

**PROFITABILITY ANALYSIS OF POTATO
CULTIVATION: A STUDY AT DEBIGANJ THANA UNDER
PANCHAGARH DISTRICT**

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***DEDICATED
TO
MY BELOVED PARENTS***



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CERTIFICATE

This is to certify that the thesis entitled **“PROFITABILITY ANALYSIS OF POTATO CULTIVATION: A STUDY AT DEBIGANJ THANA UNDER PANCHAGARH DISTRICT”** submitted to the Department of Development and Poverty Studies, Faculty of Agribusiness Management, Sher-e-Bangla Agricultural University, Dhaka in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE in DEVELOPMENT AND POVERTY STUDIES**, embodies the result of a piece of bonafide research work carried out by **SUBIR KUMAR SAHA**, Registration number: **07-02305** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

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

Dated:
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ABSTRACT

The present study was basically designed to assess the “Profitability Analysis of Potato Cultivation: A Study at Debiganj Thana under Panchagarh District”. Farmers were randomly selected for data collection purpose. The selected villages were Debganj Sadar, Pamoli, Kaligonj, Vaulagonj, Dabiduba and Sonahar under Debiganj thana in Panchagarh district. Descriptive statistics and Cobb- Douglas production function were employed to achieve the objective of the study. The major findings of the study revealed that the potato production was profitable. Per hectare total cost of potato was 193779.34 TK and the gross return was 299500.00 TK. Per hectare net return for potato production is 105720.66 TK. The results of the Cobb- Douglas production function indicated that the gross return of the potato production were highly influenced by the human labour, seedlings, irrigation, manure, fertilizer, insecticide etc. The present study shows that there were some constrains in the production of potato. These problems were shortage of financial capital, high price of input, low price of output, lack of quality seed, inadequate extension services etc. It showed that inefficient management of potato cultivation may turn into loss. So the effective management of potato, enough cold storage facility was required for the highest net return of the potato cultivation. For these Bangladesh government should have play vital role for the effective management of potato. At the end of the study some policy and recommendation of the potato production are given for the view of effective management purpose.

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The Author

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CHAPTER 1

INTRODUCTION

1.1 Introduction of the study

Bangladesh is predominantly an agricultural country where agriculture sector plays a pivotal role in accelerating the economic growth. Potato (*Solanum tuberosum*) is the leading vegetable in the world. It is originated South American such as Peru, Ecuador etc. It has high nutritive value. It supplies more carbohydrate combination with many others items of food. Since provision of food security, improvement of living standard and employment opportunity of the huge population of the country are directly linked to the development of agriculture. With a view to developing the agriculture sector, the following steps should be included, these are the expansion of small irrigation facilities, enhancing the production of domestic food grains, production of improved quality and high yielding varieties of seeds and their preservation and distribution, development and expansion of the varieties of crops adaptable for the weather and environment of a particular region and producing crops suitable for a particular type of land as well as proper use of fertilizers (Heady and Dillion,1961).

The agricultural sector comprises crops, forests, fisheries and livestock. Agriculture is one of the drivers of growth of Bangladesh economy. While agriculture contributed 15.96 percent to the Gross Domestic Product (GDP) in FY 2014/15 (BBS, 2015). The growth of broad service sector, particularly the growth of wholesale and retail trade, hotel and restaurants, transport and communication sector is strongly supported by the agriculture sector. Besides, around 43.6 percent of the total labour-force of the country is engaged in agriculture sector (BBS, 2015). Agriculture being the engine of growth of Bangladesh economy. Since provision of food security, improvement of the living standard and generation of employment opportunities of the huge population of the country are directly linked to the development of agriculture. Potato production plays vital role for accelerating the growth of agricultural sector. Bangladesh stood ninth position in the potato production throughout the world (BBS, 2015). Debiganj is a place of Panchagarh district where group based potato cultivation has been practiced. Now potato and different potato products such as potato chips are exported in different countries. It helps to earn foreign currencies. In the winter season it grows well. The climate of our country

is favorable for potato cultivation. From the very beginning of Bangladesh, agriculture sector is characterized by some cropping patterns of which cultivation of potato is the most important one. It is very unlikely that a farmer does agricultural activities but does not cultivate potato.

Table 1.1 Cultivated areas of Panchagarh under different crops in 2010/11

Crop	Area(ha)	Percent
Boro	9080162.00	30.61
Aman	8004332.00	26.99
Aus	7474492.00	25.20
Wheat	3248554.00	10.95
Potato	381375.50	1.28
Vegetable	426680.16	1.44
Sugarcane	116433.20	0.39
Cotton	456802.62	1.54
Others	467802.52	1.59
Total	29656634.00	100

Source: BBS, 2014

Table 1.1 shows that in 2010/11 total rice crop area covers the highest percent of production area and potato covers only 1.28 percent of the total area of Panchagarh district.

The growth of crop production now depends almost entirely on technological progress and intensive farming by introducing better management for all the food crops and other enterprises to be produced. Aiming to food security cropping pattern as well as farming systems have been changed by the farmers with the introduction of new technology and better management. Under these farming situation farmers also changed their land use patterns and introduce new enterprise combination along with rice production which is the most important in Bangladesh. Potato (*Solanum tuberosum*) is the leading vegetable of the World. It has high nutritive value (Suraiya, 2008). It supplies more carbohydrate combination with many other items of food. Per 100gm of edible raw part of potato gives: Moisture -75percent, Carbohydrates -15.09g, Protein -1.89g, Total fat -0.10g, Cholesterol -0g, Dietary fiber -2.5g, Energy- 97 Kcal. 10 Vitamins: Folates -18mcg, Niacin -1.149mg, pantothenic acid- 0.279 mg, Pyridoxine- 0.239mg, Riboflavin - 0.038mg, Thiamine- 0.081mg, -Vitamin C- 11.4mg, Vitamin A-7 I.U, Vitamin K-

2.9micro gm. (www.health-galaxy.com) Electrolytes: sodium-10gm, potassium-455mg. Minerals: calcium-10gm, iron-.073mg, magnesium-22gm, manganese-0.141mg, phosphotus-61mg, zinc-0.33mg. Phyto-nutrients: carotene beta-4mcg, carotene alpha-0mcg (Dillon and Hardaker, 1993).

