AN ECONOMIC STUDY ON IMPROVED PULSES IN SOME SELECTED AREAS OF NORTHERN REGION OF BANGLADESH

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CERTIFICATE

This is to certify that thesis entitled, "**AN ECONOMIC STUDY ON IMPROVED PULSES IN SOME SELECTED AREAS OF NORTHERN REGION OF BANGLADESH**" submitted to the faculty of Agribusiness Management, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE IN AGRICULTURAL ECONOMICS**, embodies the result of a piece of *bona fide* research work carried out by **MD. RAKIBUR RAHMAN** bearing Registration No. **07-02296** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

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

04 December, 2014
Dhaka, Bangladesh

...
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Md. Rakibur Rahman

CONTENTS

CONTENTS (Continued)

CONTENTS (Continued)

LIST OF TABLES

LIST OF TABLES (Continued)

LIST OF FIGURES

ABBREVIATIONS AND ACRONYMS

BARI	: Bangladesh Agricultural Research Institute
BBS	: Bangladesh Bureau of Statistic
BCR	: Benefit Cost Ratio
BDT	: Bangladeshi Taka
BER	: Bangladesh Economic Review
CGPRT	: Coarse Grains, Pulses, Roots and Tubers
CIF	: Cost, Insurance and Freight
DAE	: Department of Agricultural Extension
DRC	: Domestic Resource Cost
EPC	: Effective Protection Coefficient
ESC	: Effective Subsidy Coefficient
et al.	: and others (at elli)
GR	: Gross Return
ha	: Hectare
HIES	: Household Income and Expenditure Survey
HYV	: High Yielding Variety
IOC	: Interest on Operating Capital
kg	: Kilogram
MFC	: Marginal Factor Cost
MoP	: Muriate of Potash
MPP	: Marginal Physical Product
mt	: Metric Ton
MVP	: Marginal Value Product
NGO	: Non Government Organization
NPC	: Nominal Protection Coefficient
RUE	: Resource Use Efficiency
SFYP	: Sixth Five Year Plan
t	: Ton
TC	: Total Cost
TFC	: Total Fixed Cost
Tk.	: Taka
TSP	: Triple Super Phosphate
TVC	: Total Variable Cost
US	: United States
$	: Dollar

AN ECONOMIC STUDY ON IMPROVED PULSES IN SOME SELECTED AREAS OF NORTHERN REGION OF BANGLADESH

ABSTRACT

Pulses are excellent sources of protein, but they are treated as minor crop and receive little attention from farmers and policymakers. Recent statistics shows that Lentil (*Lens culinaris*), chickpea (*Cicer arietinum*), mungbean (*Vigna radiata*) and blackgram (*Vigna mungo*) cover about 59.26 percent of the total cropped area under pulses and provide about 58.31 percent of total pulse production (BBS, 2011). The overall objective of the present study was to examine socio-demographic profile of lentil, chickpea, mungbean and blackgram farmers who are using improved varieties, to assess profitability and resource use efficiency of improved varieties of lentil, chickpea, mungbean and blackgram, and to assess cooperative advantage of lentil. Pabna and Rajshahi district was selected for the study on the basis of intensive cultivation of those crops. Simple random sampling technique had been used for collecting cross sectional data and information from 50 farmers for each crop. Thus, data were collected from a total of 200 farmers through interview schedule. After analyzing the data, per hectare gross return of lentil, mungbean, chickpea and blackgram were found to be Tk. 90200.00, Tk. 84412.00, Tk. 68510.00 and Tk. 64957.00, respectively. Total costs of lentil, mungbean, chickpea and blackgram were calculated at Tk. 57855.91, Tk. 52995.25, Tk. 49754.73 and Tk. 44455.14 per hectare, respectively. Net returns of lentil, mungbean, chickpea and blackgram were estimated at Tk. 32344.09, Tk. 31416.75, Tk. 18755.27 and Tk. 20501.86 per hectare, respectively. Benefit Cost Ratios (BCRs) were found to be 1.56, 1.59, 1.38 and 1.46 for lentil, mungbean, chickpea and blackgram, respectively. Thus, it was found that the cultivation of lentil, mungbean, chickpea and blackgram were profitable.Production function analysis suggested that, among the variables included in the model, land preparation cost, human labour cost, seed, urea and TSP had a positive and significant effect on the yield of lentil, mungbean, chickpea and blackgram, except for, urea had a negative but significant effect on the yield of blackgram. Efficiency analysis indicated that most of the farmers inefficiently used their inputs. Some of them made excessive and some of them made less use of inputs.The DRC value for lentil was found to be less than one (0.68) indicating that Bangladesh had comparative advantage in producing lentil for import substitution.

CHAPTER 1
INTRODUCTION

1.1 Background of the Study

Bangladesh is predominantly an agro-based country. Agriculture is the mainstream of Bangladesh economy and it contributes about 16.33 percent of the Gross Domestic Product (GDP) (BER, 2014). Pulses occupy about 4 percent of the total cropped area and contribute about 2 percent to the total grain production of Bangladesh (BBS, 2010). Recent statistics shows that Lentil (*Lens culinaris*), chickpea (*Cicerarietinum*), mungbean (*Vignaradiata*) and blackgram (*Vignamungo*) cover about 59.26 percent of the total cropped area under pulses and provide about 58.31 percent of total pulse production (BBS, 2011a). Pulses are excellent sources of protein, but they are treated as minor crops and receive little attention from farmers and policymakers. With the expansion of irrigation facilities, the area of production of cereal crops has increased significantly, while pulses have been pushed to marginal lands of low productivity. The growth rate for production of pulses in 1971/72 to 2008/09 was 1.01%. In 1971/72 to 1979/80 and 2000/01 to 2008/09 both area and production growth rate for pulses was negative (Begum, M. E. A. and D'Haese, Luc, 2010). Due to decreased in area under pulses production, the pulses import increased from 2.54 thousand metric tons in 1981-83 to 522.92 thousand metric tons in 2006-08. In 2009, 2010 and 2011, Bangladesh has imported 826.03 thousand metric tons, 785.07 thousand metric tons and 386.39 thousand metric tons of pulses respectively. In 2011, Bangladesh has imported 74.70 thousand metric tons of lentils and 99.08 thousand metric tons of chickpeas (FAOSTAT, 2013).

From the figure 1.1, it was revealed that the area under lentil production in Bangladesh did not show any significant change during 2001-02 to 2006-07 then it started to fall up to 2008-09. The production of lentil in Bangladesh showed almost the same pattern. From 2009-10, both area and production of lentil in Bangladesh started to increase.Figure 1.2 showed that the area under mungbean production in Bangladesh was almost same but in 2004-05 it was drastically decreased. Afterward it was almost same up to 2008-09. The production of mungbean in Bangladesh showed almost the same pattern. From 2009-10, both area and production of mungbean in Bangladesh rapidly increased (Appendix Table A-1).

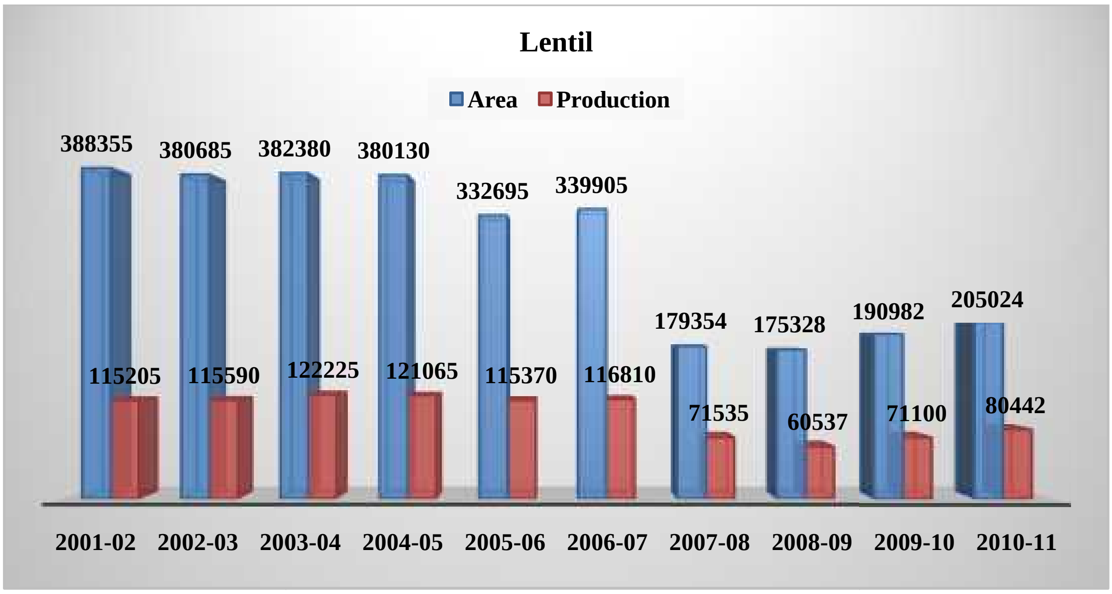


Figure 1.1: Area and Production of Lentil in Bangladesh, 2001-02 to 2010-11

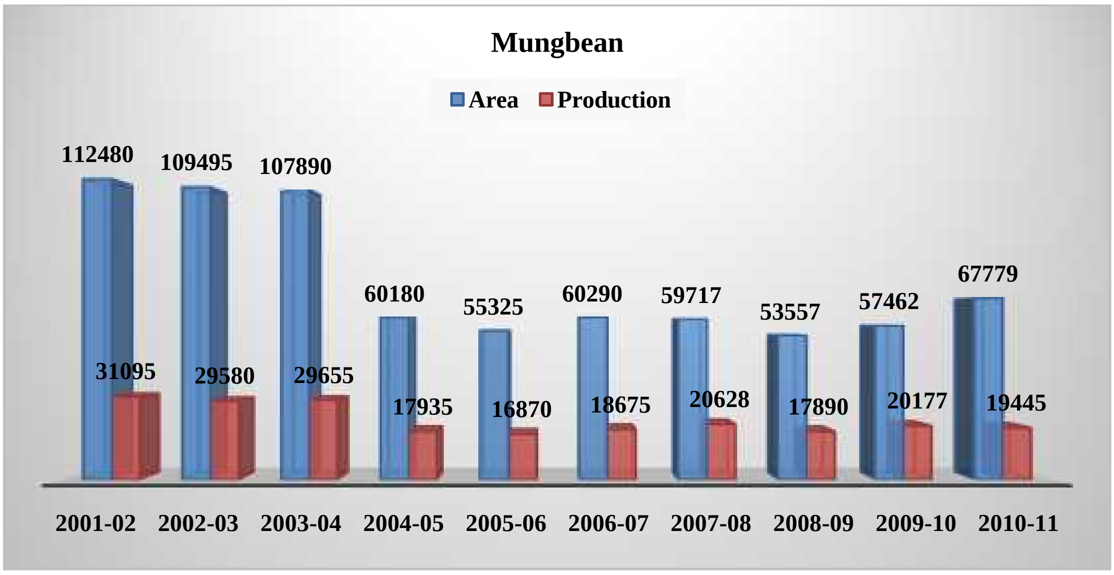


Figure 1.2: Area and Production of Mungbean in Bangladesh, 2001-02 to 2010-11

Figure 1.3 showed area and production of chickpea in Bangladesh from 2001-02 to 2010-11. The figure stated that both area and production of chickpea in Bangladesh gradually decreased from 2001-02 to 2009-10 then it started to increased.Figure 1.4 revealed area and production of blackgram in Bangladesh from 2001-02 to 2010-11. It was revealed from the figure that both area and production of blackgram in Bangladesh gradually decreased from 2001-02 to 2004-05 then started to increase from 2006-07 to onwards (See Table A-1).

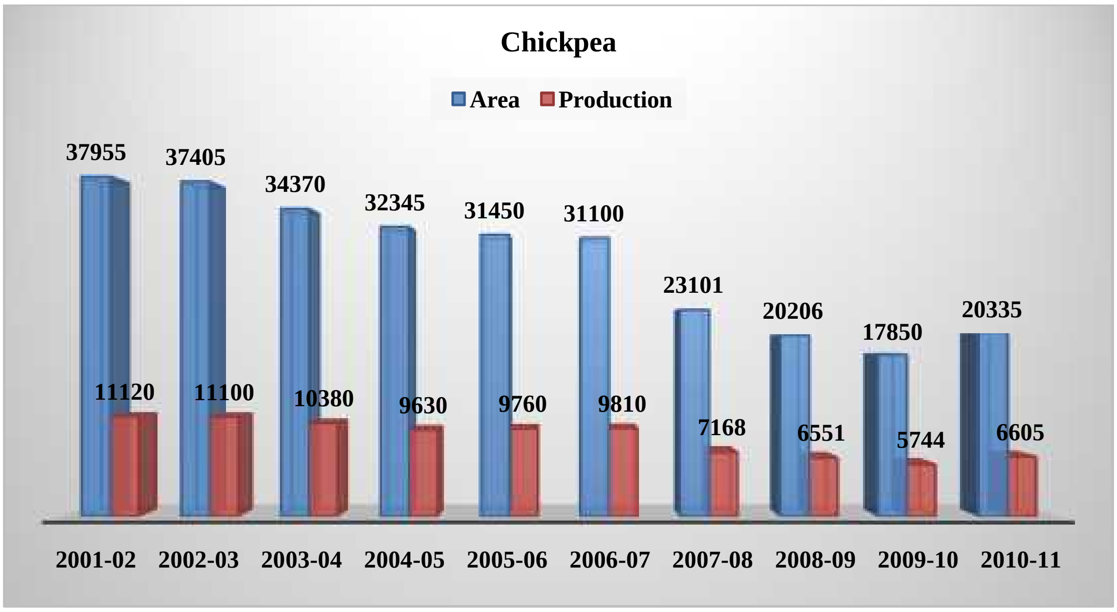


Figure 1.3: Area and Production of Chickpea in Bangladesh, 2001-02 to 2010-11

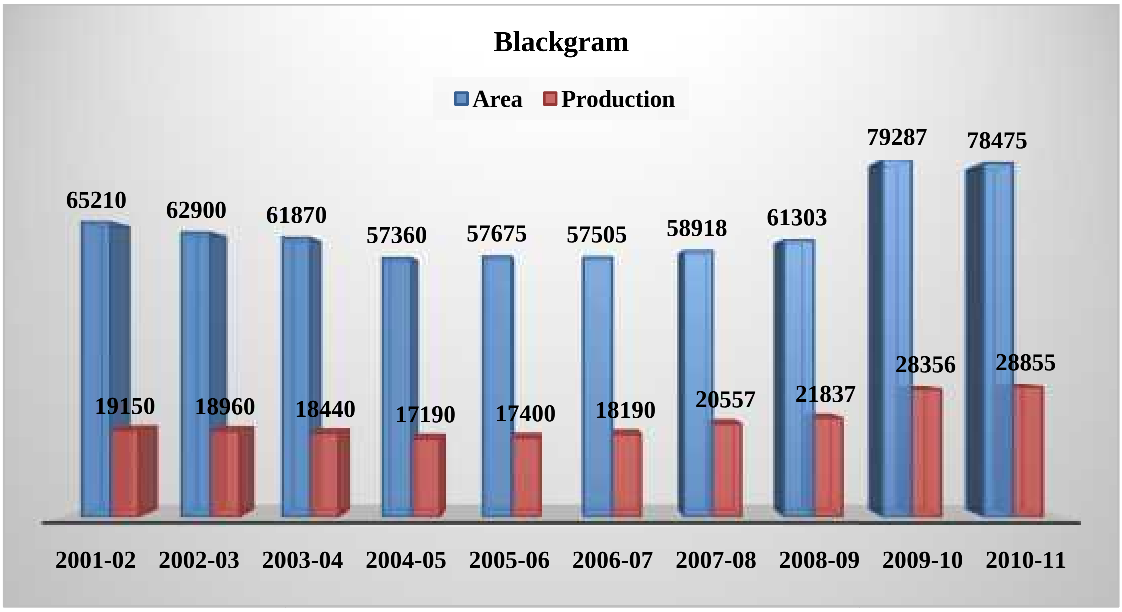


Figure 1.4: Area and Production of Blackgram in Bangladesh, 2001-02 to 2010-11

Table 1.1 shows area and production of lentil and mungbean in Pabna district. It is revealed from the table that the area under lentil production in Pabna district increased gradually from 2001-02 to 2004-05 but afterward it decreased and again started to increase from 2009-10. The production of lentil in Pabna district followed the same pattern. Formungbean, the area under production in Pabna district first decreased then rapidly increased in 2004-06 but afterward it drastically decreased. The production of mungbean did not show any significant changes from 2001-02 to 2010-11 periods.

Table 1.1: Area and Production of Lentil and Mungbean in Pabna

Year	Lentil		Mungbean	
	Area	Production	Area	Production
2001-02	33285	9355	215	50
2002-03	34170	9910	125	35
2003-04	53720	15255	165	45
2004-05	53365	15315	1235	60
2005-06	43020	12560	980	65
2006-07	42555	13105	180	50
2007-08	15347	5145	183	57
2008-09	10200	3387	172	55
2009-10	17589	7165	134	46
2010-11	19490	7935	124	44

Source: BBS, 2006 and 2011a
Note: Area in acres and production in metric tonnes

Table 1.2 shows area and production of chickpea and blackgram in Rajshahi district. It is revealed from the table that the area under chickpea production inRajshahi district drastically decreased in 2004-05 but sharply increased from 2009-10. The production of chickpea in Rajshahi district followed the same pattern. In case of blackgram, the area under production in Rajshahi district did not show any significant change until 2009-10 when area under production rapidly increased from 13858ha to 26150ha. The production of blackgram in Rajshahi district followed the same pattern. The production of blackgram in Rajshahi district in 2009-10 was almost doubled than the previous year.

