Tk. 15,083/MT. Again, the benefit cost ratio (BCR) of lentil and mung bean production were found at 1.32 and 1.29, respectively which implies that the production of these pulse crops is profitable from an economic point of view under the import parity level in Bangladesh (Table 6.1).

6.2. Comparative Advantage of Lentil and Mung bean Production in Bangladesh

Comparative advantage is an economy's ability to produce a particular goods or service at a lower opportunity cost than its trading partners. It implies that the country should produce more of those commodities which have lower opportunity costs, and be concerned about exporting those commodities, if possible. Again, the country should decrease the production of those commodities which have higher opportunity costs producing domestically rather than importing at a cheaper price from abroad. In this

study, the farm gate price was used as domestic producer price, and the CIF (Cost, insurance, and freight) was taken as world price to measure the comparative advantage for lentil and mung bean production in Bangladesh.

Comparative advantage in producing lentil and mung bean in the country was evaluated through the calculation of their domestic resource costs (DRCs). DRC of greater than one implies that the country loses foreign exchange through domestic production (in the sense that it uses more domestic resources than it generates net value added to tradable goods and services), while a DRC of less than one implying the production is efficient and makes a positive contribution to domestic value addition.

Table 6.1. Domestic Resource Cost (DRC) of Lentil and Mung bean (Import Parity)

Sl. No.	Particulars	Lentil	Mung bean
A.	Traded input (Tk./MT)	6985.85	2833.53
	Urea	1808.10	1801.20
	TSP	3985.62	807.51
	MoP	1192.12	224.81
B.	Non-Traded inputs and domestic resources (Tk./MT)	45790.82	42637.54
	Human Labour	21717.19	26849.52
	Land preparation	8665.72	5035.13
	Seed	5817.23	2010.30
	Pesticides	196.71	2382.25
	Interest on operating capital	1391.09	1393.72
	Land use cost	8002.88	4966.62
C.	Total input cost (A+B)	52776.67	45471.07
D.	Output price (Tk./MT)	69777.42	58867.06
E.	Net return (D-C)	17000.75	13395.99
F.	BCR (D/C)	1.32	1.29
G.	Value added (Tradable) (Tk./MT) (D-A)	62791.57	56033.53
H.	DRC (B/D)	0.66	0.72

Source: Field survey, 2021

Both the lentil and mung bean had a comparative advantage in domestic production for import substitution since its DRCs were less than unity (0.66 and 0.72) (Table 6.1). The present DRC estimate is higher than the estimates of 0.39, 0.62, and 0.43 found by Tithi

and Barmon (2018), Kazal et al. (2013), and Rashid and Hasan (2012), respectively. Findings of the study reveals that the country had a comparative advantage of producing lentil and mung bean in Shibchar and Sadarpur upazilas, respectively. For reaping this benefit, proper encouraging measures should be taken through extension workers to motivate the farmers of the study area to cultivate more lentil and mung bean.

6.3. Results of the Policy Analysis Matrix for Lentil Production in Bangladesh

In this sub section the thesis, the results of PAM analysis as well as the coefficients of different indicators derived from PAM are discussed sequentially with necessary interpretations.

Policy Analysis Matrix constructed for lentil and mung bean production under import parity price is presented in Table 6.2 and Table 6.3. Different policy transfer or divergences such as output, tradable input, domestic factor and net policy transfer are showed on the table. Under import parity prices of lentil and mung bean, it is evident that revenue transfer (difference between private revenue and social revenue) was positive (Table 6.2 and Table 6.3). This positive value indicates that government policies affect positively to the lentil and mung bean producers. The input transfer for both the lentil and mung bean production (differences between private and social price of tradable inputs) were also negative indicating that the domestic producers bought the imported inputs (i.e. urea, TSP, MoP) at prices which was less than the world price (Table 6.2 and Table 6.3). It means that lentil and mung bean producers received input subsidies for their production. The domestic factor transfers for both the lentil and mung bean production (difference between private and social price) were positive illustrating that the opportunity costs of non-tradable inputs were lower than their market prices (Table 6.2 and Table 6.3). Finally, the net profit/net policy transfer for both lentil and mung bean production (difference between private and social profit) were positive which means that under the existing policy circumstances, the producers earn more profit and enjoy ample scope for maximizing the net policy transfer (Table 6.2 and Table 6.3). With all these policy supports, farmers should be encouraged to produce more lentil and mung bean to meet up the domestic demand for pulses. Knowledge dissemination and inspiring programs should be taken to motivate farmers to cultivate lentil and mung bean with rice and rice based cropping patterns.