Table 1.2 Potato production at Panchagarh district 2007-2008 to 2013-2014

Year	Area ('000'hectare)	Production ('000' tones)
2007-2008	402.73	647.0
2008-2009	395.8	526.8
2009-2010	434.7	630.0
2010-2011	381.0	500.0
2011-2012	604.4	826.0
2012-2013	645.5	850.0
2013-2014	700.0	889.0

Source: BBS, 2014

Table 1.2 shows that in 2011-2012 area of total cultivation increase and it increase the potato production.

1.2 Justification of the study

The density of population in Bangladesh is much higher compared to that of other countries of the world. There is little scope of bringing more land under cultivation due to limited cultivable area. As the infrastructural and development activities are increasing, it makes the cultivable land smaller and smaller. Realizing this situation, government of Bangladesh has placed much emphasis on potato production to meet the nutritional need for growing population and for increasing employment opportunities and income of farmers. In this context, potato may be considered as to important diversified winter crops, which may deal pride such opportunities (BER, 2015). Before giving emphasis on the production of potato, relevant and adequate information on different aspects of production of potato at farm level are required. Such knowledge of production is also necessary to make appropriate decision by the growers especially when several alternatives are open to them. However, some systematic economic investigations on this potato production may have undertaken either by the government or private organization in order to satisfy the demand of extension workers, policy makers, research personnel, NGO officials and the farmers. The present study is an attempt to analyze the profitability of potato production and to identify the main factors that affect the yields. Therefore, the

individual farmers would be benefited from this study for effective operation and management of their farms. The result of this study will be helpful to the planner for making effective and judicious plan. This study will be helpful to the research workers for further studies of similar nature and to extension personnel that are directly involved in the different agricultural development programs and help them to learn about various problems of the selected winter vegetables. Therefore, they will be able to give suggestions to the farmers various aspects of potato production. It will also be helpful to the policy makers who serve the farmers centrally for macro level policy, decision and planning.

1.3 Objectives of the study

The objectives of the study are given bellow:

- i. To know the socioeconomic characteristics of the potato producing farmers.
- ii. To measure the profitability of the potato producing farmers.
- iii. To determine factors affecting the gross return of the potato producing farmers.
- iv. To identify the major problems associated with potato production.
- v. To suggest some policy guidelines/recommendations.

1.4 Outline of the study

The study consists of nine chapters. Chapter 1 describes introduction of the study, Chapter 2 relevant of literature. Chapter 3 deals with the methodology of the study. In Chapter 4, a brief description of the study area is presented. Socioeconomic characteristics of the sample farmers are presented in Chapter 5. Chapter 6 estimated and analysis the costs and returns of the potato production. The results of Cobb- Douglas production function analysis are given in Chapter 7. Chapter 8 is designed to identify production problems of the potato growers. Finally, conclusion and recommendations of the study are presented in Chapter 9.

CHAPTER 2

REVIEW OF LITERATURE

The purpose of this chapter is to review some previously completed researches related to the present study. The economic studies on potato production are limited in Bangladesh. Some of the important works regarding present study are reviewed here.

Nahar, (1998) reported that the farmers of Mymensingh district were very happy much to get the bumper production of potato in 1998. About 20 thousand farmers of the upazilla, who were cultivating potato on there a total of 180 hectares of land, were brought under potato cultivation in that year. The cultivator easily can earn taka 50 to 60 thousand except investment cost from one hectare of land.

Hossin, (2004) conducted a research on a comparative economic analysis of some selected high yielding varieties of winter vegetables in an area of Bangladesh. The major findings of the study revealed that production of all selected homestead potato were profitable. Per acre gross cost of production of potato Tk 75215.50 and gross returns were Tk 148540. Per acre net returns of potato was Tk 73324.50. Benefit cost ratio of was 1.97.

Rahman, (1993) conducted a cooperative study of HYV potato and wheat production in some area of Jamalpur District. Potato cultivation is getting popular in Jamalpur. Farmers have become inclined because sustainable cost and good production.

Rahman, (2000) conducted An women's employment in Bangladesh agriculture: composition determinants and scope. The major findings of the study were that the potato production were profitable from the viewpoint of marginal, small, medium and large farmers and it helps to women employment.

Suraiya, (2008) studied on an economic analysis of some selected summer vegetables production in Purbadhala Upazila of Netrokona District. The selected vegetables were potato, okra, white gourd and snake gourd. The major findings of the study revealed that all the selected vegetables cultivation were profitable.

Roy, (1993) conducted a research on relative profitability of potato-based cropping patterns in Bangladesh: A study in a selected area of Lalmonirhat district. He found that sixty three percent potato growers reported that their income, 57.00 percent children education, 80.00 percent household furniture increased due to potato production. Improvement of health and sanitation for potato growers was better than before. Sixty three percent overall socioeconomic improvements occurred due to potato cultivation. Finally he found that livelihood of potato farmers were better off than before and from non-potato growers.

Shaikh, (1997) conducted a study on Agricultural Research and Development in Bangladesh: Present and Future, Agribusiness. The study found that in exporting marketing channels the vegetables farmers sold their major portion of potato to selected agents. The study revealed that it was more profitable to export potato to Asian countries compared to Middle East countries. Although profit was the highest in exporting potato to EU countries, there exists a lot of formalities and risk for exporting potato in those countries. The fresh vegetable exporters were facing problems in exploiting export market due to lack of required cargo facilities and high freight rate charge by the Biman Bangladesh Airlines.

Miah, (1987) conducted a study in Sadar thana of Mymensingh district to assess the performance of crops and potato producing on the marginal land and resource efficiency of the farmers. It revealed that all the crops were found to be profitable in terms cash cost, full cost and variable costs but HYV Boro and jute gave negative returns in many cases. Profitability's of different cropping patterns were compared in respect to farm size and types of land. In case of small farms cropping pattern Bean- Teasle gourd, Pumpkin leaf. Amaranth- Amaranth- T. Aman and black gram gave the highest gross margin for high, medium high and low land respectively. In the case of medium farmers land, gross margin the highest for Banana- Pumpkin leaf- okra- water spinach and potato for high, high and low land, respectively. In the case of large farmers, Banana gave the highest gross margin for high and medium high land and Rabi chilli for low land. In order to measure the efficiency to dominant cropping patterns, rice grain equivalent, land use efficiency and production efficiency were calculated. In the most cases, these are the highest in the cases of vegetable based cropping patterns. He found that in the most of the vegetable production the MVP of human labour was greater than one and it was also

significant implying that it was a very crucial input and there prevails a greater chance to generate employment. In general, however, farmers appeared to be rational in the use of resources in producing crops and potato. The author conducted that the sample farmers found potato production more profitable than other crops.