Table 1.2: Area and Production of Chickpea and Blackgram in Rajshahi

Year	Chickpea		Blackgram	
	Area	Production	Area	Production
2001-02	7060	1955	16615	4950
2002-03	6435	1800	14800	4425
2003-04	7815	1360	13650	3780
2004-05	3580	950	12490	3510
2005-06	3575	1035	12720	3780
2006-07	3615	1075	12910	4700
2007-08	3342	989	13200	5470
2008-09	3323	1078	13858	5336
2009-10	5388	1957	26150	9491
2010-11	5323	1728	24150	10667

Source: BBS, 2006 and 2011a
Note: Area in acres and production in metric tonnes

1.2 Importance of Pulse Crop in Bangladesh Agriculture

Pulses are important legume crops in Bangladesh because of their importance in food, feed, and cropping systems. It contains about twice as much protein as cereals. It also contains amino acid lysine which is generally deficient in food grains (Elias *et al*., 1986). Pulses are generally grown without fertilizer since they can meet their nitrogen requirement by symbiotic fixation of atmospheric nitrogen in the soil (Senanayake*et al*., 1987; Zapata *etal*., 1987; Fried and Middleboe, 1977). The per capita consumption of pulse in Bangladesh is only 12g/day, which is much lower than WHO recommendation of 45g/day (Afzal *et al*., 1999). The major pulses grown are khesari*(Lathyrussativus*), lentil *(Lens culinaris*), chickpea *(Cicerarietinum*), blackgram*(Vignamungo*), mungbean*(Vigna radiate*), and cowpea *(Vignaunguiculata*) and they contribute to more than 95% of total pulses production in the country. Bangladesh government is committed to provide standard nutritional food to 85% of the population by 2021 (SFYP, 2011). In the development vision of Sixth Five Year Plan (SFYP), there has been record "by the year 2021 malnourishment would be reduced to 85%. Bangladesh has to become food exporting country by reducing the import dependency". Visions like this are available in many parts of the report but no mention of the specific strategy for realizing such expectations. Among the objectives, no specific priority based issues have been raised related to pulses which demand very high level attention in the policy for not only providing better and nutrient-rich food to the population but also to reduce import dependency and improving soil health and fertility.

1.3 Objectives of the Study

The objectives of this studywere:

1. To examine socio-demographic profile of lentil, chickpea, mungbean and blackgram farmers who are using improved varieties in the selected areas of northern region of Bangladesh.
2. To estimate profitability of improved varieties of lentil, chickpea, mungbean and blackgram in the selected areas of northern region of Bangladesh.
3. To assess resource use efficiency of lentil, chickpea, mungbean and blackgram farmers who are using improved varieties in the selected areas of northern region of Bangladesh.
4. To assess comparative advantage of lentil.

1.4 Justification of the Study

The study generated information on productivity and profitability. The present study also provided pertinent information useful for making sound management decisions in resource allocations and for formulating agricultural policies and institutional improvements. Information so collected might be also useful to improve the production of nutritionally balanced food and thus minimize the existing nutritional deficiency. This study might also be used as a basis for further study and as a guideline for the future researchers and policymakers in Bangladesh. With the information, NGOs, donor agencies and other local organizations involved in improving the socio-economic development of rural people might take development program to create self-employment opportunity for the target groups through production and distribution of improved seeds of these crops. Future policies to be taken by policy makers, research managers, NGOs and extension agents for the development of pulses obviously benefit the farmers in terms of higher production, higher income, and creation of self-employment opportunity. Finally, the country might be benefited by saving foreign currency through less import of pulses which will improve the economic wellbeing of the country. Furthermore, a few field level studies had been conducted in Bangladesh to determine profitability, resource use efficiency and comparative advantage of pulse production. Moreover, this type of study had not been conducted much in the selected study areas. So, further investigations were necessary to help the policy makers in coming to right conclusion and formulating appropriate policies.

1.5 Organization of the Study

With the above introduction, the remaining part of the thesis is organized as follows. Chapter 2 presents review of literature on profitability, resource use efficiency, comparative advantage analysis and constraints of pulse production. Subsequently, methodology of the study is presented in chapter 3, socio-demographic profile of household population of pulse growers presented in chapter 4, financial profitability of pulse production presented in chapter 5, factors affecting the yield of pulses presented in chapter 6, comparative advantage of lentil presented in chapter 7. The chapter 8 represents summary, conclusion and recommendations.

CHAPTER 2
REVIEW OF LITERATURE

The main purpose of this chapter is to review some related studies in connection with the present study. Only a few studies have so far conducted related to economic study on improved pulses in Bangladesh. Again, some of these studies may not entirely relevant to the present study, but their findings, methodology of analysis and suggestions have a great influence on the present study. Review of some research works relevant to the present studies, which have been conducted in the recent past, are discussed below.

Afzal*et al*. (2004) conducted a study on technology dissemination to boost pulse production and human nutrition in Bangladesh. The study revealed that pulses occupied about 4% of cropped area in Bangladesh but played a significant role in rain-fed agriculture. Among the pulses lathyrus, lentil, chickpea, black gram and mungbean were the important ones. Their cultivation was mainly concentrated in the Gangetic calcareous floodplain with soil pH 6.5-7.5. In recent years, there was substantial progress in pulses research and development in Bangladesh. Although systematic research on pulses began in the mid-sixties a total of 39 improved varieties of pulse crops have been released. Yield potential of theses varieties was found much higher than the local ones. A substantial endeavor was made from 1997-2003 to expand the cultivation of modern varieties to replace old and degenerated varieties and the attendant production technologies, through a special pilot project. In five years the project resulted in increased annual production of 28,000 m tonnes of lentil and 37,000 tonnes of mungbean. This represented a replacement of about 60% of the lentil production area, and 75% of mungbean varieties. A substantial increase in black gram production was also achieved by replacing 41% local varieties. It was estimated that a cumulative increase of 80,000m tonnes of these three pulses were achieved by intensive efforts of technology dissemination.

Alam (2004) conducted a study on enhancing sustainable development of diverseagriculture in Bangladesh. The study showed that Bangladesh had comparative advantage in producing CGPRT (Coarse grains, pulses, roots and tubers) crops, as DRC (Domestic Resource cost) valueswere found less than 1 for the last three decades. The value was positive for potato even at exportparity level during the most recent years. Results implied that Bangladesh had thepotential for export promotion and import substitution through diversification of the crop sectorby promoting CGPRT crop production.It appears that DRC values were more than 1 for coarse rice over all timeperiods indicating comparative disadvantage for this major food grain consumed by the majorityof the people in Bangladesh. However, DRC values were less than 1 for fine rice and wheatindicating comparative advantage for them. It implied that further expansion of cultivation ofcoarse rice at the cost of secondary (CGPRT) crops would be unrealistic from an economicpoint of view.

Badal*et al.* (2008) conducted a study on technical efficiency in production ofmungbean (*Vignaradiata*). The results of the study showed that the mean technical efficiency in mungbean production was 56 percent. This indicated that even with the existing level of production technology yield could be increased substantiallyby removing inefficiencies. Policy implication stemming from this is that it might be more cost-effective to achieve short-runincreases in farm output, and thus income, by concentrating on improving efficiency rather than sole dependence on introducingnew technology. The technical efficiency could be increased with the help of a number of policy instruments such as improvingmarketing facilities, creating irrigation infrastructure, better education and providing better access to credit facilities. Reduction in the unit cost of production through improvement intechnical efficiencies would lead to greater income and will be highly effective in encouraging pulses production in the country.

Haque (2011) conducted a study on quality improvement of stored seeds of mungbeans, lentil and chickpeas in farmers' storages. The study revealed that mungbeans, lentil and chickpeas were the most important group of pulse and largely consumed bythe people of this county. According to the study, the pulses were still the cheapest source of plant protein compared tothe high cost of animal protein. The pulse crops occupied the second largest cropped area (4%) afterrice. These 3 pulses contributed to about 90% production of the total legumes in the country.The productivity of these pulse corps were low compared to wheat and rice. They are traditionallycultivated under rain fed with low input. These pulses were inherently low in yield, high indisease-infection and sensitive to changes in micro-climate. They werere mostly marginalized cropswith resultant decrease in areas (6 lac ha), production (5.57 lac tons) and yield (0.93 t/ha). Theprimary reasons to such low yield were mainly (a) cultivation in marginal land with low inputunder rain-fed condition, and (b) use of low quality seeds originating from bad storage andinsect-damages.

Haque*et al.* (2014) conducted a study on adoption of mungbean technologies and technicalefficiency of mungbean (*Vignaradiata*) farmers inselected areas of Bangladesh. Thestudy assessed thefarm level adoption of mungbean technologies, technical efficiency ofmungbean growers, and find out constraints to its higher production. The highly adopted mungbeanvarieties were BARI Mung-3, 4 and 5. Technologies, such as ploughing,weeding, and seed rate occupied higher level of adoption. Sowing time andinsect-pest control were medium level and irrigation was lower level adoption.In case of chemical fertilizer, urea secured higher level of adoption followed byTSP and MoP. The yield and net return of mungbean was 1196 kg and Tk.15678 per hectare, respectively. The benefit cost ratio was 1.69 and 2.47 on fullcost and cash cost basis, respectively. About 67% farmers achieved more than90% technical efficiency level. Twenty eight percent farmers' technicalefficiency level was between 81-90% and the rest 5% farmers' technical efficiencylevel was less than 80%. Diseases and pest infestation, lack of good quality seed,lack of knowledge about improved technologies were the major constraints tomungbean cultivation. Government should provide hand-on training anddistribute quality seed to the farmers for increasing the area of mungbeancultivation.

Islam*et al.* (2007) have conducted a study on productivity and profitability of mungbean cultivation in selected areas of Bangladesh. The study was conducted at Barisal and Jhalokati districts during 2007 to estimate the profitability and resource use efficiency of mungbean production. It revealed that mungbean production is profitable to the farmer. The mungbean farmers obtained 928 kg yield per hectare. The gross margin was found to be Tk. 24236 per hectare. Benefit cost ratio was estimated at 2.53 on full cost and 3.56 on cash cost basis. The net benefit received per kilogram of mungbean was Tk. 26.45. Functional analysis showed that human labour, urea and insecticides had positive significant contribution to mungbean production. Mungbean farmers encountered various problems like untimely rainfall, lacking of quality seed and disease and insect infestation, etc.

Islam*et al.* (2009) conducted a study on technical efficiency of mungbean growers in selected coastal areas of Bangladesh. The study revealed that mungbean production was profitable and the average benefit cost ratio (BCR) was found to be 2.22. The estimated results showed that the average level of technical efficiency among the sample farmers was 89. This implies that given the existing technology and level of inputs, the output could be increased by 11 percent. In inefficiency model, the coefficient of farmers' education and experience in mungbean cultivation had positive significant effect on mungbean production. Eighty two percent farmers produced outputs to the maximum frontier output level (82-99%). Farmers in the study area also mentioned some problems like high price of fertilizer, insecticides, severe attack of insects etc. to its production.

Islam *et al.* (2013) conducted a study on adoption of BARI Mung varieties and its constraints tohigher production in southern region of Bangladesh. Thestudy focused the level of technology adoption in terms of variety use, input useand agronomic practices. The study revealed that all the farmers adoptedimproved mungben varieties of which 51% farmers adopted BARI Mung-5variety. The level of adoption of seed rate, use of urea, and MoP was found to behigh. The level of adoption of agronomic practices like ploughing, sowing time,weeding and insecticides use were also found to be high. The farmers weremostly influenced by DAE personnel and neighboring farmers in adoptingimproved mungbean technology. Most farmers showed positive attitude towardsimproved mungbean cultivation of which 67% farmers wanted to increase itscultivation in the next year. The major constraints to improved mungbeanproduction were high price of insecticides, lack of labour and disease and insectinfestation. Farmers required improved mungbean seeds and productiontechnology which may increase the yield and income of the farmers.

Karim*et al.* (2014) have conducted a study on profitability and technical efficiency of BARI improved mungbean cultivation in selected areas of Bangladesh. The study was conducted in Jessore, Jhenaidah and Chuadangadisrtricts during 2001-2002 to see the efficiency of mungbean production under farmers' practices. It was found that improved varieties of mungbean grown in kharif-I was highly profitable the sesame. The technical efficiency of mungbean at the existing level of resource use was found 90%. This indicated 10% high potential for increasing mungbean yield at present level of resource use. The issues related to the performance of this variety exhibit that economic returns from mungbean were found higher than sesame, it prevents environmental degradation through increasing soil health and it provides food and nutrition security to farm families and increase employment opportunities to rural people to some extent.

Kazal*et al.* (2013) conducted a study on financial and economic profitability ofselected agricultural crops in Bangladesh. The study revealed that lentil production was found to be financially profitable based on positive net return and BCR in the north-western region of Bangladesh. Though the net return and BCR were highest for medium/large farms in case of lentil production, the net returns from its production were found to be the lowest compared to other crops for all types of farms. This perhaps explain consistent decline in acreage under pulses over the years in Bangladesh.

Kumar andBourai(2012) conducted a study on economic analysis of pulses production their benefits andconstraints in sample villages of Assan valley of Uttarakhand, India. The researcher had made an effort to find out the out the economics, benefit, and constraints of pulsesin the state of Uttarakhand. This study revealed that the rotation of chickpea and pigeon pea reduces the useof chemical fertilizers and also enhances the output of paddy and wheat significantly.Pulses like chickpea, lentil, blackgram and pigeonpea were found less labor-intensive crops; and cheapcomparatively to other competitive winter crops like wheat, etc. On an average, human andbullock (or machine) labor constituted 84%, 80%, 81% and 78% share of the total operational expenses for chickpea, lentil, blackgram and pigeonpea production, respectively. Average share of seed in the totaloperational expenses were 11% in chickpea, 7.35% in lentil, 19% in blackgram and 11.65% in pigeonpeaproduction. The rest of the factor share was spent on compost fertilizers and technology inputs and to controlinsects and diseases.

Magar*et al*. (2014)conducted a study on varietal adoption and marketing of lentilin the mid and far western region of Nepal. The study revealed that higher adoption (43%) of local variety of lentil followedby Khajura-2 (31%) and Khajura-1 (16%) with a very low level of adoption of otherimproved varieties in the study area. Own saved seed was the major source of seednot only for growing local lentil variety but also for improved lentil varieties. Lowlevel of awareness among farmers on improved varieties, limited seed availability ofimproved lentil varieties, common practice of using own saved seed by farmers werethe major factors behind lower adoption of improved varieties of lentil. Lentil wasgrown either as a sole crop, mixed crop or a relay crop in the study area. Averagelentil production was 772 kg per hectare when grown as sole crop, 698 kg per hectarewhen grownas mixed crop and 488 kg per hectareas relay crop.

Miah*et al.* (2004) conducted a study on adoption of improved pulse technologies in selected areas of Bangladesh. The study was conducted in six types of pulse growing districts namely Jhenaidah, Kustia, Rajbari, Faridpur, Barisal and Nowabganj in 2004 in order to assess the farm level adoption of improved pulse technologies with farmers experience and attitudes toward pulse production. The overall adoption of pulse technologies was found to be very encouraging since 44% of the pulses farmers adopted improved pulses and 52% of the total pulse area was devoted to improved pulse production. The highly adopted varieties were BARI Mash-1, 2 & 3, BARI Masur-4 and BARI Mung-4 & 5. Indigenous mungbean had almost completely been replaced by improved varieties in most of the study area. The adopters ploughed their lands and sowed seed according to the recommendation, but did not follow the recommended sowing method and fertilizer doses. Farmers' attitude seemed to be very positive toward pulse production since 63% of the adopters wanted to increase their pulse area to increase pulse production in the coming year.Insect and diseases, heavy rainfall and lack of quality fertilizers and insecticides were the major constraints of pulse cultivation.

Miah*et al.* (2013) conducted a study on policy options for supportingagricultural diversification in Bangladesh.The study revealed that pulses are important legume crops that play an importantrole in sustaining the productivity of soils of Bangladesh through centuries. According to the study, production of pulses needed less input with minimum cost.Lentil production was found profitable to the farmers since it requires less input andminimum cost. During the period from 2000 to 2011, different economic studies revealed thatlentil cultivation was remunerative to the farmers since the net returns ranged between Tk.6712 and Tk. 27838 and the BCRs ranged from 1.51 to 2.26. Mungbean cultivation was gainingpopularity day by day due to lower cost and higher profit.The cultivation of mungbean was profitable to the farmer since the netreturn and BCR were Tk. 6719 and 1.36 respectively. The cultivation of blackgram found profitable to the farmer. The net returns receivedby the farmers ranged from Tk.8445 to Tk.23111 during the period from 2004 to 2007. TheBCRs found in 2004 and 2007 were much higher than that in 2005 because land use costs werenot included in calculating net return. Chickpea was found to be a profitable crop in Bangladesh. The study revealed that farmers received a good financial return from littleinvestment on chickpea cultivation. The benefit cost ratios were also impressive to the farmerswhich were ranged from 1.57 to 3.13.