Table 6.2. Policy Analysis Matrix for Lentil Production in Bangladesh

Items	Revenue	Costs		Profit
		Tradable inputs	Domestic factors	
Private prices	77083.33	4307.49	45790.82	26985.02
Social prices	69777.42	6985.85	40361.53	22430.05
Divergences	7305.92	-2678.36	5429.30	4554.97

Source: Field survey, 2021

Table 6.3. Policy Analysis Matrix for Mung bean Production in Bangladesh

Items	Revenue	Costs		Profit
		Tradable inputs	Domestic factors	
Private prices	71583.33	2260.79	42637.54	26685.01
Social prices	61295.94	2833.53	35925.16	22537.25
Divergences	10287.39	-572.75	6712.38	4147.76

Source: Field survey, 2021

6.4. Ratio Indicators under Import Parity Condition

Important indicators for estimating the level of protection and different ratios such as Nominal Protection Coefficient on Output (NPCO), Nominal Protection Coefficient on Input (NPCI), Effective Protection Coefficient (EPC) and Private Cost Ratio (PCR) were used to measure the effects of policy interventions on the producer incentives and comparative advantage. Results of the ratio indicators are presented in Table 6.4.

Table 6.4. Results of the Nominal Protection Coefficient on Output (NPCO), Nominal Protection Coefficient of Input (NPCI), Effective Protection Coefficient (EPC) and Private Cost Ratio (PCR)

Ratio indicators	Lentil	Mung bean
Nominal Protection Coefficient on Output (NPCO)	1.10	1.17
Nominal Protection Coefficient on Input (NPCI)	0.62	0.80
Effective Protection Coefficient (EPC)	1.16	1.19
Private Cost Ratio (PCR)	0.63	0.62

Source: Field survey, 2021

a) Nominal Protection Co-efficient on Output (NPCO)

In the study, NPCO values under import parity were found to be greater than one (>1) for lentil (1.10) and mung bean (1.17) production in Bangladesh (Table 6.4). These findings indicate that existing policies provide positive nominal protection for the producers of these crops.

b) Nominal Protection Coefficient on Input (NPCI)

The NPCI values were found to be less than one (<1) for lentil (0.62) and mung bean (0.80) production in Bangladesh under import parity suggesting that the government policies are reducing input costs and reducing their average market prices below the world prices (Table 6.4). NPCI values of less than one clearly indicates that the government provides efforts to support the sectors.

c) Effective Protection Coefficient (EPC)

The study also estimated EPC which is better indicator of effective incentive than the NPC, as it finds the impact of protection on inputs and outputs, and depicts the degree of protection according to the value addition process in the production activity. The EPC values under import parity were found to be more than one (>1) for lentil (1.16) and mung bean (1.19) production in Bangladesh (Table 6.4) implying that government policies provides positive incentives to producers of these crops.

d) Private Cost ratio (PCR)

Furthermore, the PCR values were found to be less than one (<1) for lentil (0.63) and mung bean (0.62) production in Bangladesh under import parity (Table 6.4) indicating that the commodity system is competitive at producer level.

The above findings based on the indicators of NPCO, NPCI, EPC and PCR conclude that the existing government policy environment tends to protect the interest of the lentil and mung bean producers in agricultural sector at production level. So, the government including other stakeholders should continue and strengthen the ongoing interventions to provide positive incentives to the producers of lentil and mung bean. Besides, policy interventions should be taken to encourage the farmers to produce more lentil and mung bean in the country.

CHAPTER VII

CONSTRAINTS FACED IN THE LENTIL AND MUNG BEAN CULTIVATION

Despite having so many policy supports, lentil and mung bean farmers of the study areas are facing several problems during their cultivation, storage and marketing process. In this chapter of the thesis, researcher discussed about the constraints faced by the lentil and mung bean farmers and opted to generate some suggestions based on the farm level survey. A list of problems related to lentil and mung bean cultivation was stated in the interview schedule based prior literature review and the farmers of the study area were asked to express their confirmation on those if they had encountered that. Besides, open ended questions regarding the constraints of lentil and mung bean cultivation were also asked to the respondents. The respondents were free to mention all the problems they have faced during their cultivation, storage and marketing activities.

7.1. The Constraints Faced by Lentil and Mung bean Farmers in the Study Area

There is no doubt about that the lentil and mung bean cultivations were profitable from both the financial and economic point of view. However, the farmers were also encountered by some problems during their cultivation practices. Most of the stated problems were mainly input related problem. Among the cited problems seed, fertilizer and labour input related problems, insect/disease outbreak related problems and storage related problems were mostly mentioned. More details on these problems are presented on Table 7.1.