Islam and Karim, (1997) conducted a study to assess the comparative profitability of selected winter vegetables like potato, cauliflower and tomato. It revealed that all the vegetables were profitable. Per hectare total costs of production of potato, cauliflower and tomato were tomato Tk. 51396.79, Tk. 64406.06 and Tk. 61663.87, respectively and the corresponding gross incomes were Tk. 99401.44, Tk. 119165.12 and Tk. 93442.24, respectively. The estimated net return of producing potato, cauliflower and tomato were Tk.48004.65, Tk. 54759.06 and Tk. 31778.38 respectively. However, for producing three alternate winter vegetables, net returns was the highest for cauliflower followed by potato and tomato. It was also found that there was a large variation of yields in producing these winter vegetables among different categories of farmers. In the case of producing potato and cauliflower, per hectare yield was the highest for small farmers followed by medium and large farmer.

Hossain, (1997) carried out a study on a comparative economic analysis of some selected high yielding varieties of winter vegetables such as potato, cucumber, cauliflower and cabbage production in an area under Baraigram thana in the district of Natore. Author observed that the per hectare gross returns potato, cucumber, cauliflower and cabbage were Tk. 74725, Tk. 75847, Tk. 62313 and Tk. 59626, respectively. He found that cucumber growers received the highest per hectare gross and net returns above cash costs. He also found that the variation in yield was greatly by the use of human labour, animal labour, and application of fertilizer, date of transplanting / sowing and date of harvesting. These factors were directly or jointly responsible in yields of winter vegetables.

Badiuzzaman, (1993) carried out a research on identification and evaluation of optimal patterns for an irrigated area in Madhupur Thana in Tangail district. He found that seven cropping patterns under irrigated condition, the best pattern was found to be Banana + Ginger + Potato/tomato/garlic followed by the second patterning pattern Teaselgourd + ginger + Bottle gourd /country bean-chilli.

Haque, (1993) conducted a study on the comparative profitability of sweet potato and groundnut with particular reference to small farmers in six villages under Kuliachar thana of Kishoreganj district. He showed that both sweet potato and groundnut were profitable enterprise.

Hakim, (1993) carried out a comparative economic analysis of cardinal and multa variety of in Kotwali thana in Bogra district. He found that the average per hectare total costs of production including costs were Tk. 32097 and Tk. 30819 for cardinal and multa varieties of potato. The respective costs amounted to Tk. 115896 and 12702. The average net returns per hectare on full-cost basis were Tk.28995 and 26994 for producing carnal multa varieties of potato, respectively and their respective average net returns over cash costs were Tk.45197 and 45112.

Sejuty, (1993) studied two alternative cropping patterns: Potato+Boro (HYV) + Aman and Wheat +T.Aman +T.Aus in two villages namely Dumuria and Thangao in Chandina thana of Comilla district. He found that the gross return from potato was Tk. 57533 per hectare and net return above full cost was Tk. 1709 per hectare. He also observed that cropping patterns, i.e Potato+Boro (HYV) +T. Aman yielded higher net returns than wheat based cropping pattern, i.e. Wheat +T. Aman+ T.Aus.

Basak, (1992) undertook a study in three villages of Gabtoli thana in Bogra district and found that the average returns to each taka spent on full-costs and cash-costs were Tk. 1.53 and 3.43 for LV and Tk. 1.69 and 3.62 for HYV, respectively. The farmer's preference for potato was found to be mainly due to high returns and consumptions.

The above review reveals that some studies have already done concerning potato production. However, no study has so far been reported in Debganj sadar, Pamoli, Kaligonj and Vaulagonj under Debiganj thana in Panchagarh district. Therefore it is expected to bring into focus important information regarding profitability analysis of potato cultivation in the study area.

CHAPTER 3 METHODOLOGY OF THE STUDY

3.1 Introduction

This chapter represents the methodology followed in this study, which included the selection of study area, selection of samples, collection of data and analytical techniques. The design of any survey mainly depends on the aims and objectives of the study and it is again dependent on the availability of necessary resources, materials and time. Proper methodology is a prerequisite of a good and scientific research. There are various methods of collecting information for a socioeconomic research. A farm business study usually involves collection of information from individual farmers; collection of data for farm business analysis involves judgment of the analyst in the selection of data collection methods within the limits imposed by the resources available for the work. The word survey refers to the method of study in which an overall picture of a given universe is obtained by a systemic collection of all available data on the subject (Yang, 1965). In this study, "survey method" was employed mainly due to two reasons:

- Survey enables quick investigations of large number of cases; and
- Its results have wider applicability.

Survey method is more advantageous than other methods of data collection. This method is less expensive and its coverage is much wider. The major defect of survey method is that the investigator has to rely upon the memory of the respondents/farmers when answering the question. To overcome this problem, repeated visits were made to collect information in the study area and in the case of any omission or contradiction the farmers were revisited to obtain the missing and correct information. The methodology followed in this study involves the following Steps.

3.2 Selection of the study area

Six villages namely Debiganj upazila sadar, Sonaher, Vowlaganj, Kaliganj, Dabiduba and Pamoli were selected for this study. This area were selected because potato grows well in this area. The study sites were selected with the consultation of relevant agricultural offices for systematic sampling. Sometimes the farmer became uncomfortable to give the

adequate information in Pamoli and Dabiduba. People of the Pamoli and Dabiduba were not so educated so they didn't appreciate this to give adequate information.

Table 3.1 Selected study areas for primary data collection:

Thana	villages
Debiganj	1. Debiganj Sadar
	2. Kaliganj
	3. Sonaher
	4. Vaolaganj
	5. Dabiduba
	6. Pamoli

3.3 Selection of sample and sampling techniques

In selecting samples for a study two factors need to be taken into consideration (Dillon and Hardaker,1993). The sample size should be as large as to allow for adequate degrees of freedom in the statistical analysis. On the other hand, administration of field research, processing and analysis of data should be within the limitation imposed by physical, human and financial resources. Because of diversity in the technical and human environment, it is necessary to several numbers of the population before any conclusion can be drawn. Therefore, the purpose of sampling is to select a sub-set of the population that is representative of the population.

It is not possible to include all the farmers in area studied due to limitation of time, money and personnel. A Systematic sampling technique was followed in the present study for minimizing cost, time and to achieve the ultimate objectives of the study. It is also called an Nth name selection technique. About 50 farmers producing potato were selected to achieve the ultimate objective of the study. The farmers were selected through a maintained procedure. Firstly, collected the list of potato growers in the study area were with the help of agricultural extension officer. The growers were 950 in the study area. Secondly, The potato growers were divided by the sample size (50) and gets result 19. Thirdly, The potato growers were selected in every 19 intervals from the potato grower list.