Rahman*et al.* (2012) have conducted a study to determine the adoption status andprofitability of BARI lentil production and to examine the factors affecting theyield of BARI lentil during 2010-2011.The study revealed that 98% of the total lentil cultivated areas wereoccupied by BARI lentil varieties in the study areas. The average level ofadoption of BARI Masur-3, BARI Masur-4, BARI Masur-5 and BARI Masur-6were 49%, 47%, 1% and 1%, respectively at farm level. The cultivation ofBARI lentil was profitable to the farmers since the per hectare total cost, grossreturn and net return of BARI lentil cultivation were Tk. 52,734, Tk. 80,572 andTk. 27,838, respectively.Unavailability of latest BARI lentil seed, lack of technical know-how, lack oftraining, and diseases were the main constraints to BARI lentil cultivation at farm level. BARI Masur-3 and BARIMasur-4 were the highly adopted varieties. The lentil production was profitableto the farmers in the study areas.

RaoandKyle (1997) conducted a study on effective incentives and chickpea competitiveness in India. This study attempted to measure the impact of government intervention in product and factor markets on chickpea competitiveness in India. This was done by estimating the Nominal Protection Coefficient (NPC), EffectiveProtection Coefficient (EPC) and Effective Subsidy Coefficient (ESC) for chickpea and its main competing crops -wheat and mustard. Further, the Net Economic Benefit (NEB) in the production of these three crops was estimated to indicate where comparative advantage and production efficiency in production lie.The protection coefficients indicated that the government's output price, subsidy and trade policies had discriminated against chickpea producers. In Haryana wheat received greater protection than chickpea, though in both Madhya Pradesh and Rajasthan chickpea had greater protection than wheat. This result indicated a general policy bias against chickpea producers in the northern wheat growing belt of India. The Net Economic Benefit coefficients showed that all states had a comparative advantage in wheat and chickpea production, while only Uttar Pradesh, Madhya Pradesh and

Rajasthan hadcomparative advantage in mustard production also. However, across all states, wheat was the most efficient crop to produce. From a standpoint of economic efficiency, this result implied that India was better off allowing resources to flow into wheat production and importing its chickpea and mustard requirements.

Salami andAhmadi (2010) have conducted a study on energy inputs and outputs in a chickpeaproduction system in Kurdistan, Iran. The aims of this study were to determine the amount of input–output energy used in chickpea production, to investigate the efficiency of energy consumption, to make aneconomic analysis of chickpea production, and to establish a relation between energy inputs and yield. Diesel energy engrossed 37.9% of total energy,followed by chemical fertilizer 29.6% during production period. Energy efficiency was 1.04, and energy productivitywas 0.07 kg MJ^{-1}. The profit-cost ratio of the farms was 1.17. Calculated net return was US $ 42.2per hectare in theinvestigated farms.

Sarker*et al.* (2013) conducted a study on lentil improvement in Bangladesh. The study showed that technology demonstration anddissemination were the key to success in improving lentil production andproductivity in Bangladesh.Creating farmer awareness andinterest in new technologies was a critical step in technology adoption. The average benefit cost ratio on full cost basis was 1.80 forfarmers who used improved production technologies, and 1.35 for thosewho did not. On a cash cost basis, the ratio was 5.77 for blockfarmers and 3.89 for non-block farmers.With the cultivation of improved varietiesand adoption of appropriate production technologies, lentil productionin Bangladesh had raised 28,000 ton per year.

ShahabuddinandDorosh (2002) conducted a study on comparative advantage in Bangladesh cropproduction. The study showed that pulses appeared to be quite competitive as a non-irrigatedrabi crop in terms of both financial and economic profitability. The economicreturns (under both import and export parity prices) were greater than the correspondingfinancial returns indicating that they had a comparative advantage in production not onlyfor import substitution, but export as well. It should be recognized, however, that pulseshad traditionally been grown in dryland soils during seasonal intervals, which do notcompete with HYV boro rice, because profits though reasonably high for a non-irrigatedrabi crop, are much lower than high-yielding varieties of rice. That’s why althoughdomestic prices were generally lower than the import parity price; the country was on theverge of switching from self-sufficiency to an import regime with substantial importstaking place in deficit years and lean seasons.The estimated DRC ratios of different types of pulses were observed to be less thanone in all cases thereby demonstrating their efficiency in domestic production not onlyfor import substitution but export as well, although the relative efficiency is observed tobe less in case of the later as compared to the former. Among the three types of pulses,khesari was found to performe worse than the other two, masur and gram. Of the two types of spicesconsidered in this exercise, the production of dry chilies did not appear to be efficientunder either modern irrigation or traditional/non-irrigated conditions, with DRC ratiosexceeding unity in both cases. Onion, on the other hand, was observed to be highlyefficient in production for import substitution, as reflected in its low estimate of DRCratio (0.25).

CHAPTER 3
METHODOLOGY

Methodology is an indispensable and integral part of any study. The reliability of a specific study finding depends to a great extent on the appropriate methodology used in the study. Improper methodology very often leads to misleading result. So, careful considerations are needed by an author to follow a scientific and logical methodology for carrying out the study. The author has great responsibility in describing clearly what sorts of method and procedure is to be followed in selecting the study areas, the sources of data and the analyses as well as interpretations to arrive at a meaningful conclusion. A chronological description of the methodology used for this study is presented below.

3.1 Sources of Data

Both primary and secondary data hadbeen collected. Primary data had been collected by survey method with the help of pre-designed and pretested interview schedule. Questions had been designed to raise basic issues on the assessment. Besides, other necessary information had been collected from various research documents and papers like-

- Statistical Yearbook of Bangladesh,
- Yearbook of Agricultural Statistics
- Bangladesh Economic Review
- The national and international journals, articles and publications and
- Internet

3.2 Sampling Technique

Sampling is an important part of survey work. Out of 16 districts in the northern region of Bangladesh, Rajshahi and Pabna districts were purposively selected. Rajshahi district was selected for chickpea and blackgram, whilePabna district was selected for lentil and mungbean. The study areas were selected on the basis of intensive cultivation of those crops.Simple random sampling technique was used for collecting cross sectional data and information from a total of 200 farmers (lentil-50, mungbean-50, chickpea-50 and blackgram-50) who were cultivating improved varieties of pulses, especially varieties released from BARI, in the selected areas.

3.3 Processing, Editing and Tabulation of Data

The data was checked and verified for the sake of consistency and completeness. Editing and coding were done before putting the data in computer. All the collected data were summarized and scrutinized carefully to eliminate all possible errors. Data were presented mostly in the tabular form, because it was of simple calculation, widely used and easy to understand. Besides, functional analysis was also adopted in a small scale to arrive at expected findings. Raw data were inserted in computer using the concerned software Microsoft Excel.

3.4 Analytical Technique

Data were analyzed with a view to achieving the objectives of the study. Descriptive statistics like average, percentage etc.were followed to analyze the data to achieve the objectives of the study.

3.5 Economic Profitability Analysis

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

- Land preparation
- Human labour
- Seed
- Urea
- TSP
- Mop
- Insecticide
- Irrigation
- Interest on operating capital
- Land use

The returns from the crops were estimated based on the value of main products and by-products.

3.6 Description and Method of Measuring Cost Items

In this study variable cost, fixed cost and total cost had been described. Total variable cost (TVC) included land preparation, human labour, seed, urea, TSP, MoP, insecticides and irrigation. Fixed cost (FC) included interest on operating capital and rental value of land. Total cost (TC) included total variable cost and fixed cost.

3.6.1 Cost of Land Preparation

Land preparation considered one of the most important components in the production process. Land preparation for pulse production included ploughing, laddering and other activities needed to make the soil suitable for sowing seeds. It was revealed that the number of ploughing varied from farm to farm and location to location.

3.6.2 Cost of Human Labour

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

3.6.3 Cost of Seed

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

3.6.4Cost of Urea

Urea was one of the important fertilizers in pulse production. The cost of urea was computed on the basis of market price. The market price of urea was Tk. 20 per kg for the study areas. In order to calculate cost of urea the recorded unit of urea per hectare were multiplied by Tk. 20.

3.6.5Cost of TSP

The cost of TSP was also computed on the basis of market price. The market price of TSP was Tk. 25 per kg for the study areas. In order to calculate cost of TSP the recorded unit of TSP per hectare were multiplied by Tk. 25.

3.6.6Cost of MoP

Among the three main fertilizers used in pulse production,MoP was one of them. To calculate the cost of MoP per hectare,the market price of MoP was multiplied by per unit of that input per hectare for a particular operation. The market price of MoP was Tk. 16 per kg.

3.6.7Cost of Insecticides

Farmers used different kinds of insecticides for 2-3 times to keep their crop free from pests and diseases. Cost of insecticides was calculated based on the market price of the insecticides which was used in the study areas per hectare.

3.6.8Cost of Irrigation

Water management helps to increase pulse production. Cost of irrigation varies from farmers to farmers. It was calculated based on how many times irrigation needed per hectare and how this was done.

3.6.9 Interest on Operating Capital

Interest on operating capital was determined on the basis of opportunity cost principle. The operating capital actually represented the average operating cost over the period because all costs were not incurred at the beginning or at any single point of time. The cost was incurred throughout the whole production period; hence, at the rate of 10 percent per annum interest on operating capital for four months was computed for pulses. Interest on operating capital was calculated by usingthe following formula (Miah and Hardekar, 1988)

IOC= AIit

Where,

IOC= Interest on operating capital

i= Rate of interest

AI= Total operating capital / 3

t = Total time period of a cycle

3.6.10 Land Use Costs

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

3.7 Calculation of Returns

3.7.1 Gross Return

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

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

3.7.2 Gross Margin

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

Gross margin = Gross return – Variable cost

3.7.3 Net Return

Net return or profit was calculated by deducting the total production cost from the total return or gross return. That is,

Net return = Total return – Total production cost

The following profit equation was used to assess the profitability of pulse production at the farm level:

$$\Pi = P_rQ_r + P_bQ_b - \sum_{i=1}^{n} (P_{xi}.X_i) - TFC$$

Where,

Π = Profit per hectare for producing pulse

P_r = Per unit price of output (Tk/Kg)

Q_r = Quantity of output (Kg/ha)

P_b= Per unit price of by-products (Tk/kg)

Q_b= Quantity of by-product (Kg/ha)

P_{xi}= Per unit price of the i^{th} (Variable) inputs (Tk/kg)

X_i = Quantity of the i^{th} inputs (Kg/ha)

i = 1, 2, 3………..n and

TFC = Total fixed cost

3.7.4 Undiscounted Benefit Cost Ratio (BCR)

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

$$BCR = \frac{T\ R}{T\ C}$$

3.8 Cobb-Douglas Production Function

A Cobb-Douglas regression model was used to estimate the production function of pulses. It was used to find out the factor effect in pulse production.The advantage of using the Cobb-Douglas production function is its reasonable proximately with economic theory and its ability for easy computation of the partial elasticity of output with respect to input and returns to scale. To determine the contribution of the most important variables in the production process, the following type of Cobb-Douglas production function was used in the study.

$$Y= a X_1^{b1} X_2^{b2} X_3^{b3} X_4^{b4} X_5^{b5} X_6^{b6} X_7^{b7} X_8^{b8} + U_i$$

For the purpose of the present empirical exercise, the Cobb-Douglas production function was converted into the following logarithmic (Double log) form:

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

Where,

ln= Natural logarithm

Y= Yield of pulse (Kg/ha)

X_1=Land preparation cost (Tk. /ha)

X_2= Human labour cost (Tk. /ha)

X_3= Amount of seed (Kg /ha)

X_4= Amount of urea (Kg/ha)

X_5= Amount of TSP (Kg/ha)

X_6= Amount of MoP (Kg/ha)

X_7= Cost of insecticide (Tk/ha)

X_8= Cost of irrigation (Tk/ha)

a= Constant or intercept term

b_1,b_2, b_3, b_4, b_5, b_6,b_7, b_8 = Coefficient of the respective variables to be estimated; and

$U_{i=}$ Error term

3.9 Resource Use Efficiency

In order to test the resource use efficiency, the ratio of marginal value product (MVP) to the marginal factor cost (MFC) for each input was computed and tested for its equality to 1; MVP/MFC= 1.

The marginal productivity of a particular resource represents the additional to gross returns in value term caused by an additional one unit of that resource, while other inputs are held constant. When the marginal physical product (MPP) is multiplied by the product price per unit, the MVP is obtained. The most reliable, perhaps the most useful estimate of MVP is obtained by taking resources (Xi) as well as gross return (Y) at their geometric means.

In this study the MPP and the corresponding values of MVP were obtained as follows:

$MPP_{xi} * P_{yi} = MFC$,

Where, $MPP_{xi} * P_{yi} = MVP$,

But, MPP = bi*(Y/Xi)

So, MVP = bi* (Y/Xi) P_{yi}

Where,

b_i = regression coefficient per resource

Y = Mean output

X_i = Mean value of inputs

P_{yi} = price of output

MFC = price per unit of input.

Thus, when Resource-use efficiency (RUE) =1, resources are optimally utilized, when RUE < 1, resources are over utilized and when RUE > 1, resources are under-utilized.

3.10 Comparative Advantage

To estimate the comparative advantage in lentil production, Domestic Resource Cost (DRC) was calculated using the following formula (Bruno, 1972).

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

$$\text{Or, } DRC = \frac{\sum f_{ij} P_j^d}{U_i - \sum a_{ik} P_k^b} \quad (j = 1;2;3;.........m,\ k = 1;2;3;..............n)$$

Where,

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

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

U_i = Border price of i-th output

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

P^b_k = Border price of traded intermediate input

If DRC>1, the economy will save foreign exchange by producing the i crop 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 goods is less than the foreign exchange earned or saved. In contrast, if DRC<1, domestic costs will be in excess of foreign costs or savings indicating that the crop should not be produced domestically and should be imported instead.

CHAPTER 4

DESCRIPTION OF THE STUDY AREA

A short description has been presented in this chapter to know the overall featuresof the study area. It is essential to know the agricultural activities, possibledevelopment opportunities and potentials of the study area. Location, area,population, monthly average temperature and rainfall, agriculture, occupation,cropping patterns, communication and marketing facilities of the study area arediscussed in this chapter. However, for the production of pulses, it is very essentialto know the climate and topography of the study areas.

4.1 Location

The selected sample farmers are located in four villages namely Aronkhola, Dadapur,Debipur, Umipurand Nobogram, Baliaghata, Khajurtala, Kodomshohor under Ishwardi and Godagariupazila respectively. Ishwardi is under the Pabna district and Godagariupazila is under the Rajshahidistrict. These eight villages are located from 10 to 12 km of the upazila headquarters.The locations of the upazila are presented in the Map 4.1 and 4.2 respectively.

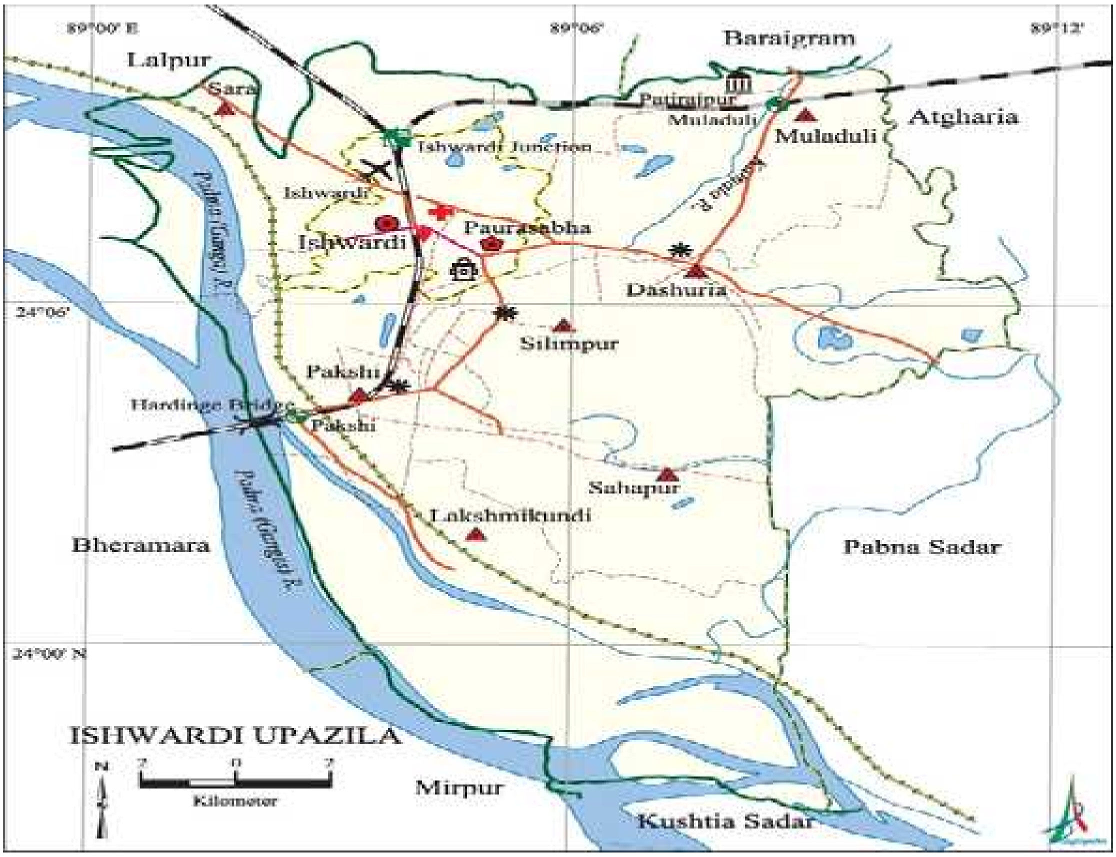


Figure 4.1: Map of IshwardiUpazila, Pabna

Figure 4.2: Map of GodagariUpazila, Rajshahi

4.2 Physical Features, Topography and Soil Condition

Pabnaincludes the region of both High Ganges River Floodplain and Lower Ganges River Floodplain whereas Rajshahi includes High Ganges River Floodplainregion.High Ganges River Floodplain (13,205 sq km) includes the western part of the Ganges river floodplain which is predominantly highland and medium highland. General soil types predominantly include calcareous dark grey floodplain soils and calcareous brown floodplain soils. Organic matter content in the brown ridge soils is low but higher in the dark grey soils. Soils are slightly alkaline in reaction. General fertility level is low.Lower Ganges River Floodplain (7,968 sq km) comprises the eastern half of the Ganges river floodplain which is low-lying. Soils of this region are silt loams and silty clay loams on the ridges and silty clay loam to heavy clays on lower sites. General soil types predominantly include calcareous dark grey and calcareous brown floodplain soils. Organic matter content is low in ridges and moderate in the basins. General fertility level is medium.Pulses can be grown inany type of soil, ranging from sandy loam to heavy clay. It was evident from thestudy that medium highland with clay soil and high land with siltyloam soil at Pabna and Rajshahi were mostly used for pulses bulb production(Table 4.1). The soil texture and structure of the study areas are almost similar tothe other parts of the district. Soils are calcareous within a depth of 1.2 m below ofthe surface. Clays are highly cracking when dry, drought, prone and have heavyconsistence. The soil of the study area is very fertile and suitable for cultivating the various crops.