In case of input related problems, an alarming majority (76.67% of lentil and 51.67% of mung bean) of the farmers mentioned that they had to buy fertilizer specially TSP higher than the nationally declared price which increased their cost of production. In case of seed related problems, unavailability of improved/HYV seed was the mostly mentioned constraint and about 32% lentil farmers and 38% mung bean farmers expressed their concern on that problems. They also complained that they had fetched lower yield due to this seed related constraints (Table 7.1). The problem of high price of seeds was also mentioned by 36.67% of lentil farmers and 28.33% of mung bean farmers. Farmers also mentioned about the problem of disease and insect infestation in

their field. That problem was more common in mung bean field (46.67%) than that of lentil (28.33%).

Table 7.1. Problems Faced by the Farmers in Lentil and Mung bean Cultivation

Particulars	Percentage of the farmers opined	
	Lentil	Mung bean
Higher fertilizer price than the national declaration specially for TSP	76.67	51.67
Unavailability of improved/HYV seed	31.67	38.33
High price of seeds	36.67	28.33
Prevalence of disease and insect infestation	28.33	46.67
Higher wage rate	36.67	18.33
Unavailability of labour in harvesting season	26.67	28.33
Lack of storage facilities	26.67	30.00
Insect infestation during storage period	21.67	18.33
Untimely rainfall	25.00	11.67
Lower yield	11.67	18.33

Source: Field survey, 2021

Labour related problems were also mentioned by the farmers. A significant portion (26.67% of lentil and 28.33% of mung bean) of the farmers mention about the scarcity of labour in harvesting monsoon. Besides, 36.67% of lentil farmers and 18.33% of mung bean farmers mentioned about the problem on higher wage rate of labour during harvesting season. Farmers also mentioned about some storage related problems. About 26.67% of lentil farmers and 30.00% of mung bean farmers stated their problems regarding storage facilities of pulse crops. Besides, 21.67% lentil and 18.33% of mung bean farmers expressed their opinion about the insect infestation in storage time. Farmers also mentioned about some uncontrollable climate related problems like untimely rainfall and prolonged foggy weather in winter season. Production of lentil and mung bean were severely affected due to the event of these climatic hazards. The problems in lentil and mung bean cultivation were also studied by different researchers in different times. Most of the problems explored in this research were also identified by Islam et al. (2008), Islam et al. (2011), Rahman et al. (2012), Matin et al. (2018), Tithi and Barmon (2018), Hajong et al. (2020), Islam et al. (2020a), Islam et al. (2020b), Sarkar et al. (2020) and Miah et al. (2021).

7.2. Suggestions to Overcome the Problems on Lentil and Mung bean Cultivation

The constraints faced by lentil and mung bean farmers during their cultivation practices were discussed in previous section. The farmers also offered some suggestions to overcome those problems as well as to improve the productivity and efficiency of this farming activities. The suggestions, generated from the lentil and mung bean farmers opinion, are being discussed in this section. Among the proposed suggestions, dissemination of knowledge on insecticide, pesticide and fertilizer application, availability of improved/HYV seed, introduction of mechanization technology and controlling measures to reduce price of TSP were mostly mentionable (Table 7.2).

Table 7.2. Suggestions to Overcome the Problems Faced in Lentil and Mung bean Cultivation

Particulars	Percentage of the farmers opined	
	Lentil	Mung bean
Dissemination of knowledge on insecticide, pesticide and fertilizer application	41.67	36.67
Availability of improved/HYV seed	33.33	36.67
Introduction of mechanization technology	23.33	21.67
Controlling measures to ensure fair price of TSP	31.67	16.67

Source: Field survey, 2021

To overcome the constraints of lentil and mung bean cultivation, 41.67% of lentil and 36.67% of mung bean farmers expressed their opinion for disseminating the knowledge on insecticide, pesticide and fertilizer application through different knowledge sharing programmes. Easy access to improved/HYV seeds was also suggested by more than one-third of the respondents. Besides, 23.33% of the lentil and 21.67% of the mung bean farmers expressed their opinion for introducing handy mechanization technologies for these pulse crops production. Moreover, some of the respondents (31.675 of lentil and 16.67% of mung bean farmers) were also suggested to take necessary measures to ensure fair price of TSP in the study area.

CHAPTER VIII

SUMMARY, CONCLUSION AND RECOMMENDATIONS

This chapter presents the major findings, conclusions and recommendations of the study. The summary of the study shows the findings in brief. By conclusion, the main points of the report can be identified quickly. Recommendation draws the attention of the respective authority to implement some strategies for encouraging the farmers to cultivate lentil and mung bean domestically.