3.4 Preparation of interview schedule

For collecting data through survey method, preparation of interview schedule is of crucial need. In conformity with the objectives of the study, a draft schedule was prepared in such a way that all factors associated with the economic organization and performance of the farm business could be included. A set of interview schedule was prepared for eliciting desired information from the farmers. The draft survey schedule was pre tested by interviewing some farmers of the study area. In the pre-test survey, attention was paid to inclusion of any new information which was not included in the draft schedule. Thus, the draft schedule was improved, rearranged and modified in the light of the actual and practical experiences. After making necessary adjustments, a final survey schedule was developed in logical sequences. The final interview schedule included the following information:

- i. Identification of the sample farmers;
- ii. Farm size of the sample farmers;
- iii. Family size and composition, availabilities and use of family labour and occupation of the sample farmers;
- iv. Use of material inputs for cultivation of potato;
- v. Yield, output, cost and return of potato; and
- vi. Problems faced by the farmers and their solutions.

3.5 Period of data collection

In this study, the relevant primary data were collected by the author himself through personal interviews. Data were collected for whole production season of potato. However, the formal data were collected during April, 2014.

3.6 Method of data collection

The researcher himself collected the relevant data from the selected farmers through face to face interview. Before taking actual interviews the whole academic purpose of the study was explained to the sample farmers. Initially, the farmers were hesitated to answer the question; when they were assured that the study was purely an academic one and it would not affect them adversely then they were co-operative with the researcher. At the

time of interview, the researcher asked questions systematically and explained the questions whenever it was felt necessary. Farmers were requested to provide correct information as far as possible. After each interview was over, the interview schedule was checked so as to ensure that information to each item had properly been recorded. If there were such items which was over looked or contradictory, were corrected by another interview. In order to minimize the errors, data were collected in local unit, but later those were converted into standard international units. During the period of data collection, the author had to face the following problems:

- i. Most of the farmers in the study area were illiterate and they had no idea about farm management research study and therefore, it was difficult to explain the purpose of this research and convince them;
- ii. The farmers did not keep any written records of their farming business. Therefore the author had to depend upon their memory;
- iii. The farmers always hesitated to give the correct information about their size of holding, income and expenses. They thought that if they would provide correct information, new taxes would be imposed to them or their land would be acquired by the government; and
- iv. On many occasions, farmers were not available at home and therefore the author had to give extra efforts and time to collect the required information.

3.7 Accuracy of the data

The following measures were taken during the period of data collection to minimize the possible errors:

- i. Built - in- check the interview schedule;
- ii. Field checking; and
- iii. Independent re- interviewing of the respondents.

In case of any inconsistency and lapses, the neighboring farmers were asked for necessary verification and data were checked and corrected through repeated visits. In order to ensure consistency and reliability of the parameters being generated out of the data, follow up visits were also made to the field to obtain supplementary information. Data were collected both at farmers house and in the field. Most of the farmers in the

selected area were illiterate. So they didn't have enough knowledge. Sometimes they became very uncomfortable for the giving information. To maintain the accuracy and reliability of the data field checking and re-interviewing were played vital role for the research study of the selected area.

3.8 Processing of data

After collecting requisite data, they were processed and analyzed with a view to achieve the objectives of the study. The primary data collected from the farmers were processed (edited and coded) and computerized using MS Excel and SPSS 14.0 (Statistical Package for Social Science). All the collected qualitative and quantitative data were analyzed in accordance with the set objectives of the study so as to answer the issues involved in the study.

3.9 Analytical technique

Data were collected in accordance with the specified design to accomplish the objectives set for the study. In the present study, the following analytical techniques were used.

3.9.1 Activity budget

Activity Budget is the technique that is commonly followed to find out the crude association or differences between variables and output. This technique was applied with the help of some statistical measures like the sum, average, percentage etc. to show the relationship between the selected variables. To determine per hectare Income for selected potato farming from the view point of individual farmers, the following algebraic equation was followed.

$$\pi = TR - TC$$

Here, It is showed in the equation that net returns of potato cultivation will increase when total cost of potato production will decrease. This is directly affected towards the net return of the potato production. Total cost of potato production mainly depends on Human labour cost, tillage cost, seed cost, Urea cost, MOP cost, TSP cost, Irrigation cost, Insecticide cost and manure; oil cake cost. Total revenue of potato production mainly

depends on the total production of the selected area and the price of the potato. Group based potato cultivation is occurred in Debiganj thana under Panchagarh district. So the group cultivation directly affect towards the people of the selected area. For the potato production human labour, seed, Urea, MOP, TSP, Irrigation, Insecticide and manure; oil cake become available in the selected area. So people of the selected area are highly encouraged to produce potato. Bombay sweets company also conducted their activities in the selected area.

The equation (Heady and Dillon,1961) of measuring profitability is written bellow:-

$$\pi = \sum Q_y \cdot P_y + \sum Q_b \cdot P_b - \sum (X_i \cdot P_{X_i}) - TFC$$

Where,

π = Net returns from potato (Tk/ha)

Q_y = Total quantity of potato outputs (kg/ha)

P_y = Per unit prices of potato (Tk/kg)

Q_b = Total quantity of concentrated by product (kg/ha)

P_b = Per unit prices of the relevant by product (Tk/kg)

X_i = Quantity of the concerned i^{th} inputs

P_{X_i} = Per unit prices of the relevant i^{th} inputs

TFC = Total fixed cost involved in production

$i = 1, 2, 3, \dots, n$ (number of inputs)

3.9.2 Cobb-Douglas production function model

Cobb-Douglas production function model was chosen to estimate the effects of key variables on production processes of potato. The double log form of the Cobb-Douglas production function model proved to be a superior alternative on theoretical and econometric grounds. Thus Cobb-Douglas model was selected for this study. The Cobb-Douglas production function model has the following characteristics:

- i. The function is linear in logs;
- ii. The exponents are the elasticity of production and can be used directly;
- iii. Total variations in the output explained by the selected inputs are measured by coefficient of multiple determination;

- iv. The individual co-efficient represents relative factors share if there is constant returns to scale; and
- v. For testing the significance level of individual co-efficient having sufficient degrees of freedom, 1 percent, 5 percent and 10 percent probabilities are used.