Table 4.1 Land Topography in Survey Areas

Study areas	Land type					
	High Land	Medium High land	Medium Low Land	Low land	Very Low land	Total
Pabna	52312	52112	42892	33125	6136	238795
Rajshahi	115352	42432	22458	6985	0	208537

Source: BBS, 2010.

4.3 Area and Population

The total area, population and density of population of the selected Upazila arepresented in Table 4.2 .The highest population density (1251 sq.km) isIshwardi and the lowest population density (696 sq. km) is in GodagariUpazilla.

Table 4.2 Population Size of Upazilas under the Study Areas

Upazila	Area (sq. km)	Population	Male %	Female %	Population density
Ishwardi	250.89	3,26,823	50.38	49.62	1251
Godagari	475.26	3,44,330	50.23	49.77	696

Source: BBS, 2011c.

4.4 Climate, Temperature and Rainfall

The climate, temperature and rainfall are very important factors for production ofpulses and other crops. There was no local arrangement of meteorological centerfor recording temperature and rainfall in the study area. It is basically warm andhumid in Pabna and Faridpur region. Maximum temperature of the study areasvaries from 30.5°C to 32.5°C and minimum temperature varies from 20.2°C to22.01°C (Table

4.3). The annual total rainfall of the study areas varies from 893mm to 2040mm (Table 4.4). The monthly rainfall of the study areas in 2010 presented in Table 4.5.

Table 4.3 Average Maximum and Minimum Temperature in Selected Station

Name of Station	2007		2008		2009		2010		2011	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Ishwardi	31.2	20.5	31.0	21.3	31.9	20.8	32.5	21.1	30.8	20.2
Rajshahi	30.5	21.4	30.8	22.1	31.67	21.7	31.9	22.0	30.7	21.2

Source: BBS, 2011a.

Table 4.4 Annual Total Rainfalls in Millimeter in Selected Station

Name of Station	2005	2006	2007	2008	2009	2010	2011
Ishwardi	1819	1286	1573	1304	1292	893	1736
Rajshahi	1405	1145	2018	1315	1043	792	1475

Source: BBS, 2011a.

Table 4.5 Monthly Rainfalls in Millimeter by Station, 2010

Name of Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ishwardi	0	3	0	46	100	162	175	127	109	105	3	63
Rajshahi	0	6	0	12	142	367	215	209	195	189	12	62

Source: BBS, 2011a.

4.5 Land and Agriculture

Total cultivable land in two districts is 25000 hectares and25504 hectares respectively. Pulses is the main crop grown in the study areas. Besides, paddy, jute, wheat,sugarcane, garlic, pulse, groundnut, brinjal are also grows well in the areas. It is evident fromthe study that, cropping pattern in the study areas are almost same and it was jute-fellow-pulses, jute-short crops-pulses, jute- pulses- jute and fellow-amon-pulses. Land under cropped in thestudy areas are given in Table 4.5.It is evident from the table that almost half of the lands are utilized as double cropped land in the study areas. It also cleared from the table that near about half of the cultivated lands are under irrigation in the study areas.

Table 4.6Information of Land under the Study Areas

Upazillas	% distribution of land			
	Single crop	Double crop	Treble crop	Under irrigation
Ishwardi	15.62	46.54	37.84	43.1
Godagari	12.13	48.69	39.18	47.1

Source: National Encyclopedia of Bangladesh, 2014

4.6 Occupations

The major occupations of the peoples under study areas are agriculture, non-agriculturallabourer, wage labourer, industrial labourer, service holder and others. Average wage rate of agricultural labourvaries in different areas. Day labours were charged with high wage rate and they became scarce during harvesting period. Major types of occupations of the peoples in the study areas are given in Table 4.6.

Table 4.7Types of Occupation in the Study Areas

Upazilas	Types of Occupation (%)						
	Agriculture	Non-Agril. Labour	Industry	Commerce	Transport	Service	Others
Ishwardi	61.17	2.89	5.95	12.73	2.71	6.3	8.25
Rajshahi	39.72	4.03	1.65	17.49	9.19	15.79	12.13

Source: National Encyclopedia of Bangladesh, 2014

4.7 Transportation, Communication and Marketing Facilities

Transportation and communication is the pre-condition for the development of a particular region or a country. The selected areas for the study are well communicated with the different places of Bangladesh. The road network of this area facilitates the local people to market their agricultural as well as other products to the nearby and distance market places. Most of the roads in the study areas are concreted and some of the roads are muddy. Dueto well communication with the different markets, usually farmers do not deceive from having good prices of their produced commodities. The modes of transportation of this area are rickshaw, van, bullock carts, truck, by-cycle, motorcars and boats. There are many hats, which are sit on more than one day in a week and the local bazars are held on every morning and afternoon.

CHAPTER 5
SOCIO-DEMOGRAPHIC PROFILEOF HOUSEHOLD POPULATION

Socioeconomic condition of the sample farmers is very important in case of research planning because there are numerous interrelated and constituent attributes characterizes an individual and profoundly influences development of his/her behavior and personality.People differ from one another for the variation of socioeconomic aspects. However, for the present research, a few of the socioeconomic characteristics have been taken into consideration for discussion.

5.1 Age and Sex

The sample of 100 household in each study area comprised a total population of 652 and 655 in Ishwardiupazila, Pabna and Godagariupazila, Rajshahi, respectively (Table 5.1**)**. In Ishwardiupazila, 53.07 percent of the sample populations were male and 46.93 percent were female. About 30 percent of household populations were below 15 years of age, about 67 percent of the populations were under 15-64 years age group and only 2.30 percent were of 65 years or above. On the other hand, in Godagariupazila, 52.52 percent and 47.48 percent were male and female, respectively. About 30 percent of household populations were below 15 years of age, about 68 percent of the populations were under 15-64 years age group and only 1.68 percent was of 65 years or above.The sex ration in Ishwardi and Godagari were found 113 and 111 male per 100 women, respectively, which were remarkably higher than the national figure (105) (BBS, 2012), possibly because of the sample framework used for the survey. The dependency ratios of the study population were estimated at 48.52 and 46.21 which were significantly lower than that reported in HIES-2010 survey (65.30) (BBS, 2011b).

5.2 Marital Status

In Ishwardiupazila, marital status of the household population aged 16 years or more (at the time of survey) indicated that about 30 percent were married and about 68 percent were unmarried(Table 5.2**)**. The proportion of unmarried people was found lower for female population in comparison with that of male population. On the other hand, In Godagariupazila, marital status of the household population aged 16 years or more (at the time of survey) clearly indicated that about 33 percent were married and about 65 percent were unmarried. Here, the proportion of unmarried people was found lower for male population in comparison with that of female population.

5.3 Education

Figure 5.1 showed that, inIshwardiupazila, about 18 percent of the study population aged 5 years or more were found to have no education and/or read/write, about 43 percent were found to have primary level education, about 36 percent were found to have secondary and/or higher secondary level education and only 3.18 percent people were found to have attained/completed graduation level of education. In Godagariupazila, about 17 percent of the study population aged 5 years or more were found to have no education and/or read/write, about 41 percent were found to have primary level education, about 38 percent were found to have secondary and/or higher secondary level education and only 3.81 percent people were found to have attained/completed graduation level of education. The proportion of attainment of post-secondary or higher level of education was relatively higher for men than women in both study areas, partly due to gender discrimination against female (Table 5.3).

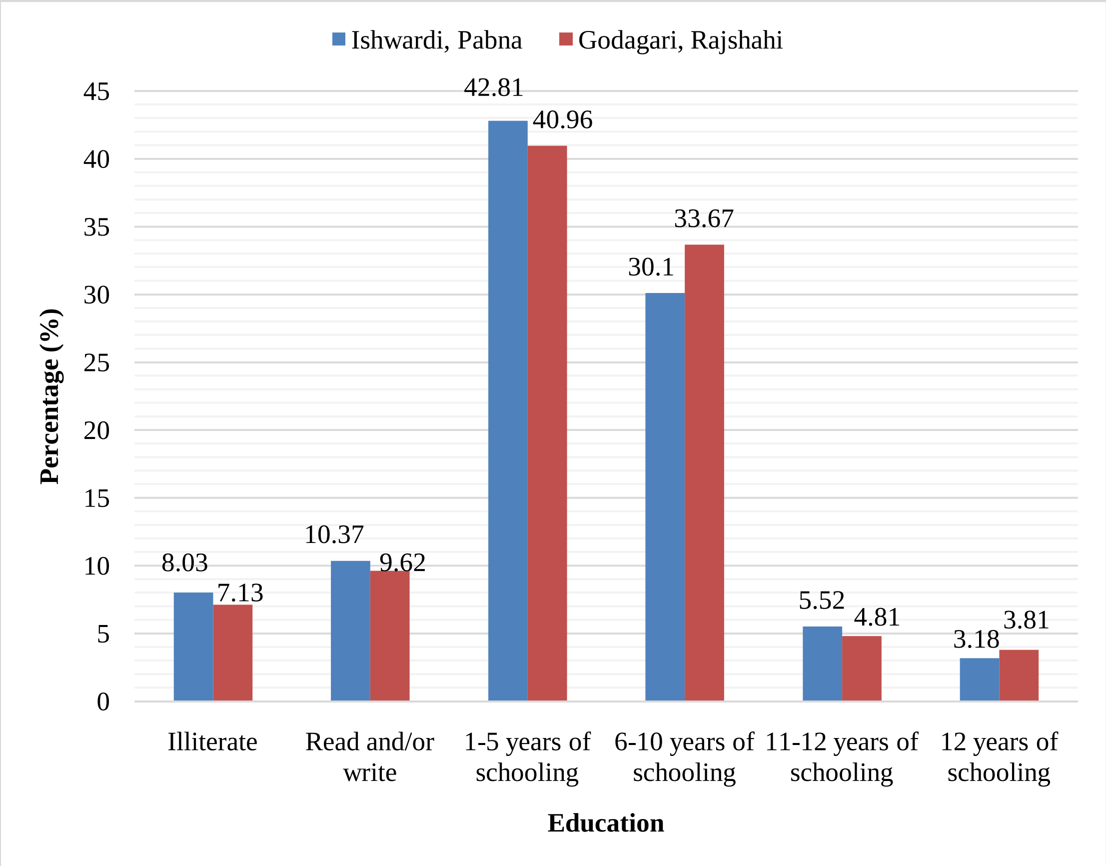


Figure 5.1: Education of the Household Members by Study Area

Table 5.1: Age Distribution of the Household Members by Sex

Age Group	Ishwardi, Pabna						Godagari, Rajshahi					
	Male		Female		Total		Male		Female		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
0-14 years	109	31.50	89	29.08	198	30.37	101	29.36	95	30.55	196	29.92
15-64 years	231	66.76	208	67.97	439	67.33	237	68.90	211	67.85	448	68.40
65 years or above	6	1.73	9	2.94	15	2.30	6	1.74	5	1.61	11	1.68
Total	346	100.00	306	100.00	652	100.00	344	100.00	311	100.00	655	100.00
Sex Ratio	113 male per 100 women						111 male per 100 women					
Dependency Ratio	48.52						46.21					

Source: Field survey, 2014.

Table 5.2: Marital Status of the Household Members by Sex and Study Area

Maritral Status (Age>15 years)	Ishwardi, Pabna						Godagari, Rajshahi					
	Male		Female		Total		Male		Female		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Married	62	28.57	64	32.16	126	30.29	72	33.64	67	32.21	139	32.94
Unmarried	153	70.51	129	64.82	282	67.79	141	65.89	133	63.94	274	64.93
Others	2	0.92	6	3.02	8	1.92	1	0.47	8	3.85	9	2.13
Total	217	100.00	199	100.00	416	100.00	214	100.00	208	100.00	422	100.00

Source: Field survey, 2014.

5.4 Occupation

The occupation of the study population aged 16 years or more showed that, in Ishwardi, about 38 percent (out of 416) were engaged in agriculture as a main occupation and about 44 percent (out of 118) were engaged in agriculture as a subsidiary occupation. On the other hand, in Godagari, about 35 percent (out of 422) were engaged in agriculture as a main occupation and about 37 percent (out of 127) were engaged in agriculture as asubsidiary occupation(Figure 5.4 and Table 5.4**)**. In Ishwardi and Godagari, respectively, 37.50 percent and 36.26 percent were engaged in domestic work as household activities and, 11.54 percent and 13.74 percent were engaged in study. Household activities and study are not directly included in Gross Domestic Product (GDP).

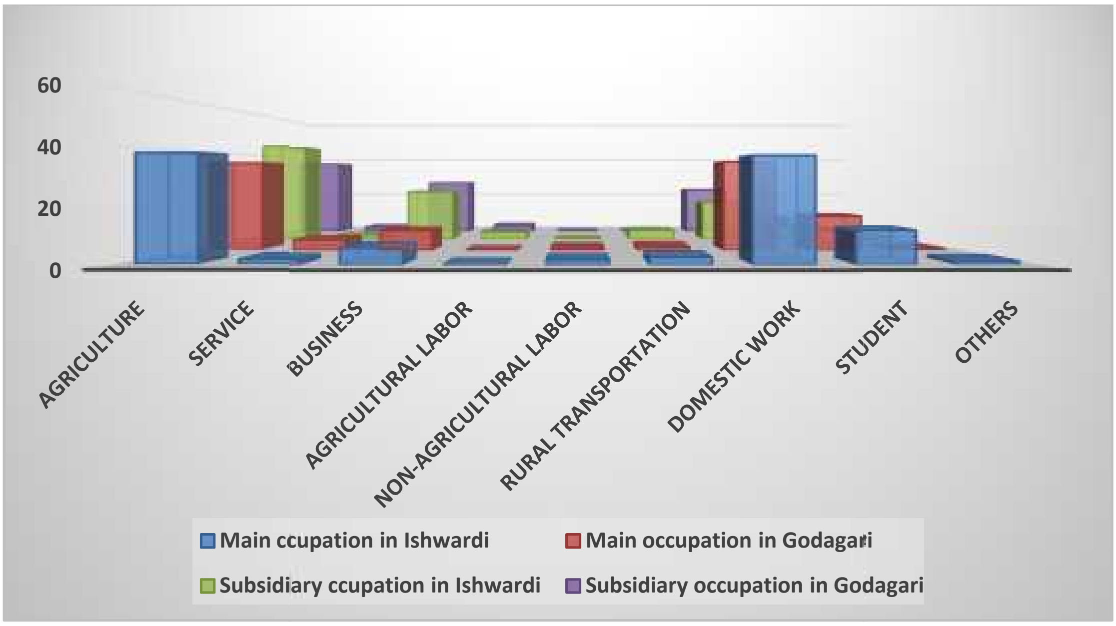
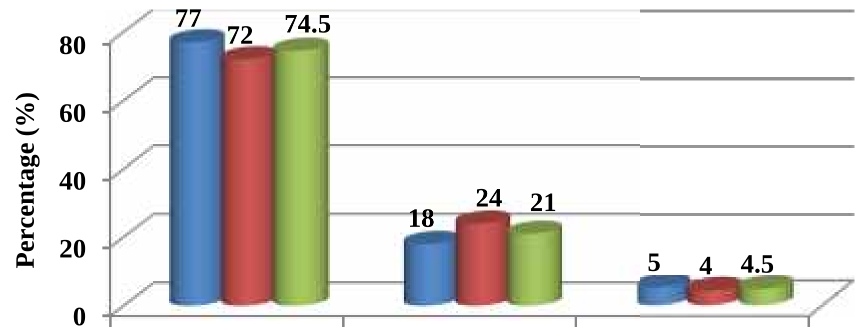


Figure 5.2: Occupation of the Household Members by Occupational Category

5.5 Type of Family

A family of the household has been defined as total number of persons of either sex living together and taking meal from same kitchen.Type of the family of pulse farmers was divided into three types nuclear, joint and extended. Percentage of nuclear family was slightly higher (77 percent) in Ishwardi than that of Godagari (72 percent). But percentage of joint family was higher in Godagari (24 percent) compared to Ishwardi (18 percent). Considering all farmers, on an average, 21 percent, 74.50 percentand 4.50 percent were joint family, nuclear family and extended family, respectively (Figure 5.3**)**.