8.1. Summary

Lentil and mung bean are mainly cultivated in Faridpur, Rajshahi, Madaripur, Jashore, Kushtia, Jhenidah, Magura and the other districts. Madaripur and Faridpur district were selected as the study area of this research to delineate the socio-demographic profile of the lentil and mung bean cultivators, to estimate the comparative profitability of lentil and mung bean cultivation, to assess the import substitution status of lentil and mung bean; and to drive the policy implications from the study.

Besides extensive study on all the secondary sources, 120 farmers (60 lentil and 60 mung bean) were randomly selected for conducting field level survey to collect primary data. A structured interview schedule was developed based on the background information, expert's appraisal and pre-test questionnaire. Various important data on international price were taken form faostat (www.faostat.org).

Data obtained by administering interviews with the respondents were coded appropriately and entered into a database system using Microsoft Excel. Finally, obtained dataset were analyzed using MS Excel software. Descriptive statistics (percentage, mean, range, standard deviation etc.) were used to describe the socio-economic variables and policy analysis matrix was used to estimate the import parity status of producing lentil and mung bean domestically.

The socio-demographic profile of the lentil and mung bean farmers reveals that the highest 46.67% of lentil farmers were old aged (>50 years) and 48.33% of mung bean farmers were young aged (36-50 years). Among the respondents, 63.33% had at least primary education. Although the respondents had much higher agricultural farming

experience, majority of them (50% of lentil and 76.67% of mung bean farmers) had medium duration (13 to 34 years) lentil and/or mung bean farming experience. Although, medium sized family (having 4-7 members) were more prevalent (70%) in the study areas, the average family size of that area (5.33) was higher than the national average of 4.06. Small farm holders constituted the highest proportion (47.50%) of the respondents. However, the average household farm size of the study area (1.17 hectare) was higher than that of national average (0.60 hectare) of Bangladesh. Average size of the lentil and mung bean farms were 0.15 ha and 0.29 ha, respectively. Although, average household income of the respondents (Tk. 26,969/month) were well above the national average of Tk. 15,988/month, a disappointing 48.33% of the respondents fall below the poverty line.

The inputs used for lentil and/or mung bean production were grouped into six broad categories. However, among the inputs used for lentil production, resource allocation for human labour comprises the highest (52.04%) position followed by land preparation (20.76%), seed (13.94%), fertilizers (10.75%), machinery inputs (2.03%) and insecticides & pesticides (0.47%), etc. On the other hand, for mung bean production, resource required for human labour input also holds the highest position with 64.22% of allocation and followed by land preparation (12.04%), fertilizers (6.93%), machinery inputs (4.81%), insecticides & pesticides (5.70%) and seed (4.81%), etc. The total cost of lentil and mung bean production were estimated to be Tk. 62616 and Tk. 38995 per hectare, respectively. The variable cost of lentil and mung bean production were Tk. 51111 and Tk. 33846 per hectare, respectively.

The average yield of lentil and mung bean production were about 1.22 t/ha and 0.81 t/ha, respectively which were slightly lower than the national average of 1.27 t/ha and 0.93 t/ha. Financial profitability analysis shows that the gross return of lentil and mung bean production were Tk. 104113 and Tk. 63621, respectively. The per hectare gross margin of lentil and mung bean cultivation were Tk. 53002 and Tk. 29775, respectively. Again, the net return of lentil and mung bean production were Tk. 41497 and Tk. 24626 per hectare, respectively. Considering total cost of production, the undiscounted benefit cost ratio (BCR) of lentil (1.66) was slightly higher than that of mung bean production (1.63).

The economic profitability of lentil and mung bean production were Tk. 17001/MT and Tk. 13396/MT, respectively. However, the BCR of lentil and mung bean production were found at 1.32 and 1.29, respectively. Domestic resource cost (DRC) analysis reveals that both the lentil (DRC = 0.66) and mung bean (DRC = 0.72) had a comparative advantage in domestic production for import substitution.

Policy Analysis Matrix constructed for lentil and mung bean production under import parity price evident that revenue transfer was positive, input transfer was negative and domestic factor transfers was positive. Moreover, the net profit/net policy transfer for both lentil and mung bean production were positive which means that under the existing policy circumstances, the producers earned more profit and enjoyed ample scope for maximizing their net policy transfer.

The estimated value of Nominal Protection Coefficient on Output (NPCO), Nominal Protection Coefficient on Input (NPCI), Effective Protection Coefficient (EPC), Private Cost Ratio (PCR) for lentil were 1.10, 0.62, 1.16, 0.63 and for mung bean were 1.17, 0.80, 1.19, 0.62, respectively. Findings of these ratio indicators under import parity condition show that existing government policy environment tends to protect the interest of the lentil and mung bean producers at production level.