The Cobb–Douglas function form can be estimated as a linear relationship using the following expression:

$$\ln(Y) = a_0 + \sum a_i \ln(I_i);$$

Where,

Y= Output

I_i = Input

a_i = Model co-efficient

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

$$Y = a X_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4} X_5^{b_5} X_6^{b_6} X_7^{b_7} X_8^{b_8} X_9^{b_9} e^{u_i}$$

By taking ln in both sides the Cobb-Douglas production function was transformed into the following logarithmic form, because it could be solved by the ordinary least squares

$$(\text{OLS}) \text{ method } \ln Y = \ln a + b_1 \ln x_1 + b_2 \ln x_2 + b_3 \ln x_3 + b_4 \ln x_4 + b_5 \ln x_5 + \dots + b_9 \ln x_9 + u_i$$

Where,

Y = Gross return (Tk/ha);

X₁ = Human labour cost (Tk/ha);

X₂ = Tillage cost (Tk/ha);

X₃ = Seed cost (Tk/ha);

X₄ = Urea cost (Tk/ha);

X₅ = MOP cost (Tk/ha);

X₆ = TSP cost (Tk/ha);

X₇ =Irrigation cost (Tk/ha);

X₈ = Insecticides cost (Tk/ha);

X₉ = Manure and oil cake (Tk/ha);

a = Constant or intercept term;

b₁, b₂, ---, b₉ = Coefficients of the respective input variables to be estimated; and

u_i = Error term.

3.10 Major cost items

Estimation of cost was exclusively necessary for enterprise costing and subsequently determining the profitability of the enterprise from the point of view of farmers. Farmer's decision about production is mainly influenced by the cost of inputs. Input used in the study area was both purchased and family supplied. Thus the total production costs consisted of cash and non-cash expenses. Farmers had to pay cash for the purchased inputs like hired labour, seeds, fertilizers, insecticides, irrigation water charge, manure etc. It was easy to calculate the costs of these items. On the other hand, for the home supplied inputs i.e., family labour, seeds etc costs were estimated by applying the opportunity cost principle. In determining the opportunity cost of an individual enterprise the relevant input price is the value forgone by replacing this input from another enterprise. The input items were valued at the existing market price in the area during survey period or the prices at which the farmers really bought the inputs. A list of cost items and their estimation procedure has been discussed under the following heads:

- i. Human labour cost;
- ii. Tillage cost;
- iii. Seeds cost;
- iv. Fertilizers cost;
- v. Manures and oilcake cost;
- vi. Insecticides cost;
- vii. Irrigation water cost;
- viii. Interest on operating capital;

3.10.1 Cost of human labour

Human labour was the most important input in producing potato. In pricing the labour no discrimination was made between the family and hired labour. Family labour was paid in cash as hired labour. There was no fixed wage rate all over the season and different wage rates were found for different activities in different seasons. In the survey area, the average wage rate was Tk. 300.00 per person-day.

3.10.2 Cost of tillage

Tillage cost was used by the farmers for land preparation for producing potato. There was a competitive rate for power tiller used in the study area. The payment involved charge for land preparation use of the power tiller and the driver. It was very difficult to separate the cost for the power tiller and the driver. A power tiller owner supplied fuel as well as driver for land preparation. The farmers paid the charge for power tiller used at a fixed rate prevailing in the area.

3.10.3 Cost of seed

In Bangladesh potato growers usually used both home supplied and purchased seeds. The cost of purchased seeds was calculated on the basis of actual price paid by the farmers. The costs of home supplied seeds were valued at the market price.

3.10.4 Cost of fertilizers

In the study area farmers used different kinds of fertilizers for high yield of potato production. They normally used Urea, Triple Super Phosphate (TSP) and Muriate of Potash (MOP). Costs of these fertilizers were estimated according to the price paid by the farmers.

3.10.5 Cost of manures and oilcake

For producing potato most of the farmers used manures such as cow dung and oilcake. The cost of purchased cow dung and oilcake were calculated at the prevailing local market prices. It was also charged for farm supplied manure.

3.10.6 Cost of insecticides

Most of the sample farmers used insecticides in producing potato such as Bistarin, Basudin, Darsbun, Fenfen, Kenalux, Nockroch, Nogos, Pairiven, etc. The cost of these insecticides was estimated as the actual price paid by the farmers.

3.10.7 Cost of irrigation water

In the study area most of the farmers used irrigation water for producing potato. Shallow tube-well irrigation was widely applied in the study area. Some farmers had their own shallow tube-well to irrigate their crop field, while others bought irrigation water from the shallow tube-well owners. In the study area, only one payment system was practiced; under this system farmers had to pay cash Taka for irrigation water charge per unit of land. The cost of irrigation water was estimated as the actual amount of money paid by the farmers.

3.10.8 Interest on operating capital

Interest on operating capital (OC) was determined by taking all costs incurred on various operations in the process of cultivation of potato. It was assumed that if the farmers borrowed the money from a bank, they had to pay interest at the same rate. It was estimated by using the following formula (Miah, 1987):

$$\text{Interest on operating capital} = \text{AI} \times i \times t$$

Where:

$$\text{AI} = (\text{Total investment}) / 2$$

i = Rate of interest

t = Period of crop cultivation (in month)

The interest was charged at the rate of 10 percent per annum. The period considered for an enterprise ranged from the time of land preparation to the harvesting of the crop, i.e. 3 months each for potato cultivation.

CHAPTER 4 DESCRIPTION OF THE STUDY AREA

4.1 Introduction

This chapter attempts to focus on a brief description of the study area where the sample farmers were located. To understand the activities of the farmers, their attitude, possible development opportunities and potentials as well as the limitations, it was necessary to know about the selected study areas. The following salient features of the study area have been designed to focus mainly on the existing agricultural status and supporting services available in the study area.

4.2 Location of the study area

Keeping in view the main objectives of the study six villages namely Debiganj upazila sadar, Sonaher, Vowlaganj, Kaliganj, Pamoli and Dabiduba were selected for this study. The study sites were selected with the consultation of relevant agricultural offices. The selected villages are situated near Debiganj Thana.

4.3 Soil types and land topography

The soil of the selected village is alluvial type. The features of the soil vary from sandy loam to loam. The top soil consists of 10 to 15 cm thick surface layer. The colour of the layer varies from gray to dark gray. The land surface of the study area is plain. The soil of the villages is fertile. Distribution of agricultural land types of Panchagarh district is presented in Table 4.1:

Table 4.1 Distribution of agricultural land types of Panchagarh district

High land (ha)	Medium high land (ha)	Medium low land (ha)	Low land (ha)	Very low land (ha)	Total (ha)
6565296	5588265	4562295	7523284	5417494	29656634

Source: BBS, 2014

Table 4.1 shows that in Panchagarh District total agricultural land is 29656634.00 (ha) where low land area is maximum and this kind of land is used for potato cultivation.