	Nuclear	Joint	Extended
Ishwardi, Pabna	77	18	5
Godagari, Rajshahi	72	24	4
Total	74.5	21	4.5

Family Type

Figure 5.3: Family Type of the Respondent Household

5.6 Income

Figure 5.4 revealed that, in Ishwardi, 36 percent respondent households were found to earn more than Tk. 300000 in a year followed by Tk. 200001-250000 income group (23 percent). On the other hand, In Godagari, 38 percent respondent households were found to earn more than Tk. 300000 in a year followed by Tk. 100001-150000 income groups (15 percent). Considering all farmers in the study areas, it was evident fromthe figure that, on an average, 37 percent respondent households was in ‘More than Tk. 300000’ income group followed by Tk. 200001-250000 income group (18 percent).

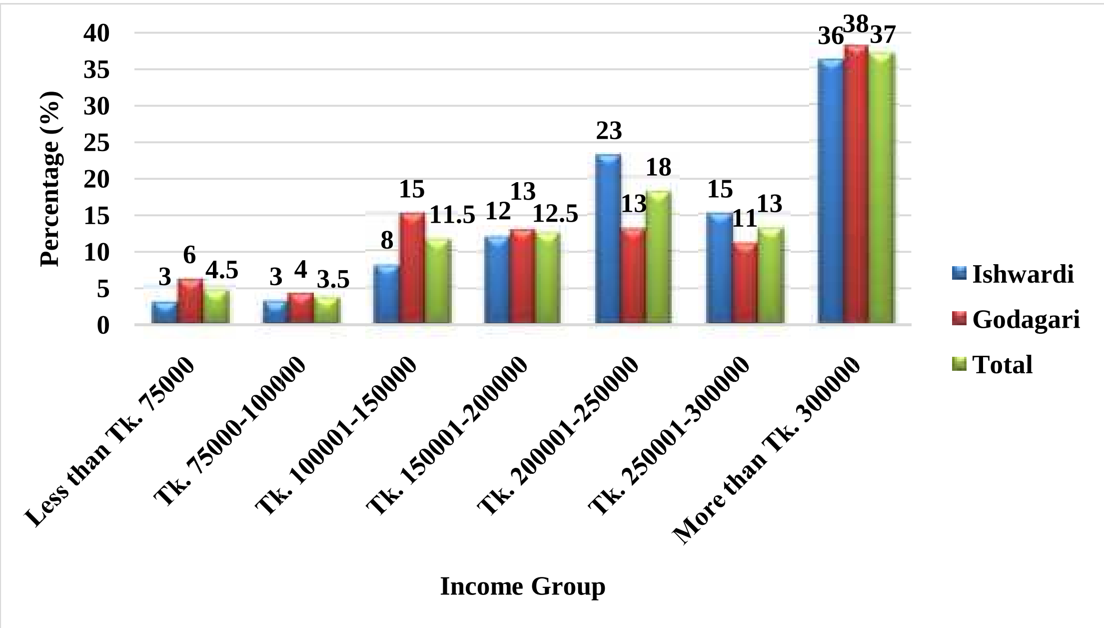


Figure 5.4: Income Distribution of the Respondent Household

Table 5.3: Education of the Household Members by Sex and Study Area

Educational status (Age>5 years)	Ishwardi, Pabna						Godagari, Rajshahi					
	Male		Female		Total		Male		Female		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Illiterate	18	5.81	30	10.42	48	8.03	17	5.35	26	9.12	43	7.13
Read and/or write	43	13.87	29	10.07	62	10.37	37	11.64	21	7.37	58	9.62
1-5 years of schooling	132	42.58	117	40.63	256	42.81	132	41.51	115	40.35	247	40.96
6-10 years of schooling	79	25.48	98	34.03	180	30.10	99	31.13	104	36.49	203	33.67
11-12 years of schooling	21	6.77	9	3.13	33	5.52	18	5.66	11	3.86	29	4.81
12 years of schooling	17	5.48	5	1.74	19	3.18	15	4.72	8	2.81	23	3.81
Total	310	100.00	288	100.00	598	100.00	318	100.00	285	100.00	603	100.00

Source: Field survey, 2014.

Table 5.4: Occupation of the Household Members by Occupational Category

Occupation (Age>15 years)	Ishwardi, Pabna				Godagari, Rajshahi			
	Main		Subsidiary		Main		Subsidiary	
	No.	%	No.	%	No.	%	No.	%
Agriculture	158	37.98	52	44.07	149	35.31	47	37.01
Service	7	1.68	2	1.69	17	4.03	3	2.36
Business	24	5.77	27	22.88	33	7.82	34	26.77
Agricultural labor	0	0.00	4	3.39	0	0.00	4	3.15
Non-Agricultural labor	7	1.68	0	0.00	4	0.95	0	0.00
Rural transportation	11	2.64	5	4.24	6	1.42	0	0.00
Domestic work	156	37.50	21	17.80	153	36.26	29	22.83
Student	48	11.54	7	5.93	58	13.74	9	7.09
Others	5	1.20	0	0.00	2	0.47	1	0.79
Total	416	100.00	118	100.00	422	100.00	127	100.00

Source: Field survey, 2014.

5.7 Agricultural Training

Among the pulse producers, 90.00 percentmungbean producers got training on different agricultural technologies followed by chickpea producers (82.00 percent), lentil producers (80.00 percent) and blackgram producers (76.00 percent) (Table 5.5). These training have improved their perceptions of good seed use, use of resistant varieties, application of insecticides and pesticides, water management, and so on.

Table 5.5: Agricultural Training of the Respondent Farmers by Crop

Training Received	Ishwardi, Pabna				Godagari, Rajshahi			
	Lentil		Mungbean		Chickpea		Blackgram	
	No.	%	No.	%	No.	%	No.	%
Yes	40	80.00	45	90.00	41	82.00	38	76.00
No	10	20.00	5	10.00	9	18.00	12	24.00
Total	50	100.00	50	100.00	50	100.00	50	100.00

Source: Field survey, 2014.

5.8 Membership

Among the pulse producers, 64.00 percent lentil producers were found to have membership in different NGOs and/or farmers' organizations followed by mungbean producers (56.00 percent), chickpea producers (52.00 percent) and blackgram producers (48.00 percent) (Table 5.6).

Table 5.6: Membership of the Respondent Farmers by Crop

Membership in any organization	Ishwardi, Pabna				Godagari, Rajshahi			
	Lentil		Mungbean		Chickpea		Blackgram	
	No.	%	No.	%	No.	%	No.	%
Yes	32	64.00	28	56.00	26	52.00	24	48.00
No	18	36.00	22	44.00	24	48.00	26	52.00
Total	50	100.00	50	100.00	50	100.00	50	100.00

Source: Field survey, 2014.

CHAPTER 6
PROFITABILITY OF PULSE PRODUCTION

Profitability is a major criterion to make decision for producing any crop at farm level. It can be measured based on net return, gross margin and ratio of return to total cost. The costs of all items were calculated to identify the total cost of production. The returns from the crops have been estimated based on the value of main products and by-products.

6.1 Profitability of Lentil Production

6.1.1 Variable Costs

6.1.1.1 Cost of Land Preparation

Land preparation is the most important components in the production process. Land preparation included ploughing, laddering and other activities needed to make the soil suitable for lentil cultivation. For land preparation in lentil production, no. of tiller was required 3 with Tk. 2246.93 per tiller. Thus, the average land preparation cost of lentil production was found to be Tk. 6740.79 per hectare, which was 11.65% of total cost (Table 6.1).

6.1.1.2 Cost of Human Labour

Human labour cost is one of the major cost components in the production process. It is one of the most important and largely used inputs for producing lentil. It is generally required for different operations such as land preparation, sowing, weeding, fertilizer and insecticides application, irrigation, harvesting and carrying, threshing, cleaning, drying, storing etc. The quantity of human labour used in lentil production was found to be about 59.82 man-days per hectare and average price of human labourwas Tk. 300.00 per man-day.Therefore, the total cost of human labour was found to be Tk. 17946.00 representing 31.02 percent of total cost (Table 6.1).

6.1.1.3 Cost of Seed

Cost of seed varied widely depending on its quality and availability. Per hectare total cost of seed for lentil production were estimated to be Tk. 4670.00, which constituted 8.07 percent of the total cost (Table 6.1).

6.1.1.5 Cost of Urea

In the study area, farmers used different types of fertilizers. On an average, farmers used urea 60.60 kg per hectare. Per hectare cost of urea was Tk. 1212.00, which represents 2.09 percent of the total cost (Table 6.1).

6.1.1.6 Cost of TSP

Among the different kinds of fertilizers used, the rate of application of TSP (67.90 kg) was higher than those of other fertilizers. The average cost of TSP was Tk. 1697.50 which representing 2.93 percent of the total cost (Table 6.1).

6.1.1.7 Cost of MoP

The application of MoP per hectare (61.50 kg) was found higher than urea (60.60 kg). Per hectare cost of MoP was Tk. 984.00, which represents 1.70 percent of the total cost (Table 6.1).

Table 6.1: Per Hectare Cost of Lentil Production

Items of Cost	Quantity (kg/ha)	Rate (Tk./Kg)	Cost (Tk./ha)	% of Total Cost
Land preparation	3.00	2246.93	6740.79	11.65
Human labour	59.82	300.00	17946.00	31.02
Seed	46.70	100.00	4670.00	8.07
Urea	60.60	20.00	1212.00	2.09
TSP	67.90	25.00	1697.50	2.93
MoP	61.50	16.00	984.00	1.70
Cost of insecticides			1085.27	1.88
Cost of irrigation			2299.19	3.97
A. Total Variable Cost (TVC)			**36634.75**	**63.32**
Interest on operating capital @ of 10% for 4 months			1221.16	2.11
Rental value of land			20000.00	34.57
B. Total Fixed Cost (TFC)			**21221.16**	**36.68**
C. Total Cost (A+B)			**57855.91**	**100.00**

Source: Field survey, 2014.

Note: Quantity and rate for land preparation are expressed in no. of tiller per hectare and Tk. per tiller units, respectively. Quantity and rate of human labour are expressed in man-days per hectare and Tk. per man-days units, respectively.

6.1.1.8 Cost of Insecticides

Farmers used different kinds of insecticides to keep their crop free from pests and diseases. The average cost of insecticides for lentil production was found to be Tk. 1085.27 which was 1.88 percent of the total cost (Table 6.1).

6.1.1.9 Cost of Irrigation

Cost of irrigation is one of the most important costs for lentil production. Production of lentil largely depends on irrigation. The average cost of irrigation was found to be Tk. 2299.19 per hectare, which represents 3.97 percent of the total cost (Table 6.1).

6.1.10 Total Variable Cost

Therefore, from the above different cost items it was clear that the total variable cost of lentil production was Tk. 36634.75 per hectare, which was 63.32 percent of the total cost (Table 6.1).

6.1.2 Fixed Cost

6.1.2.1 Interest on Operating Capital

Interest on operating capital for lentil production was estimated atTk. 1221.16 per hectare, which represents 2.11 percent of the total cost (Table 6.1).

6.1.2.2 Rental Value of Land

Rental value of land was calculated on the basis of opportunity cost of the use of land per hectare for the cropping period of three months. Cash rental value of land has been used as cost of land use. On the basis of the data collected from the lentil farmers the land use cost was found to be Tk. 20000.00 per hectare, and it was 34.57 percent of the total cost (Table 6.1).

5.1.3 Total Cost (TC) of Lentil Production

Total cost was calculated by adding all the cost of variable and fixed inputs. In the present study per hectare total cost of producing lentil was found to be Tk. 57855.91(Table 6.1).

6.1.4 Return of Lentil Production

6.1.4.1 Gross Return

Return per hectare of lentil cultivation is shown in table 6.2. Per hectare gross return was calculated by multiplying the total amount of product with respective per unit price and then adding the value of by-product. It is evident from table that the average yield of lentil per hectare was 1305.00 kg and the price of lentil was Tk.65.00. The value of by-product was found to be Tk.5375.00. Therefore, the gross return was found to be Tk. 90200.00 per hectare.

6.1.4.2 Gross Margin

Gross margin was calculated by deducting the total variable cost from the gross return. On the basis of the data, gross margin was found to be Tk. 53565.25 per hectare (Table 6.2).

6.1.4.3 Net Return

Net return or profit was calculated by deducting the total production cost from the gross return. On the basis of the data the net return was estimated as Tk. 32344.09 per hectare (Table 6.2).

Table 6.2: Per Hectare Cost and Return of Lentil Production

Measuring Criteria	Quantity (kg/ha)	Rate (Tk./kg)	Cost (Tk./ha)
Main Product Value	1305.00	65.00	84825.00
By-product Value			5375.00
Gross Return (GR)			90200.00
Total Variable Cost (TVC)			36634.75
Total Cost (TC)			57855.91
Gross Margin (GR-TVC)			53565.25
Net Return (GR-TC)			32344.09
BCR (undiscounted)(GR/TC)			**1.56**

Source: Field survey, 2014.

6.1.4.4 Benefit Cost Ratio (undiscounted)

Benefit cost ratio (BCR) was found to be 1.56 which implies that one taka investment in lentil production generated Tk. 1.56 (Table 6.2). From the above calculation it was found that lentil cultivation is profitable in Bangladesh.

6.2 Profitability of Mungbean Production

6.2.1 Variable Costs

6.2.1.1 Cost of Land Preparation

Land preparation, same as lentil cultivation, included ploughing, laddering and other activities needed to make the soil suitable for mungbean cultivation. The average land preparation cost of mungbean production was found Tk. 5752.04 per hectare for Pabna district indicating10.85 percent of total cost (Table 6.3).

6.2.1.2 Cost of Human Labour

Human labour is one of the most important and largely used inputs for producing mungbean. It is generally required for different operations such as land preparation, sowing, weeding, fertilizer and insecticides application, irrigation, harvesting and carrying, threshing, cleaning, drying, storing etc. The quantity of human labour used in mungbean production was found to be about 58.27 man-days per hectare. The total cost of human labour was found to be Tk. 17481.00 representing about 32.99 percent of total cost (Table 6.3).

6.2.1.3 Cost of Seed

In case of mungbean production, farmers used 45.80 kg seed per hectare. Per hectare total cost of seed for mungbean production were estimated Tk. 4580.00 per hectareand it constituted 8.64 percent of the total cost (Table 6.3).

6.2.1.5 Cost of Urea

Farmers used different types of fertilizers for mungbean production. On an average, farmers used 40.50 kg urea per hectare. Per hectare cost of urea was Tk. 810.00, which represents 1.53 percent of the total cost(Table 6.3).

6.2.1.6 Cost of TSP

Among the different kinds of fertilizer used, the rate of application of TSP (56.20 kg per hectare) was higher than those of other fertilizers for mungbean production. The average cost of TSP was Tk. 1405.00 per hactare which constituted 2.65 percent of the total cost(Table 6.3).

6.2.1.7 Cost of MoP

The application of MoP per hectare (47.10 kg) was found higher than urea (40.50 kg). Per hectare cost of MoP was about Tk. 753.60, which represents 1.42 percent of the total cost(Table 6.3).

6.2.1.8 Cost of Insecticides

Farmers used different kinds of insecticides to keep their crop free from pests and diseases. The average cost of insecticides for mungbean production was found to be Tk. 1440.81 which was 2.72 percent of the total cost(Table 6.3).

6.2.1.9 Cost of Irrigation

Irrigation is also needed to increase the yield of mungbean and it is one of the most major cost items for mungbean production. The average cost of irrigation was found to be Tk. 2611.67 per hectare which represented4.93 percent of the total cost(Table 6.3).

6.2.1.10 Total Variable Cost

The total variable cost of mungbean production was Tk. 34834.12 per hectare which was about 65.73 percent of the total cost (Table 6.3).

Table 6.3: Per Hectare Cost of Mungbean Production

Items of Cost	Quantity (kg/ha)	Rate (Tk./Kg)	Cost (Tk/ha)	% of Total Cost
Land preparation	2.78	2069.08	5752.04	10.85
Human labour	58.27	300.00	17481.00	32.99
Seed	45.80	100.00	4580.00	8.64
Urea	40.50	20.00	810.00	1.53
TSP	56.20	25.00	1405.00	2.65
MoP	47.10	16.00	753.60	1.42
Cost of insecticides			1440.81	2.72
Cost of irrigation			2611.67	**4.93**
A. Total Variable Cost (TVC)			**34834.12**	**65.73**
Interest on operating capital @ of 10% for 4 months			1161.14	2.19
Rental value of land			17000.00	32.08
B. Total Fixed Cost (TFC)			**18161.14**	**34.27**
C. Total Cost (A+B)			**52995.25**	**100.00**

Source: Field survey, 2014.

Note: Quantity and rate for land preparation are expressed in no. of tiller per hectare and Tk. per tiller units, respectively. Quantity and rate of human labour are expressed in man-days per hectare and Tk. per man-days units, respectively.

6.2.2 Fixed Cost

6.2.2.1 Interest on Operating Capital

Interest on operating capital for mungbean production was estimated at Tk. 1161.14 which represented 2.19 percent of the total cost (Table 6.3).

6.2.2.2 Rental Value of Land

Rental value of land was similarly calculated as lentil on the basis of opportunity cost of the use of land per hectare for the cropping period of three months. Cash rental value of land has been used as cost of land use. On the basis of the data collected from the mungbean farmers the land use cost was found Tk. 17000 per hectare, and it was 32.08 percent of the total cost (Table 6.3).

6.2.3 Total Costs of Mungbean Production

Total cost was calculated by adding all the variable and fixed costs items. By doing so, per hectare total cost of producing mungbean was found to be Tk. 52995.25 per hectare(Table 6.3).