Although lentil and mung bean cultivation were financially and economically profitable and have comparative advantage in domestic production, farmers still encountered some problems. About 32% lentil farmer and 38% mung bean farmers faced unavailability problem of improved/HYV seed. They also complained that they had fetched lower yield due to this seed related constraints. The problem of high seed cost was also mentioned by some lentil (36.67%) and mung bean (28.33%) farmers. An alarming majority of the farmers mentioned that they had to buy fertilizer specially TSP higher than the nationally declared price. Farmers also mentioned about the problem of disease and insect infestation in their field. A significant portion of the farmers mentioned about the scarcity of labour and higher wage rate in harvesting monsoon. About 26.67% of lentil farmers and 30% of mung bean farmers stated their problems regarding storage facilities of pulse crops. Farmers also mentioned about some uncontrollable climate related problems like untimely rainfall and prolonged foggy weather in winter season.

The farmers also offered some suggestions to overcome the problems as well as to improve the productivity and efficiency of this farming activities. Among the proposed suggestions, dissemination of knowledge on insecticide, pesticide and fertilizer application, availability of improved/HYV seed, introduction of mechanization technology and controlling measures to reduce price of TSP were mostly mentionable.

8.2. Conclusion

For the importance to ensure food and nutrition security in Bangladesh, domestic production of lentil and mung bean are being more emphasized in recent times. This study was conducted to estimate the economic profitability of lentil and mung bean cultivation and to assess its comparative advantage in domestic production. Findings of the study reveals that lentil and mung bean production were profitable from both financial and economic point of view. Domestic resource cost (DRC) analysis reveals that both the lentil and mung bean had a comparative advantage in domestic production for import substitution. Policy analysis matrix constructed for lentil and mung bean production under import parity price suggests that government policies were favourable to the domestic producers. Findings of the ratio indicators under import parity condition (NPCO, NPCI, EPC and PCR) also show that existing government policy environment tends to protect the interest of the lentil and mung bean producers at production level. Among the ample opportunities, lentil and mung bean farmers still encountered some problems. To overcome the problems, farmers urged for disseminating knowledge on insecticide, pesticide and fertilizer application and ensuring availability of improved/HYV seed at affordable prices. Based on the findings of this study it can be concluded that there are numerous policy support to enhance the production of pulse crops in Bangladesh. However, still further research is warranted for successful adoption of the pulse crops specially lentil and mung bean in between the predominant rice and rice based cropping patterns in Bangladesh.

8.3. Recommendations

On the basis of experience, observation and conclusions drawn from the findings of the study some recommendations have been prescribed to the concerned authorities, planners and executioners. These recommendations are as follows:

a. **Input and output support should be strengthened**

   Findings of the study reveals that there are numerous policy support to enhance the production of pulse crops in Bangladesh. Government and other stakeholders should continue and even, strengthen the ongoing interventions to provide positive incentives i.e. input subsidies to the producers. Besides, output price support should be strengthened.

b. **Technology oriented training should be provided**

   Knowledge dissemination and inspiring programs should be taken to motivate farmers to cultivate lentil and mung bean with rice and rice based cropping patterns. With all these policy supports, farmers should be encouraged to produce more to meet up the domestic demand for pulses.

c. **Input price should be regulated and monitored**

   Farmers had to purchase some inputs of lentil and mung bean production on a higher price. To mitigate these problems input price should be regulated and monitored on a consistent basis.

d. **Research and development should be enhanced**

   Farmers mentioned the problems regarding unavailability of improved/HYV seed, scarcity of human labour in harvesting monsoon and their associated costs. Research and development should be strengthened for introducing some mechanization and enhancing availability of improved seed. Besides, research is also needed for successful adoption of pulse crops in between the rice based cropping patterns.

8.4. Limitations of the Study

Considering the time, respondents, communication facilities and other necessary resources available to the researcher and to make the study meaningful, it became necessary to impose certain limitations as mentioned bellow:

a. The study was confined to Shibchar upazila of Madaripur district and Sadarpur upazila of Faridpur district only.
b. Primary data required for the study were collected through interviewing the lentil and mung bean farmers. In some questions they felt uncomfortable to respond. That might bring some unexpected errors.
c. The information gathered were mostly based on the memories of the farmers which may not always fully correct. There might have some chance of errors.
d. Due to resource and time constraints, a broad-based study was hampered to some extent.
e. Further research should be carried out for successful adoption of the pulse crops specially lentil and mung bean in between the predominant rice and rice based cropping patterns in Bangladesh.

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