4.4 Climate, temperature and rainfall

Climate means the regular pattern of weather conditions (temperature, humidity, rain, wind, fog, etc.) of a particular place. Like other areas of Bangladesh, the selected study area also comprised in tropical monsoon climate. There was no arrangement for recording temperature and rainfall in the study area. As a result, exact climate data were not known. However, the climate of the study areas is similar to that in other parts of Panchagarh district. The Panchagarh Meteorological Office keeps records of temperature and rainfall. Therefore information available in the Panchagarh district regarding temperature, rainfall and humidity was used.

Table 4.2 Monthly temperatures, humidity and rainfall in Panchagarh district

Month	Maximum temperature (°C)	Minimum temperature (°C)	Average humidity (percent)	Rainfall (mm)
January	22.02	10.7	83	1
February	27.3	15.03	73	12
March	29.9	19.7	73	32
April	31.9	21.8	77	80
May	31.7	23.5	82	239
June	32.0	25.9	85	449
July	31.6	26.1	86	333
August	32.3	26.2	86	741
September	32.2	26.1	84	242
October	32.3	23.8	83	18
November	28.7	16.9	81	0
December	24.05	13.6	81	0

Source: BBS, 2014

Table 4.2 shows that in the month of November and December there is no rainfall average humidity is 81 maximum temperature is 28.7 and minimum temperature is 13.6 which is favorable to grow potato in Panchagarh district.

The climate of the study area is warmed and humid; but moderately cold and dry weather prevails in winter. Maximum and minimum temperature in the study area varies from 29.6°C to 20.8°C. Cold weather persisted from November to February and hot temperature prevailed during March to October. However, the extremely low temperature is observed during the period from December to January, while the extremely high temperature exists in June and September. The average maximum temperature was the

highest in May which was 33⁰C and the average minimum temperature was recorded in January which was 10.7⁰C. The average humidity percentage of the study area was the highest humidity percentage was recorded as 86 percent in July and August. The lowest humidity percentage was recorded as 73 percent in February and March. The rains are usually started from late April and continue up to September. The maximum rainfall is about 741 mm with the highest during the month of August and the lowest 001 during the month of October (BBS 2015).

4.5 Area and population

According to the Census Report (Population census, 2011) of the study areas namely Debiganj upazila sadar, Sonaher, Vowlaganj, Kaliganj, Pamoli and Dabiduba were selected for this study area, the total area and number of population in these villages were 11.28 km² and 16836, respectively of which, 8712 was male and female number was 8124. The total number of households was 3531.

Table 4.3 Area and population of study area

Area (km ²)	Population (person)	Male (person)	Female (person)	Sex ratio	No of Household
11.28	16836	8712	8124	1.07	3531

Source: Population census, 2011

Table 4.3 shows that the sex ratio is 1.07 almost equal number of male and female are supplied and they are engaged in group based potato production.

4.6 Farm and non-farm sources of income and economic condition

Agriculture is the main occupation and source of employment of the people in the study area. About 70 percent of households have agriculture as the main source of income. A small number of people are engaged in services in different government and non-government organization and they have agriculture as the secondary occupation. The main income sources of landless and small farmer's are wage earning, rickshaw and van pulling as well as running petty business. There are no special facilities for employment of destitute woman in the village.

4.6.1 Agriculture

In the study area the principle crop is rice which grown in two seasons namely Aman and Boro. Besides rice, other crops namely jute, mustard, wheat, pulses and vegetables like potato, carrot, cauliflower, cabbage, sweet potato, brinjal, bottle gourd, bean, radish, spinach, lalshak etc are grown in the village. Farming of the study area is mostly traditional. However many of the farmers follow modern seed-water-fertilizer technology. Some farmers have started to use insecticides. In dry season a large number of farmers also use shallow tube-well.

4.6.2 Livestock

The farmers of the study area raise cattle, goat, sheep, chicken and duck. Monitoring of information indicated that chicken and duck population gradually increased per farm in the village. This was due to intervention through improved breed, management and regular vaccination program which reduced mortality.

4.7 Educational institution and religion

The literacy rate (aged 7 years and above) of the study area 61.34 percent for both sexes of which 53.26 percent for male and 46.74 percent for female. The area was found to have primary school, high schools and madras's. Female education was generally confined unto the primary level but the attitude regarding female education was changing into positive direction. A good numbers of students belonging to both sexes were reportedly attending different school and college studied in Panchagarh district. The majority of the villagers of the study area were muslims and few were hindus . Debiganj N. N. Govt. high school and Alodini School which is situated in Debiganj thana under Panchagarh district. These two schools are very familiar in Panchagarh District. Primary and Kindergarten school of these area plays vital role to reduce the illiteracy rate of these study area. People of different religion lives here peacefully. Most of the people of the local area are Muslim, some are Hindus. People of different cultures live here very peaceful life. They celebrate their different cultural programs.

CHAPTER 5

SOCIOECONOMIC CHARACTERISTICS OF THE SAMPLE FARMERS

5.1 Introduction

Socioeconomic characteristics of the farmers are important in influencing production planning. A person differs from one another in many aspects. Behavior of an individual is largely determined by his/her characteristics. Socioeconomic characteristics of the farmers influence their farm decision making. A number of socioeconomic aspects of the sample households were examined. These were age distribution, composition of family size, level of education, occupation, and dependency ratio and farm size and land ownership pattern.

5.2 Age distribution of sample farmers

All categories of farmers of the study area were grouped into different ages represented in Table 5.1. It is evident from the Table 5.1 that none of the owners had the age below 20 years. The classified groups were 20 to< 30 years, 30 to<40 years, 40 to <50 years, 50 to <60 years and above 60 years. Table 5.1 shows that out of the total potato growers, 10 percent belonged to the age group of 20 to<30 years, 20 percent fell into 30 to<40 years, 32 percent belonged to the age group of 40 to<50 years, 28 percent fell into 50 to<60 years and 5.00 percent of them were above 60 years age group.