6.2.4 Return of Mungbean Production

6.2.4.1 Gross Return

Return per hectare of mungbean cultivation is shown in Table 6.4. Per hectare gross return was calculated by multiplying the total amount of product with respective per unit price and then adding the value of by-product. It is evident from Table 6.4 that the average yield of mungbean per hectare was 1325.60 kg and the price of mungbean was TK. 60.00. The value of by-product was found to be Tk. 4876.00. Thus the gross return was found to be Tk. 84,412 per hectare.

6.2.4.2 Gross Margin

Gross margin was calculated by deducting the total variable cost from the gross return. On the basis of the data, gross margin was found to be Tk. 59577.88 per hectare (Table 6.4).

6.2.4.3 Net Return

Net return was calculated by deducting the total production cost from the gross return. On the basis of the data the net return was estimated as Tk. 31416.75per hectare (Table 6.4).

Table 6.4: Per Hectare Cost and Return of Mungbean Production

Measuring Criteria	Quantity (kg/ha)	Rate (Tk./kg)	Cost (Tk./ha)
Main Product Value	1325.60	60.00	79536.00
By-product Value			4876.00
Gross Return (GR)			84412.00
Total Variable Cost (TVC)			34834.12
Total Cost (TC)			52995.25
Gross Margin (GR-TVC)			49577.88
Net Return (GR-TC)			31416.75
BCR (undiscounted)(GR/TC)			**1.59**

Source: Field survey, 2014.

6.2.4.4 Benefit Cost Ratio (undiscounted)

Benefit cost ratio (BCR) was found to be 1.59 which impliedthat one taka investment in mungbean production generated Tk. 1.59(Table 6.4). From the above calculation it was found that mungbean cultivation is profitable in Bangladesh.

6.3 Profitability of Chickpea Production

6.3.1 Variable Costs

6.3.1.1 Cost of Land Preparation

The average land preparation cost of chickpea production was found to be Tk. 5052.09 per hectare,which is about 10.15 percent of total cost(Table 6.5).

6.3.1.2 Cost of Human Labour

Chickpea cultivation is labour intensive.Human labour is one of the most important and largely used inputs for increasing the yield of chickpea. It is generally required for different operations such as land preparation, sowing, weeding, fertilizer and insecticides application, irrigation, harvesting and carrying, threshing, cleaning, drying, storing etc. The quantity of human labour used in chickpea production was about 48.10 man-days per hectare.The total cost of human labour was found to be about Tk. 14430.00 representing 29.00 percent of total cost(Table 6.5).

6.3.1.3 Cost of Seed

Cost of chickpea seed varied widely depending on its quality and availability. Per hectare total cost of seed for chickpea production was estimated Tk. 5348.50, which constituted 10.75 percent of the total cost(Table 6.5).

6.3.1.5 Cost of Urea

On an average, farmers used about 41.8 kg urea per hectare. Per hectare cost of urea was about Tk. 836.00, which represented 1.68 percent of the total cost(Table 6.5).

6.3.1.6 Cost of TSP

The rate of application of TSP was found 72.00 kg per hectare for chickpea production. The average cost of TSP was Tk. 1800.00 which accounted for 3.62 percent of the total cost(Table 6.5).

6.3.1.7 Cost of MoP

The rate of application of MoP per hectare (44.60 kg) was found higher than urea (41.80 kg). Per hectare cost of MoP was Tk. 713.60, which represented 1.43 percent of the total cost(Table 6.5).

6.3.1.8 Cost of Insecticides

In the study area, farmers used different kinds of insecticides to keep chickpea free from pests and diseases. The average cost of insecticides was found to be Tk. 1778.58 which was 3.57 percent of the total cost(Table 6.5).

6.3.1.9 Cost of Irrigation

Irrigation is regarded as an important input to increase chickpea production. So, cost of irrigation is one of the most important costs in chickpea production. The average cost of irrigation was found to be Tk. 2223.22 per hectare, which represents 4.47 percent of the total cost(Table 6.5).

6.3.1.10 Total Variable Cost

The total variable cost of chickpea production was Tk. 32181.99 per hectare which was 64.68percent of the total cost (Table 6.5).

Table 6.5: Per Hectare Cost of Chickpea Production

Items of Cost	Quantity (kg/ha)	Rate (Tk./Kg)	Cost (Tk./ha)	% of Total Cost
Land preparation	2.62	1928.28	5052.09	10.15
Human labour	48.10	300.00	14430.00	29.00
Seed	56.30	95.00	5348.50	10.75
Urea	41.80	20.00	836.00	1.68
TSP	72.00	25.00	1800.00	3.62
MoP	44.60	16.00	713.60	1.43
Cost of insecticides			1778.58	3.57
Cost of irrigation			2223.22	4.47
A. Total Variable Cost (TVC)			**32181.99**	**64.68**
Interest on operating capital @ of 10% for 4 months			1072.73	2.16
Rental value of land			16500.00	33.16
B. Total Fixed Cost (TFC)			**17572.73**	**35.32**
C. Total Cost (A+B)			**49754.73**	**100.00**

Source: Field survey, 2014.

Note: Quantity and rate for land preparation are expressed in no. of tiller per hectare and Tk. per tiller units, respectively. Quantity and rate of human labour are expressed in man-days per hectare and Tk. per man-days units, respectively.

6.3.2 Fixed Cost

6.3.2.1 Interest on Operating Capital

Interest on operating capital in growing chickpea was found to be Tk. 1072.73 per hectare, which represents 2.16 percent of the total cost (Table 6.5).

6.3.2.2 Rental Value of Land

On the basis of the data collected from the chickpea farmers the land use cost was estimated at Tk. 16500.00 per hectare, which was 32.16 percent of the total cost (Table 6.5).

6.3.3 Total Costs of Chickpea Production

Total cost was calculated by adding all the cost of variable and fixed inputs as it was done for lentil and mungbean. In the present study per hectare total cost of producing chickpea was found to be Tk. 49754.73(Table 6.5).

6.3.4 Return of Chickpea Production

6.3.4.1 Gross Return

Return per hectare of chickpea cultivation is shown in Table 6.6. Per hectare gross return was calculated by multiplying the total amount of product with respective per unit price and then adding the value of by-product. It is evident from Table 6.6 that the average yield of chickpea per hectare was 1230 kg and the price of chickpea was Tk. 52.00. The value of by-product of chickpea was found to be Tk. 4550.00 per hectare. Thus, the gross return was found to be Tk. 68510 per hectare.

Table 6.6: Per Hectare Cost and Return of Chickpea Production

Measuring Criteria	Quantity (kg/ha)	Rate (Tk./kg)	Cost (Tk./ha)
Main Product Value	1230.00	52.00	63960.00
By-product Value			4550.00
Gross Return (GR)			68510.00
Total Variable Cost (TVC)			32181.99
Total Cost (TC)			49754.73
Gross Margin (GR-TVC)			36328.01
Net Return (GR-TC)			18755.27
BCR (undiscounted)(GR/TC)			**1.38**

Source: Field survey, 2014.

6.3.4.2 Gross Margin

Gross margin was calculated by deducting the total variable cost from the gross return. On the basis of the data, gross margin was found to be Tk. 36328.01 per hectarefor producing chickpea (Table 6.6).

6.3.4.3 Net Return

Net return for chickpea production was calculated by deducting the total production cost from the gross return. The net return was estimated as Tk. 18755.27 per hectare (Table 6.6).

6.3.4.4 Benefit Cost Ratio (undiscounted)

Benefit cost ratio (BCR) was found to be 1.38 which impliedthat one taka investment in chickpea production generated Tk. 1.38(Table 6.6). From the above calculation it was found that chickpea cultivation is profitable in Bangladesh.

6.4 Profitability of Blackgram Production

6.4.1 Variable Costs

6.4.1.1 Cost of Land Preparation

Land preparation is needed to make the soil suitable for blackgram cultivation. The average land preparation cost of blackgram production was found Tk. 4389.36per hectare for Godagariupazila under Rajshahi district (Table 6.7).

Table 6.7: Per Hectare Cost of Blackgram Production

Items of Cost	Quantity (kg/ha)	Rate (Tk./Kg)	Cost (Tk./ha)	% of Total Cost
Land preparation	2.22	1977.19	4389.36	9.87
Human labour	45.73	300.00	13719.00	30.86
Seed	46.00	85.00	3910.00	8.80
Urea	51.00	20.00	1020.00	2.29
TSP	44.00	22.00	968.00	2.18
MoP	24.00	16.00	384.00	0.86
Cost of insecticides			798.00	1.80
Cost of irrigation			1865.00	4.20
A. Total Variable Cost (TVC)			**27053.36**	**60.86**
Interest on operating capital @ of 10% for 4 months			901.78	2.03
Rental value of land			16500.00	37.12
B. Total Fixed Cost (TFC)			**17401.78**	**39.14**
C. Total Cost (A+B)			**44455.14**	**100.00**

Source: Field survey, 2014.

Note: Quantity and rate for land preparation are expressed in no. of tiller per hectare and Tk. per tiller units, respectively. Quantity and rate of human labour are expressed in man-days per hectare and Tk. per man-days units, respectively.

6.4.1.2 Cost of Human Labour

Human labour cost is one of the major cost components in blackgram production. The quantity of human labour used in blackgram production was about 45.73 man-days per hectare and the wage rate was Tk. 300 per man-days.Thus the total cost of human labour was found to be about Tk. 13719.00 representing 30.86 percent of total cost(Table 6.7).

6.4.1.3 Cost of Seed

Cost of seed varied widely depending on its quality and availability. Per hectare total cost of seed for blackgram production was estimated to be Tk. 3910.00, which constituted 8.80 percent of the total cost(Table 6.7).

6.4.1.5 Cost of Urea

In the study area, farmers used different types of fertilizers for cultivating blackgram. On an average, farmers used 51.00 kg urea per hectare. Per hectare cost of urea was Tk. 1020.00, which represents 2.29percent of the total cost(Table 6.7).

6.4.1.6 Cost of TSP

Among the different kinds of fertilizers used, the rate of application of TSP was 44 kg per hectare. The average cost of TSP was Tk. 968.00, which represented2.18percent of the total cost(Table 6.7).

6.4.1.7 Cost of MoP

The application of MoP per hectare (24kg) was found lower than urea (51kg)and TSP (44kg). Per hectare cost of MoP was Tk. 384.00, which represents 0.86 percent of the total cost(Table 6.7).

6.4.1.8 Cost of Insecticides

Farmers used different kinds of insecticides to control pests and diseases so that they can get higher yield of blackgram. The average cost of insecticides was found to be Tk. 798.00 per hectareindicating1.80percent of the total cost(Table 6.7).

6.4.1.9 Cost of Irrigation

Irrigation is also important for higher yield of blackgram. The average cost of irrigation was found to be Tk. 1865.00which represented4.20percent of the total cost(Table 6.7).

6.4.1.10 Total Variable Cost

The total variable cost of blackgram production was about Tk. 27053.36per hectare which was 60.86 percent of the total cost (Table 6.7).

6.4.2 Fixed Cost

6.3.2.1 Interest on Operating Capital

The average cost of interest on operating capital in the study areas was Tk. 901.78 per hectare, which represented 2.03 percent of the total cost (Table 6.7).

6.4.2.2 Rental Value of Land

Cash rental value of land has been used as cost of land use. On the basis of the data collected from the blackgram farmers the land use cost was found to be Tk. 16500.00 per hectare, which was 37.12 percent of the total cost (Table 6.7).

6.4.3 Total Costs of Blackgram Production

Total cost was calculated by adding all the cost of variable and fixed inputs. In the present study, total cost of producing blackgram was found to be Tk. 44455.14 per hectare(Table 6.7).

Table 6.8: Per Hectare Cost and Return of Blackgram Production

Measuring Criteria	Quantity (kg/ha)	Rate (Tk./kg)	Cost (Tk./ha)
Main Product Value	1208.0	50.0	60400.00
By-product Value			4557.00
Gross Return (GR)			64957.00
Total Variable Cost (TVC)			27053.36
Total Cost (TC)			44455.14
Gross Margin (GR-TVC)			37903.64
Net Return (GR-TC)			20501.86
BCR (undiscounted)(GR/TC)			**1.46**

Source: Field survey, 2014.

6.4.4 Return of Blackgram Production

6.4.4.1 Gross Return

Return per hectare of blackgram cultivation is shown in table 6.8. Per hectare gross return was calculated by multiplying the total amount of product with respective per unit price and then adding the value of by-product. It is evident from the table that the average yield of blackgram per hectare was 1208.00 kg and price received by the blackgram farmers was Tk. 50. The value of by-product was found to be Tk. 4557.00 per hectare. Thusthe gross return was found to be Tk. 64957.00 per hectare.

6.4.4.2 Gross Margin

Gross margin was calculated by deducting the total variable cost from the gross return. On the basis of the data, gross margin was found to be Tk. 37903.64 per hectare (Table 6.8).

6.4.4.3 Net Return

Net return was calculated by deducting the total production cost from the gross return. Thus the net return was estimated as Tk. 20501.86 per hectare for blackgram production (Table 6.8).

5.3.4.4 Benefit Cost Ratio (undiscounted)

Benefit cost ratio (BCR) was found to be 1.46which impliedthat one taka investment in blackgram production generated Tk. 1.46(Table 6.8). From the above calculation it was found that blackgram cultivation is profitable in Bangladesh.

CHAPTER 7

FACTORS AFFECTING THE YIELD OF PULSE

In this chapter an attempt has been made to identify and measure the effects of different factors on yield of pulses in the framework of production function analysis. Eight explanatory variables were taken into consideration for production function analysis. The effects of each of the variables on the yield of pulses are interpreted below:

7.1 Factors Affecting the Yield of Lentil and Mungbean

7.1.1 Land Preparation Cost(X_1)

The regression coefficients of land preparation cost were found to be positive and significant at 1 percent and 10 percent level for lentil and mungbean respectively(Table 7.1). Co-efficient of land preparation cost (X_1) was 0.189633 for lentil and 0.138957 for mungbean production. The result of the analysis indicated that, keeping other factors constant, a 1 percent increase in additional expenditure on land preparation would increase the yield of lentil and mungbean by 0.189633 and 0.138957 percent respectively.

7.1.2 Human Labour (X_2)

The regression coefficients of Human labour (X_2) were positive and significant at 5 percent level for both lentil and mungbean production. The regression coefficients of human labour (X_2) were 0.137523 and 0.224212 for lentil and mungbean production respectively, which implied that, other factors remaining the same, if expenditure on human labour was increased by 1 percent then the yield of lentil and mungbean would be increased by 0.137523 and 0.224212 percent respectively (Table 7.1).

7.1.3 Seed (X_3)

The regression coefficients of seed were 0.319748 (significant at 5 percent level) and 0.448421 (significant at 5 percent level) for lentil and mungbeanrepectively, which implied that, holding other factors constant, 1 percent increase in the amount of seed would increase the yield of lentil and mungbean by 0.319748 percent and 0.448421 percent respectively (Table 7.1).

7.1.4 Urea (X_4)

The regression coefficients of urea (X_4) were positive and significant at 5 percent level for both lentil and mungbean production (Table 7.1). The regression coefficients of urea (X_4) were 0.029387 and 0.022261for lentil and mungbean production respectively, which implied that, other factors remaining the same, if amount of urea was increased by 1 percent then the yield of lentil and mungbean would be increased by 0.029387 and 0.022261 percent respectively.

7.1.5 TSP (X_5)

The regression coefficients of TSP (X_5) were 0.014362 (significant at 10 percent level) and 0.014459 (significant at 10 percent level) for lentil and mungbeanrepectively, which implied that, holding other factors constant, 1 percent increase in the amount of seed would increase the yield of lentil and mungbean by 0.014362 and 0.014459 percent respectively (Table 7.1).

7.1.6 MoP(X_6)

The regression coefficients for MoP (X_6) were found positive but insignificant for both lentil and mungbean production (Table 7.1).

7.1.7 Cost of Insecticide (X_7)

The regression coefficient of insecticides cost (X_7) of lentil production was negative and significant at 10 percent level but positive and significant at 10 percent level for mungbean, which implied that if the expenditure on insecticides was increased by 1 percent then the yield of lentil would be decreased by 0.00694 percent and the yield of mungbean would be increased by 0.008553 percent, other factors remaining constant (Table 7.1).

7.1.8 Irrigation (X_8)

The magnitudes of the coefficients of irrigation cost were negative and insignificant for lentil production but negative and significant at 5 percent level for mungbean production(Table 7.1). The result of the analysis indicated that, keeping other factors constant, a 1 percent increase in additional expenditure on irrigation would decrease the yield of mungbean by 0.01608 percent.

7.2 Performance of the Lentil and Mungbean Production Model

The Adjusted R^2's were found to be 0.772752 and 0.853164 for lentil and mungbean, which implied that about 77.28 percent of the total variation in yield of lentil and about 85.32 percent of the total variation in yield of mungbean could be explained by the independent variables included in the model (Table 7.1). Other 22.72 percent and 14.68 percent variables depend on the factors which were not included in the regression model of lentil and mungbean. The F-values of lentil and mungbean production were about 21.83 and 36.59, and both were significant at one percent level which implied good fit of the models. Highly significant F-value implied that the included variables collectively were important for explaining the variations in yield of lentil and mungbean.

7.3 Returns to Scale in Lentil and Mungbean Production

The summation of all the regression coefficients of the estimated production function of lentil and mungbean were 0.694382 and 0.82375 respectively (Table 7.1). It indicated that the production functions exhibited a decreasing return to scale. If all the inputs specified in the function were increased by 1 percent then the yield of lentil and mungbean would be increased by 0.694382 and 0.82375 percent respectively.