Table 5.1: Distribution of the Sample Farmers According to Age Groups

Age group (years)	20 to<30 (years)	30 to<40 (years)	40 to<50 (years)	50 to<60 (years)	Above 60 (years)	All groups (years)
Potato farmer	5 (10)	10 (20)	16 (32)	14 (28)	5 (10)	50 (100)

Source: Field survey, 2014

Note: Values in the parentheses indicate the percentages of total farmers.

Table 5.1 shows that the major populations of potato growers were in the most productive age group, which was 40 to<50 years.

5.3 Composition of family size

In this study, a family was defined as total number of persons living together and having meals from the same kitchen under the administration of the same head of the family. The term family includes husband, wife, sons, unmarried daughters, brothers, father and mother. Sometimes unemployed brothers, unmarried sisters and persons who have been employed in farm family for household works like servants, caretakers etc. have been included as the family members.

Table 5.2 shows that the average size of the family of the potato growers in the study area. Potato growers had the largest family size consisting of 5.14 members. The proportion of male members was the highest for potato grower's family (53.89 percent) and the female portion is 46.10. Thus the total family size for potato growers was 5.14.

Table 5.2 Family size by age and sex of the potato growers of the study area:

Ages	Male (Number)	Female (Number)	Total (Number)
Up to<7 years	0.51 (9.92)	0.56 (10.81)	1.07 (20.81)
7 to<15 years	0.62 (12.06)	0.59 (11.47)	1.21 (23.53)
15 to<25 years	0.57 (11.08)	0.42 (8.13)	0.99 (19.25)
25 to<57 years	0.95 (18.48)	0.65 (12.64)	1.6 (31.12)
Above 57	0.12 (2.33)	0.15 (2.91)	0.27 (5.24)
Total	2.77 (53.89)	2.37 (46.10)	5.14 (100)

Source: Field survey, 2014

Note: Values in the parentheses indicate the percentages of total farmers.

Table 5.2 shows those 25 to<57 years old male and female member are highly occupied in potato cultivation.

5.4 Occupational status

The selected farmers of the study area were engaged in various types of occupations, although agriculture was the main source of employment for the people of the study area. The work in which a person engaged throughout the year is known as the main occupation of that person (Roy, 1993). Besides agriculture, some farmers were engaged

in petty business; some were engaged in government, semi- government, non-government schools, madras ; some of them were engaged in rural non- farm activities like weaving, rickshaw pulling, shop keeping and other wage earning activities. The occupations of the farmers were classified into two broad groups: main and subsidiary. Table 5.3 shows that incase of potato growers 60 percent farmers had agriculture, 30 percent had business and 10 percent had service as their main occupation.

Table 5.3 Occupational status of the sample farmers

Primary occupation of potato farmers	Potato farmers (Number)	Potato farmers (Percentage)
Agriculture	30	60
Business	15	30
Service	5	10
Total	50	100

Source: Field survey, 2014

Table 5.3 shows that about 60 percent of the potato farmers were depended on agriculture. Other 30 percent of the potato farmers were took it as a secondary occupation as they involved in other business. Other 10 percent of the potato farmers pursue as a service holder and cultivate potato as well.

5.5 Dependency ratio

Each and every family is rationally composed of both income earners and dependents.

Table 5.4 Dependency ratio of the sample households

Categories	Numbers
Earning members through potato	2.85
Family members	5.14
Dependency ratio	1.80

Source: Field survey, 2014

Note: Depending ratio = Total family members ÷ Total earning members. Table 5.4 appears from the table that dependency ratio for potato growers were 1.80 in the study area.

5.6 Land distribution pattern

Land tenure refers to the possession of and the right to the use of all types of land in the study area. Land distribution of farmers is presented in Table 5.5.

Table 5.5 Average land distribution of the sample farmers

Land type	Potato area (ha)	Potato percentage	Other area (ha)	Other percentage	Total area (ha)
Homestead area	0.06	10.16	0.05	8.19	0.11
Area under crops and fisheries	0.31	52.54	0.36	59.01	0.67
Area under vegetables	0.22	37.29	0.20	32.79	0.42
Total	0.59	100	0.61	100	1.20

Source: Field survey, 2014

Table 5.5 shows that the average farm size of the sample farmers was 1.20 hectares 0.42 ha occupied by vegetables; 0.11 ha belongs to homestead area for both potato and other crop growers; 0.67 ha area under crops and fisheries respectively.

5.7 Concluding remarks

From the above discussion it is clear that there are some variations in socioeconomic characteristics of potato growers. But the magnitude of variations was not large. Well planned management training in accordance with their problems, needs, goals and resource base can lead to viable production practices and sustainable income from potato.

CHAPTER 6

PROFITABILITY OF POTATO CULTIVATION

6.1 Introduction

The main purpose of this chapter is to assess the costs and returns through potato production. Moreover, an attempt has been made to compare the costs and returns of growing per hectare potato. Hence, costs and returns of potato are estimated in this chapter. For calculating the costs and returns of potato production, the costs items were classified in to two groups: (1) variable cost; and (2) fixed cost. Variable cost included the cost of all variable factors like human labour, tillage, seed, fertilizer, manure and oil cake, irrigation water, and insecticides. On the other hand, fixed cost was calculated for interest on operating capital. On the return side net return and undiscounted benefit cost ratio (BCR) were determined in this chapter.

6.2 Variable cost

6.2.1 Cost of human labour

Human labour was considered the most important and largely used input in producing potato. It shared a large portion of total cost of potato production. Human labour is required for various activities and management such as land preparation, weeding, fertilizing, using insecticides and herbicides, harvesting etc. There were two sources of human labour in the study area, one was family supplied labour and another one was hired labour. The valuation of hired labour was done as the nominal cash wages paid to the farmers. It can be seen from Table 6.1 that the amount of human labour used for potato cultivation was 325 man days per hectare. Total cost of human labour amounted to Tk. 97500 per hectare. The valuation of family supplied labour was done as the average wage of the hired labour was taken as the opportunity cost of the family supplied labour. It can be observed that potato growers used on an average 325 man-days/ha total human labour where on an average 100 man-days/ha was family supplied labour. In the study area on an average wage rate was Tk 300.00 per man-day. So, total cost of family supplied labour for potato amounted to Tk 30000.00 per hectare. Table 6.1 shows that for the operation of weeding and mulching and harvesting carrying most of the human labour

were forced to operate the activities. Here 18.6 percent of the human labour is involved in the operation of weeding and mulching. According to the table, it is found that 60 people out of 325 were involved in weeding and mulching. If people get 300 tk per day then it will be cost 18000 tk which is 18.46 of the total. For the operation of harvesting and carrying 95 people out of 325 is involved in these activities. If people get 300 tk per day then it will be cost 28500 which is 29.23 percent of the total. As the potato production is the labour intensive work. It reduces the unemployment problem. Group based potato cultivation in the selected area plays vital role for the reduction of the poverty at Debiganj thana in Panchagarh district.