7.4 Resource Use Efficiency in Lentil and Mungbean Production

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

The ratio of MVP and MFC of power tiller/tractorfor land preparation was positive and more than one in both lentil (2.70) and mungbean (2.14) production, which indicated that in the study areas power tiller/tractor was under used (Table 7.2). So, farmers should increase the use of power tiller/tractor to attain efficiency considerably.

Table 7.1: Estimated Values of Coefficients from Cobb-douglas Production Function Analysis for Lentil and Mungbean

Variables	Lentil			Mungbean		
	Co-efficient	Standard error	T-value	Co-efficient	Standard error	T-value
Intercept	2.822434***	0.454263	6.213222	2.159303***	0.431093	5.008905
Land preparation cost	0.198633***	0.051161	3.882483	0.138957*	0.082236	1.689724
Human labour cost	0.137523**	0.06612	2.079884	0.224212**	0.094117	2.382278
Seed	0.319748**	0.143711	2.224944	0.448421**	0.211186	2.123346
Urea	0.029387**	0.013922	2.110761	0.022261**	0.011112	2.003269
TSP	0.014362*	0.007883	1.821941	0.014459*	0.007941	1.820824
MoP	0.004139	0.018958	0.218324	-0.01703	0.012405	-1.37264
Cost of Insecticides	-0.00694*	0.003911	-1.77466	0.008553*	0.005126	1.668497
Cost of Irrigation	-0.00247	0.003159	-0.78206	-0.01608**	0.007531	-2.13475
Adjusted R^2	0.772752			0.853164		
F value	21.82793***			36.58829***		
Return to scale	0.694382			0.823753		
Observations (n)	50			50		

Source: Field survey, 2014.

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

Table 7.2: Estimated Resource Use Efficiency in Lentil and Mungbean Production

Variables	Lentil					Mungbean				
	GM	MVP	MFC	MVP/MFC	Comment	GM	MVP	MFC	MVP/MFC	Comment
Power tiller/Tractor	2.82	5897.42	2181.09	2.70	Under utilized	2.54	4242.50	1979.97	2.14	Under utilized
Human labour	56.71	203.04	300.00	0.68	Over utilized	54.62	318.33	300.00	1.06	Under utilized
Seed	46.39	577.09	100.00	5.77	Under utilized	44.98	773.11	100.00	7.73	Under utilized
Urea	54.99	44.74	20.00	2.24	Under utilized	34.93	49.42	20.00	2.47	Under utilized
TSP	44.25	27.17	25.00	1.09	Under utilized	41.64	26.93	25.00	1.08	Under utilized
MoP	56.65	6.12	16.00	0.38	Over utilized	32.35	-40.82	16.00	-2.55	Over utilized

Source: Field survey, 2014.

Table 7.2 revealed that the ratio of MVP and MFC of human labour was positive but less than one (0.68) in lentil production which indicated that in the study area farmers were over using the human labour. Farmers should reduce the use of human labour to reduce the total cost of production. On the other hand, the ratio of MVP and MFC of human labour was positive and more than one (1.06) in mungbean production which indicated that in the study area human labour was under used. Farmers should increase the use of human labour to attain efficiency in mungbean production.

The ratio of MVP and MFC of seed was positive and more than one in both lentil (5.77) and mungbean (7.73) production, which indicated that, in the study area, seed was under used (Table 7.2). So, farmers should increase the use of seed to attain efficiency considerably.

The ratios of MVP and MFC of both urea and TSP were positive and more than one in lentil (2.24 and 1.09 respectively) and mungbean (2.47 and 1.08 respectively) production, which indicated that, in the study area, both urea and TSP were under used (Table 7.2). So, farmers should increase the use of both urea and TSP to attain efficiency in lentil and mungbean production.

Table 7.2 showed that the ratio of MVP and MFC of MoP was positive but less than one (0.38) in lentil production.So, in the study area, farmers were over using MoP. Farmers should reduce the use of MoP to reduce the total cost of production. On the other hand, the ratio of MVP and MFC of MoP was negative and less than one (-2.55) in mungbean production which indicated that, in the study area,MoP was over-used. Farmers should reduce the use of MoP to reduce the total cost of production.

7.5 Factors Affecting the Yield of Chickpea and Blackgram

7.5.1 Land Preparation Cost (X_1)

The regression coefficients of land preparation cost were found to be positive and significant at 5 percent and 1 percent level for chickpea and blackgram respectively(Table 7.3). The regression coefficients of land preparation cost (X_1) were 0.144782 for chickpea and 0.299447 for blackgram production. The result of the analysis indicated that, keeping other factors constant, a 1 percent increase in additional expenditure on land preparation would increase the yield of chickpea and blackgram by 0.144782 and 0.299447 percent respectively.

7.5.2 Human Labour (X_2)

The regression coefficients of Human labour (X_2) were positive and significant at 10 percent level for both chickpea and blackgram production (Table 7.3). The regression coefficients of human labour (X_2) were 0.117307 and 0.216115 for chickpea and blackgram production respectively, which implied that, other factors remaining the same, if expenditure on human labour was increased by 1 percent then the yield of chickpea and blackgram would be increased by 0.117307 and 0.216115 percent respectively.

7.5.3 Seed (X_3)

The regression coefficients for seed were 0.209271 (significant at 10 percent level) and 0.137453 (significant at 5 percent level) for chickpea and blackgram respectively, which implied that, holding other factors constant, 1 percent increase in the amount of seed would increase the yield of chickpea and blackgram by 0.209271 and 0.137453 percent respectively (Table 7.3).

7.5.4 Urea (X_4)

The regression coefficients of urea (X_4) were positive and significant at 5 percent level for chickpea but negative and significant at 5 percent for blackgram production (Table 7.3). The regression coefficients of urea (X_4) were 0.031896 and -0.01622 for chickpea and blackgram respectively, which implied that, other factors remaining the same, if amount of urea was increased by 1 percent then the yield of chickpea would be increased by 0.031896 percent and the yield ofblackgram would be decreased by 0.01622 percent.

7.5.5 TSP (X_5)

The regression coefficient of TSP (X_5) was 0.031169 (significant at 5 percent level) for chickpea, which implied that holding other factors constant, 1 percent increase in the amount of TSP would increase the yield of chickpea by 0.031169 percent. On the other hand, the regression coefficient of TSP (X_5) for blackgram was found to be positive but insignificant (Table 7.3).

7.5.6 MoP(X_6)

The regression coefficients for MoP (X_6) were found negative and insignificant for chickpea but positive and significant at 10 percent level for blackgram(Table 7.3). The regression coefficient of MoP (X_6) was 0.012724for blackgram, which impliedthat, other factors remaining the same, if amount of MoP was increased by 1 percent then the yield of blackgram would be increased by 0.012724 percent.

7.5.7 Cost of Insecticide (X_7)

The regression coefficients of cost of insecticides (X_7) were negative and significant at 1 percent level for chickpea but positive and significant at 10 percent level for blackgram production (Table 7.3). The regression coefficients of cost of insecticides (X_7) were -0.01102and 0.008258 for chickpea and blackgram respectively, which implied that, other factors remaining the same, if amount of urea was increased by 1 percent then the yield of chickpea would be decreased by 0.01102 percentand the yield ofblackgram would be increased by 0.008258 percent.

7.5.8 Irrigation (X_8)

The regression coefficients of irrigation (X_8) were found to be positive but insignificant for both chickpea and blackgram production (Table 7.3).

7.6 Performance of the Chickpea and Blackgram Production Model

The Adjusted R^2's are found to be 0.762243 and 0.76995for chickpea and blackgram, which implied that about 76.22 percent of the total variation in yield of chickpea and about 76.99 percent of the total variation in yield of blackgram could be explained by the independent variables included in the model (Table 7.3). Other 23.88 percent and 23.01 percent variation was dependent on the factors which are not included in the regression model of chickpea and blackgram respectively. The F-values of chickpea and blackgram production were about 20.64 and 21.50 respectively, and both were significant at one percent level which implies good fit of the models. Highly significant F-value implied that the included variables collectively were important for explaining the variations in yield of chickpea and blackgram.

7.7 Returns to Scale in Chickpea and Blackgram Production

The summation of all the regression coefficients of the estimated production function of chickpea and blackgram were 0.509037 and 0.665364 respectively (Table 7.3). It indicated that the production functions exhibited a decreasing return to scale. If all the inputs specified in the function were increased by 1 percent then the yield of chickpea and blackgram would be increased by 0.509037 and 0.665364percent respectively.

Table 7.3: Estimation Values of Coefficients from Cobb-douglas Production Function Analysis for Chickpea and Blackgram

Variables	Chickpea			Blackgram		
	Co-efficient	Standard error	T-value	Co-efficient	Standard error	T-value
Intercept	3.796736***	0.589568	6.439863	1.92393**	0.849069	2.265929
Land preparation cost	0.144782**	0.069783	2.074738	0.299447***	0.087835	3.409187
Human labour cost	0.117307*	0.07108	1.650356	0.216115*	0.114368	1.889639
Seed	0.209271*	0.108585	1.927246	0.137453**	0.066713	2.060364
Urea	0.031896**	0.012572	2.537181	-0.01622**	0.007582	-2.13915
TSP	0.031169**	0.01258	2.477621	0.005156	0.007565	0.681477
MoP	-0.01657	0.010309	-1.60786	0.012724*	0.007588	1.676973
Cost of Insecticides	-0.01102***	0.004099	-2.6873	0.008258*	0.004325	1.909353
Cost of Irrigation	0.002202	0.004967	0.443322	0.002431	0.003026	0.803154
Adjusted R^2	0.762243			0.76995		
F value	20.63658***			21.49968***		
Return to scale	0.509037			0.665364		
Observations (n)	50			50		

Source: Field survey, 2014.

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

Table 7.4: Estimated Resource Use Efficiency in Chickpea and Blackgram Production

Variables	Chickpea					Blackgram				
	GM	MVP	MFC	MVP/MFC	Comment	GM	MVP	MFC	MVP/MFC	Comment
Power tiller/Tractor	2.52	3629.23	1892.26	1.92	Underutilized	2.13	8278.94	1923.66	4.30	Under utilized
Human labour	46.79	158.37	300.00	0.53	Over utilized	45.14	281.94	300.00	0.94	Over utilized
Seed	55.14	239.74	95.00	2.52	Underutilized	42.28	191.45	85.00	2.25	Underutilized
Urea	25.37	79.42	20.00	3.97	Underutilized	44.12	-21.65	20.00	-1.08	Over utilized
TSP	40.22	48.95	25.00	1.96	Underutilized	37.29	8.14	25.00	0.33	Over utilized
MoP	27.25	-38.41	16.00	-2.40	Over utilized	19.83	37.79	16.00	2.36	Underutilized

Source: Field survey, 2014.

7.8 Resource Use Efficiencyin Chickpea and Blackgram Production

Resource use efficiency in chickpea and blackgram production was considered as it was considered for lentil and mungbean production.

The ratio of MVP and MFC of power tiller/tractor for land preparation was positive and more than one in both lentil (1.92) and mungbean (4.30) production, which indicated that, in the study areas, power tiller/tractor was under used (Table 7.4). So, farmers should increase the use of power tiller/tractor to attain efficiency in production considerably.

The ratio of MVP and MFC of human labour was positive but less than one in both chickpea (0.53) and blackgram (0.94) production which indicated that, in the study areas, farmers were over using the human labour (Table 7.4). Farmers should reduce the use of human labour to reduce the total cost of production.

The ratio of MVP and MFC of seed was positive and more than one in both chickpea (2.52) and blackgram (2.25) production, which indicated that, in the study areas, seed was under used (Table 7.4). So, farmers should increase the use of seed to attain efficiency in production considerably.

Table7.4 revealed thatthe ratios of MVP and MFC of both urea and TSP were positive and more than one (3.97 and 1.96 respectively) in chickpea production, which indicated that both urea and TSP were under used. So, farmers should increase the use of both urea and TSP to attain efficiency in chickpea production. On the other hand, the ratio of MVP and MFC of urea was negative and less than one (-1.08) in blackgram production, but the ratio of MVP and MFC of TSP was positive and less than one (0.33), which indicated that both urea and TSP were over utilized. So farmers in the study area should reduce the use of urea and TSP to minimize cost of blackgram production.

The ratio of MVP and MFC of MoP was positive and more than one (2.36) in blackgram production, which indicated that MoPwas under used in blackgram production. Farmers should increase the use of MoP to attain efficiency in blackgram production. On the other hand, the ratio of MVP and MFC of MoP was negative and less than one (-2.40) in chickpea production which indicated that, in the study area,MoP was over-used. Farmers should reduce the use of MoP to reduce the total cost of chickpea producing (Table 7.4).

CHAPTER 8
COMPARATIVE ADVANTAGE OF LENTIL

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. If the opportunity costs are less than the border price, then the country has a comparative advantage in the production of that crop.

8.1 Traded Intermediate Inputs

There are commodities which are either imported or exported. In the case of Bangladesh three types of chemical fertilizers viz., Urea, TSP and MoP were considered as traded intermediate inputs. Irrigation equipment and pesticides are also traded intermediate inputs, but detailed cost of production figures for irrigation equipment was not available. Since the cost of imported pesticides constituted minor proportion of input cost, the item was not taken into account in the estimation of cost of traded intermediate input costs. Cost of traded intermediate inputs per hectare divided by the yield of lentil (mt/ha) to convert the traded intermediate inputs into taka per metric tonne.

8.2 Non-Traded Intermediate Inputs and Domestic Resources

In Bangladesh, unskilled agricultural human labour, seed, manure, insectiside, irrigation and interest on operating capital are generally considered as non-traded intermediate inputs and domestic resource because these components do not usually enter the international market. The payments for non-traded intermediate inputs and domestic resources were also converted into per unit of output by adjusting yields. Methodologically, these items were to be valued at opportunity cost. In Bangladesh, the factor markets are fairly competitive; so payment for non-traded intermediate inputs and domestic resources fairly represented the opportunity cost of these resources.

8.3 Domestic Resource Cost (DRC) for Lentil

The results of DRC and some of its calculation are presented in Table 8.1, and 8.2. The results can vary whether the DRC calculation has been done based on import parity border prices. This depends actually on the tradability status of any specific commodity.

DRC calculation for lentil has been done based on import parity prices. However, the results of the calculated DRC for lentil are presented and discussed below.

Table 8.1: Calculation of Import Parity Border Prices for Lentil

Items	**Unit**	**Lentil**
A. CIF (Cost, Insurance and Freight) price at Chittagong	US$/mt	1100.00
B. CIF (Cost, Insurance and Freight) price at Chittagong	Tk/mt	84898.00
C. Marketing margin from the port	Tk/mt	3516.72
Import handling cost	Tk/mt	2348.61
Transportation cost	Tk/mt	1016.00
Domestic trading cost	Tk/mt	152.11
D. Border price at wholesale level (B+C)	Tk/mt	88414.72
E. Components of the marketing spread between the wholesale market to the produce level	Tk/mt	15199.44
Cost from mill gate to wholesale	Tk/mt	110.04
Milling cost	Tk/mt	308.61
Adjustment at 67% milling rate	Tk/mt	12270.60
Interest cost	Tk/mt	490.30
Cost from farm gate to mill gate	Tk/mt	2019.89
F. Border price of farm produce at farm gate (D-E)	Tk/mt	73215.28

Source: Own calculation by using data setof Kazal*et al.*, 2013.
Note: 1 US$=77.18 BDT

To calculate the import parity border prices for lentil, CIF (Cost, Insurance and Freight) price at Chittagong, marketing margin from the port and components of the marketing spread between the wholesale markets to the produce level was calculated. Then border price at wholesale level calculated by adding CIF price at Chittagong and marketing margin from the port. Border price of farm produce at farm gate was calculated by subtracting components of the marketing spread between the wholesale markets to the produce level from border price of farm produce at farmgate.

Table 8.2: Calculation ofDomestic Resource Cost(DRC) for Lentil

Items	**Unit**	**Lentil**
A. Traded inputs	Tk/mt	5364.20
Urea	Tk/mt	1608.22
TSP	Tk/mt	2228.97
MoP	Tk/mt	1527.01
B. Non-traded inputs and domestic resources	Tk/mt	40802.30
Land preparation	Tk/mt	4635.25
Human labour	Tk/mt	13752.49
Seed	Tk/mt	3577.78
Insecticide	Tk/mt	831.42
Irrigation	Tk/mt	1761.69
Land rent	Tk/mt	15325.67
Interest on operating capital	Tk/mt	918.01
C. Price of output	Tk/mt	65000.00
D. Value added (tradable) (C-A)	Tk/mt	59635.80
E. Domestic resource cost (B/D)		0.68

Source: Field survey, 2014 andown calculation by using data setofKazal*et al.*, 2013.
Note: 1 US$=77.18 BDT

The DRC value for lentil was found 0.68(Table 8.2) which is less than 1, indicates that Bangladesh had a comparative advantage in producing lentil domestically for import substitution. This is because the opportunity cost of domestic resources and non-traded inputs used in producing the selected crops is less than the foreign exchange earned or saved. This is plausibly attributed to the higher yield of improved lentil varieties resulting to the lower cost of production per unit of land.

CHAPTER 9
SUMMARY, CONCLUSION AND RECOMMENDATION

This chapter focuses on the summary in the light of the discussions made in the earlier chapters. Conclusion has been made on the basis of empirical result. Policy recommendations are drawn for improvement of the existing inefficiency of lentil, mungbean, chickpea and blackgram production in Bangladesh.

9.1 Summary

Pulses have become important crop in Bangladesh due to its higher yield, nutritional value and versatile uses. Demand of pulses in Bangladesh is augmenting day by day due to increasing population. Higher production of pulse depends on the expansion of High Yielding Varieties (HYV) and hybrid variety of seed, improved management and timely supplying of inputs. The rate of adoption of modern technology and sustainability of pulseproduction depend largely on its economic profitability. The efficient use of resources is an important indicator of increased production in agriculture. Efficient utilization of inputs is indispensable for higher productivity. In Bangladesh, the problem of food insecurity can be met by increased food diversification. Pulse grows within a short time period and intercropping is possible with other crops. But, till today,pulse has attained the status of only a very minor crop in Bangladesh. The present study was conducted to determinethe profitability andresources use efficiency of lentil, mungbeaan, chickpea and blackgram.Beside these, comparative advantage of lentil was also done.

Out of 16 districts in the northern region of Bangladesh, Rajshahi and Pabna districts have been purposively selected. Rajshahi district has been selected for chickpea and blackgram, while Pabna district has been selected for lentil and mungbean. The study areas were selected on the basis of intensive cultivation of those crops. Simple random sampling technique has been used for collecting cross sectional data and information from a total of 200 farmers (lentil-50, mungbean-50, chickpea-50 and blackgram-50) who are cultivating improved varieties of pulses, especially, varieties released from BARI.All the collected data were summarized and scrutinized carefully to eliminate all possible errors. Data were presented mostly in the tabular form. Descriptive statistics like average, percentage etc. were followed to analyze the data to achieve the objectives of the study. Functional analysis was also adopted in a small scale to arrive at expected findings. A Cobb-Douglas production function was used to estimate the factors affecting the yield of pulses. Domestic Resource Cost (DRC) of lentil was calculated and compared with import parity prices to assess the comparative advantage of lentil production.

It was revealed from thestudy that in Ishwardi, 53.07 percent of the sample populations were male and 46.93 percent were female.On the other hand, in Godagari, 52.52 percent and 47.48 percent were male and female, respectively. About 67.00 percent and about 68.00 percent of the populations were under 15-64 years age group in Ishwardi and Godagari, respectively. The sex ration in Ishwardi and Godagari were found 113 and 111 male per 100 women. The dependency ratios of the study population were estimated at 48.52 and 46.21. Marital status of the household population aged 16 years or moreindicated that about 30.00 percent and 33.00 percent were married in Ishwardi and Godagari, respectively. About 18.00 percent and 17.00 percent of the study population, aged 5 years or more, were found to have no formal education in Ishwardi and Godagari, respectively. The occupation of the study population, aged 16 years or more, showed that about 38 percentand 35 percent were engaged in agriculture as a main occupationin Ishwardi and Godagari, respectively. It was also revealed from the study that about 44.00 percentand 37.00 percent were engaged in agriculture as a subsidiary occupationin Ishwardi and Godagari, respectively.Most farmers lived in a nuclear family. The study indicated that, in Ishwardi, 36.00 percent respondent households were found to earn more than Tk. 300000 in a year. On the other hand,In Godagari, 38.00 percent respondent households were found to earn more than Tk. 300000 in a year. Among the pulse producers, 90.00 percentmungbean producers got training on different agricultural technologies followed by chickpea producers (82.00 percent), lentil producers (80.00 percent) and blackgram producers (76.00 percent). Among the pulse producers, 64.00 percent lentil producers were found to have membership in different NGOs and/or farmers' organizations followed by mungbean producers (56.00 percent), chickpea producers (52.00 percent) and blackgram producers (48.00 percent).

Costs and returns were calculated to identify the financial profitability of pulse farmers. Cost items were identified as land preparation, human labour, seed, urea, TSP, MoP, irrigation, insecticide, interest on operating capital and land use cost. All these cost were accounted for one production period of pulses. Per hectare gross return of lentil, mungbean, chickpea and blackgramwere calculated at Tk. 90200.00, Tk. 84412.00, Tk. 68510.00 and Tk. 64957.00, respectively. Total costs of lentil, mungbean, chickpea and blackgramwere calculated at Tk.57855.91, Tk. 52995.25, Tk. 49754.73 and Tk. 44455.14 per hectare, respectively. Net returns of lentil, mungbean, chickpea and blackgramwere calculated at Tk. 32344.09, Tk. 31416.75, Tk. 18755.27 and Tk. 20501.86 per hectare, respectively. Benefit Cost Ratios (BCRs)were found to be1.56, 1.59, 1.38 and 1.46 for lentil, mungbean, chickpea and blackgram, respectively. The net returns of four pulses were found to be positive and the BCRs were greater than one, which showed that the cultivation of lentil, mungbean, chickpea and blackgram were profitable.

Production function analysis suggested that land preparation cost, human labour cost, seed, urea and TSP had a positive and significant effect on the yield of lentil,mungbean, chickpea and blackgram, except for, urea had a negative but significant effect on the yieldof blackgram. Apart from these,MoP and irrigation cost had insignificant effect on the yield of mostly four pulses, except for, MoP had a positive and significant effect on the yield of blackgram and irrgation cost had a positive and significant effect on the yield of mungbean.Cost of insecticides had negative but significant effect on the yield of lentil and chickpea, and had a positive and significant effect on the yield of mungbean and blackgram. The Adjusted R^2swere found to be 0.772752,0.853164, 0.762243 and 0.76995 forlentil, mungbean, chickpea and blackgram, respectively, which implied that about 77.28 percent, 85.32 percent, 76.22 percent and 77.00 percent of the total variation in yield of lentil, mungbean, chickpea and blackgram, respectively, could be explained by the variables included in the models. The F-valuesof the estimated production functions of lentil, mungbean, chickpea and blackgram were foundto be significant at one percent level which implies good fit of the models. Therefore, all the explanatory variables included in the models were important for explaining the variation of lentil, mungbean, chickpea and blackgram production. Efficiency analysisindicated that most of the farmers inefficiently used their inputs. Some of them made excessive and some of them made less use of inputs.

The DRC value for lentil was found to be less than one (0.68) indicating that Bangladesh had comparative advantage in producing lentil for import substitution. This is plausibly attributed to the higher yield of improved lentil varieties which resulting to the lower cost of production of per unit of land.

9.2 Conclusion

Based on the findings, it can be concluded that lentil, mungbean, chickpea and blackgram production areprofitable. Although farmers were not aware about the right doses of inputs which could increase the cost of production to some extent, so it is necessary to make the farmers aware about efficient use of resources. Pulses, especially lentil, mungbean, chickpea and blackgram,can also help in improving the nutritional status of the rural people. As Bangladesh has comparative advantage for lentil cultivation, concern authorities need to take necessary steps to increase the area under lentil cultivation. The present and future demand oflentil, mungbean, chickpea and blackgram should be determined through a comprehensive study in order to initiate a well plannedpulse production programme at national level.

9.3 Recommendations

On the basis of the findings of the study, the following specific recommendation may be made for the development of pulse sector.

a) As Lentil, mungbean, chickpea and blackgram are profitable enterprise, government and concern institutions should provide adequate extensionprogramme to expand their area and productionproduction.

b) Lentil,mungbean, chickpea and blackgrambased cropping pattern should be developed and disseminated to those areas of Bangladesh where their production is suitable.

c) Farmers could be encouraged to employ more inputs in lentil, mungbean, chickpea and blackgram production which are under-used and which have positive significant impact on yield through extension programme.

d) Government should take necessary measures to lower the price of inputs which have positive significant impact on yield and which are under-used. It will increase the net benefit of lentil, mungbean, chickpea and blackgram producers.

e) Adequate training on recommended fertilizer dose, insecticides, water management practices, use of good seed, intercultural operations, etc., should be provided to the lentil, mungbean, chickpea and blackgramfarmers which willenhance productionas well as resource use efficiency by improving the technical knowledge of the farmers.

f) Further in-depth studies need to be conducted to identify the factors influencing the yield of lentil, mungbean, chickpea and blackgram.

g) Comparative studies between pulse crops and their competing crops should be conducted to understand the obstacles in adopting pulse based cropping pattern.

9.4 Limitations of the Study

There are some limitations of the study as the study conducted on the farmers of the country through interview schedules.

a) Most of the data collected through interview of the farmers so sometimes they were not well-cooperated with the interviewer.

b) The information gathered mostly through the memories of the farmers which were not always correct.

c) Pulses are sometimes grown without much care practices so the record of the expenses or profit were not remembered by the farmers.

d) In the resource and time constraints, broad and in-depth study got hampered to some extent.

e) Due to lack of data set and further study, it was not possible to assess the comparative advantage of mungbean, chickpea and blackgram.

REFERENCE

Afzal, M.A., Bakr, M.A. and Rahman, M.L. (1999).Lentil cultivation in Bangladesh.Lentil, Blackgram and Mungbean Development Pilot Project, Pulses Research Station, Bangladesh Agricultural Research IInstitute, Gazipur-1701.

Afzal, M.A., Hamid, A., Bakr, M.A., Sarker, A., Erskine, W., Haque, M. and Aktar, M.S.(2004).Technology Dissemination to Boost Pulse Production and Human Nutrition in Bangladesh.Proceedings of the 4th International Crop Science Congress. Brisbane, Australia, 26 September-01 October, 2004.

Alam, J. (2004). Enhancing Sustainable Development of Diverse Agriculture in Bangladesh.UNESCAP-CAPSA. Centre for Alleviation of Poverty through Secondary Crops' Development in Asia and the Pacific.

Badal, P.S., Kumar, P. and Bisaria, G. (2008). An Analysis of Technical Efficiency in Production of Mungbean (*Vigna radiate*L.). *Internat. J. Agric. Sci.***4**(1): 321-324.

BBS (2006).*Yearbook of Agricultural Statistics*, Bangladesh Bureau of Statistics, Ministry of Planning, Government of the People's Republic Bangladesh, Dhaka.

BBS (2010).*Statistical Yearbook of Bangladesh*, Bangladesh Bureau of Statistics, Ministry of Planning, Government of the People's Republic Bangladesh, Dhaka.

BBS (2011a).*Yearbook of Agricultural Statistics*, Bangladesh Bureau of Statistics, Ministry of Planning, Government of the People's Republic Bangladesh, Dhaka.

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

BBS (2011c).*Population Census -2011*, Bangladesh Bureau of Statistics, Ministry of Planning, Government of the People's Republic Bangladesh, Dhaka.

BBS (2012).*Statistical Pocketbook of Bangladesh 2012*, Bangladesh Bureau of Statistics, Ministry of Planning, Government of the People's Republic Bangladesh, Dhaka.

Begum, M.E.A. and D'Haese, Luc. (2010). Supply and demand situations for major crops and food items in Bangladesh, *Journal of Bangladesh Agricultural University***8**(1): 91–102.

BER (2014).*Bangladesh Economic Review*, Department of Finance, Ministry of Finance, Government of the People's Republic of Bangladesh, Dhaka.

Bruno, M. (1972).Domestic Resource Costs and Effective Protection: Clarificationand Synthesis. Journal of Political Economy. 80: 16-33 (cited in Nelson and Panggabean, 1991).

Elias, S.M., Hossain, M.S., Sikder, F.S., Ahmed, J. and Karim, M.R. (1986).Identification of constraints to pulse production with special reference to present farming systems.Annual Report of the Agricultural Economic Division, Bangladesh Agricultural Research IInstitute, Joydebpur,Gazipur-1701.p.1.

FAOSTAT (2013).Food and Livestock Products, FAOSTAT data, Food and Agricultural Organization of the United Nations, Rome, Italy.http://faostat3.fao.org/faostat-gateway/go/to/browse/T/TP/E

Fried, M. and Middelboe, V. (1977).Measurement of amount of nitrogen fixed by legume crop.*Plant and Soil* **47**: 713-715.

Haque, A.H.M.M. (2011). Quality Improvement of Stored Seeds of Mungbeans, Lentil andChickpeas in Farmers Storages.Pulse Research Sub-Station, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur-1701.

Haque, M.A., Miah, M.A.M., Ali, A.M. and Luna,A.N. (2014).Adoption ofMungbeanTechnologies and Technical Efficiency of Mungbean (*Vignaradiata*) Farmers inSelected Areas of Bangladesh.*Bangladesh J. Agril. Res.***39**(1): 113-125.

Islam, Q.M.S., Miah,M.A.M. and Alam, Q.M. (2007).Productivity and Profitability of Mungbean Cultivation in Selected Areas of Bangladesh.Agricultural Economics Division, Bangladesh Agricultural Research Institute,Joydebpur, Gazipur-1701.

Islam, Q.M.S., Miah, M.A.M., Rahman M.S. and Hossain, M.S. (2013). Adoption of BARI MungVarieties and Its Constraints toHigher Production in Southern Region of Bangladesh.*Bangladesh J. Agril. Res.***38**(1): 85-96.

Islam, Q.M.S., Rahman, M.S. and Hossain, M.S. (2009). Technical Efficiency of Mungbean Growers in Selected Coastal Areas of Bangladesh.Agricultural Economics Division, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur-1701.

Karim, M.R., Islam, M.N.,Bakr, M.A. and Hossain, M.I. (2014). Profitability and Technical Efficiency of BARI Improved Mungbean Cultivation in Selected Areas of Bangladesh. AgriculturalEconomicsDivision, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur-1701.

Kazal, M.M.H., Rahman, S.,Alam, M.J. and Hossain, S.T. (2013). Financial and Economic Profitability ofSelected Agricultural Crops in Bangladesh.Department of Management and Finance, Sher-e-Bangla Agricultural University (SAU), Dhaka-1207.

Kumar, S.and Bourai, V.A. (2012).“Economic Analysis of Pulses Production: Their Benefits and Constraints” (A Case Study of Sample Villages of Assan Valley of Uttarakhand, India).*IOSR Journal of Humanities and Social Science (IOSR-JHSS).***1**(4):41-53.

Magar,D.B.T., Gauchan, D. and Darai, R. (2014). Varietal Adoption and Marketing of Lentil in the Mid and Far-Western Terairegion of Nepal. Department of Plant Breeding, Genetics and Agronomy, NepalAgricultural Research Council, National GrainLegumes Research Program, Rampur, Chitwan, Nepal.

Miah, M.A.M. and Haque, A.K.E. (2013).Policy Options for Supporting Agricultural Diversification in Bangladesh.Department of Agricultural Economics, BangladeshAgricultural University, Mymensingh, Dhaka.

Miah, M.A.M., Haque, A.K.M.H., Islam, K.M.S.,BakarM.A., and Akter, M.S. (2004).Adoption of Improved Pulse Technologies in Selected Areas of Bangladesh: A Farm Level Study. Agricultural Economics Division, Bangladesh Agricultural Research Institute,Joydebpur, Gazipur.

National Encyclopedia ofBangladesh 2014,AsiaticSocietyofBangladesh, Vol.: 7, pp. 182-185, Vol.: 10, pp. 349-350.

Rahman, M. S., Hossain, M.A.,Sarker, M.J.U. and Bark, M.A. (2012).Adoption andProfitability of BARI Lentil Varietiesin Some Selected Areas of Bangladesh.*Bangladesh J. Agril. Res.***37**(4): 593-606.

Rao, K.D. and Kyle, S.C.(1997).Effective Incentives and Chickpea Competitiveness in India.Department of Agricultural, Resource, and Managerial Economics, Cornell University, Ithaca, New York 14853-7801, USA.

Salami, P.and Ahmadi, H. (2010).Energy Inputs and Outputs in a Chickpea Production System inKurdistan, Iran.*African Crop Science Journal*, **18**(2): 51–57.

Sarker, A., Erskine, W.,Bakr, M.A., Rahman, M.M., Mohan, M.A.A. and Saxena C.(2004). Lentil Improvement in Bangladesh:A Success Story of Fruitful Partnership between Bangladesh Agricultural ResearchInstitute and International Center for Agricultural Researchin the Dry Areas. Asia-Pacific Association of Agricultural Research Institutions (APAARI), FAO-RAP, Maliwan Mansion, 39 PhraAtit Road, Bangkok 10200, Thailand.

Senanayake, L., Knievel, D.P. and Stevena, S.E. (1987).Nodulation and symbiotic nitrogen fixation of cowpea (*Vignaunguiculata*L.).*Plant Soil* **99**: 435-439.

SFYP (2011).*The Sixth Five Year Plan,* Planning Commission, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka.

Shahabuddin, Q. and Dorosh, P.(2002).Comparative Advantage in Bangladesh CropProduction.Markets and Structural Studies Division, International Food Policy Research Institute. 2033 K Street, N.W.Washington D.C. 20006, USA.

Zapata, F., Danso, S.K.A., Hardarson, G. and Fried, M. (1987). Nitrogen fixation and translocation in field-grown fababean.*Agronomy Journal* **79**: 505-509.

APPENDICES

Table A-1: Area and Production of selected pulses in Bangladesh, 2001-02 to 2010-11

Year	Lentil		Mungbean		Chickpea		Blackgram	
	Area	Prod.	Area	Prod.	Area	Prod.	Area	Prod.
2001-02	388355	115205	112480	31095	37955	11120	65210	19150
2002-03	380685	115590	109495	29580	37405	11100	62900	18960
2003-04	382380	122225	107890	29655	34370	10380	61870	18440
2004-05	380130	121065	60180	17935	32345	9630	57360	17190
2005-06	332695	115370	55325	16870	31450	9760	57675	17400
2006-07	339905	116810	60290	18675	31100	9810	57505	18190
2007-08	179354	71535	59717	20628	23101	7168	58918	20557
2008-09	175328	60537	53557	17890	20206	6551	61303	21837
2009-10	190982	71100	57462	20177	17850	5744	79287	28356
2010-11	205024	80442	67779	19445	20335	6605	78475	28855

Source: BBS, 2006 and 2011