Table 6.1 : Operation wise per hectare human labour cost of potato production

Operation	Total labour (Man-days)	Total cost (TK)	Percentage of total
Land preparation	50	15000	15.38
Sowing	23	6900	7.08
Weeding and mulching	60	18000	18.46
Fertilizer, manure and insecticide application	45	13500	13.85
Irrigation	12	3600	3.69
Harvesting and carrying	95	28500	29.23
Others	40	12000	12.31
Total	325	97500	100

Source: Field Survey, 2014

Table 6.1 shows that harvesting and carrying cost is the highest cost item during potato production in Debiganj .

6.2.2 Cost of tillage

For potato production the average per hectare tillage cost was Tk 5187.00. In percentage terms it shared 2.71 percent of total cost (Table 6.3).

6.2.3 Cost of seeds

The cost of seed is the single most important cost item for potato production. In the study area, it was found that farmers used both home supplied and purchased seeds. The total amount of seed requirement per hectare for producing potato were 1200 kg/ha. The average prices of seeds were Tk 48 per kg for potato production. Table 6.3 shows that the total cost of seeds for potato production was Tk 56700.00, which shared 28.92 percent of total cost. To maintain the higher production high yield variety is required for the production. TPS (true Potato seed) is available in Debiganj thana under Panchagarh district. The production of these seed is very satisfied. So the agricultural extension officer always advice to use these TPS.

6.2.4 Cost of fertilizers

It was found that farmers used different kinds of fertilizer in producing potato. Such as Urea, MOP, TSP and Gypsum. The cost of urea is TK 6600.00 and the others are TK 3000.00, TK 3750.00, TK 200 respectively.

6.2.5 Cost of manure and oil cake

They also used cow dung and oil cake as manure. In this study total manure and oil cake cost is 7000.00 Tk per hectare when per unit manure and oil cake cost is 1.00 Tk (Table 6.3).

6.2.6 Cost of irrigation

Irrigation water is an important input in winter potato cultivation. Per hectare cost of irrigation water was Tk 7000.00 for potato which represented 3.65 percent of their respective total cost (Table 6.3).

6.2.7 Cost of insecticides

In the study area, farmers applied insecticides to protect from the attack of pests and diseases. Cost of insecticides amounted to Tk 3550 per hectare for potato, which represents 1.85 percent of their respective total cost (Table 6.3).

6.2.8 Total variable cost

Summation of the costs of variable inputs gave the total variable costs which were Tk 191387.00 per hectare for potato production. In percentage terms total variable costs covered 98.76 percent of total costs for potato.

6.3 Fixed costs

6.3.1 Interest on operating capital

Interest on operating capital was calculated by taking into account all the operating costs incurred during the production period of potato. Per hectare interest on operating capital was Tk 2392.34 for potato production. Which covered 1.24 percent for potato production (Tables 6.4).

6.4 Total cost

In order to estimate total cost per hectare all the resources used in potato production has been recapture together. Per hectare total cost of potato production was Tk 193779.34 (Tables 6.5).

Activity budgets: Per hectare potato production are written bellow:-

Table 6.2 : Gross returns

Items of returns/cost	Unit	Quantity	Price per unit (TK)	Total value(Tk)	% of total
Main product	Kg	19500.00	15.00	292500.00	97.66
By-product	TK	n.a	-	7000.00	2.34
Total returns	TK	-	-	299500.00	100.00

Source: Field Survey, 2014

Here gross returns of the potato production is= (Main product+ By-product).

In case of potato production return of by products in very difficult. But in our local area potato chips is one of the most popular food items. The valuation of by-product of potato is very little. Total value of by products is 7000 tk which is 2.34 percent of the total. The

quantity of main product is 19500 Kg. If the price of the potato per unit is 15.00 then it becomes the total value of potato main product is 292500. it is considered as the 97.66 percent. So the gross return of the potato production is= (292500.00 + 7000) = 299500.00.

If the gross return of the potato production is increased and the production cost of potato decrease then we will get highest rate of return through potato cultivation.

Table 6.3 : Variable cost

Items of returns/costs	Unit	Quantity	Price per unit (Tk)	Total value (Tk)	% of total
Human (hired) labour	Man-day	225	300	67500	35.26
Human (family) labour	Man-day	100	300	30000	15.67
Tillage	Tk	3 times	1729	5187	2.71
Seeds	Kg	1200	48	57600	28.92
Urea	Kg	300	22	6600	3.44
TSP	Kg	150	25	3750	1.95
MOP	Kg	200	15	3000	1.56
Gypsum	Kg	25	8	200	0.10
Manure and oil cake	Kg	7000	1	7000	3.65
Insecticides	Tk	n.a	-	3550	1.85
Irrigation	Tk	n.a	-	7000	3.65
Total	Tk	-	-	191387	98.76

Source: Field Survey, 2014

Table 6.4 : Fixed cost

Items of returns/costs	Unit	Quantity	Price per unit (Tk)	Total value (Tk)	% of total
Interest on OC	Tk	23923.41	@10%	2392.34	1.24
Total	Tk	-	-	2392.34	1.24

Source: Field Survey, 2014

Table 6.5: Total cost (Variable cost + Fixed cost)

Items of returns/costs	Unit	Variable cost	Fixed cost	Total (Tk)	% of total
Total cost	Tk	191387.00	2392.34	193779.34	100

Source: Field Survey, 2014

Table 6.6: Net return (Gross return - Total cost)

Items of returns/costs	Unit	Quantity	Price per unit (Tk)	Total value (Tk)
Net return	Tk	-	-	105720.66

Source: Field Survey, 2014

Here

Net return= Gross return - Total cost

So the net return of potato production is depending on both gross return and total cost of the potato production.

Undiscounted BCR

Items of returns/costs	Total Benefit	Total cost	Ratio
Undiscounted BCR	299500.00	193779.34	1.55

Source: Field Survey, 2014

6.6 Concluding remarks

On the basis of above discussion it could cautiously be concluded that the cultivation of potato was profitable in the selective study area. Though potato was profitable vegetable and huge domestic demand; their production should be expanded with effective management system. It can cautiously be concluded that the proper management and cultivation of potato would help farmers to earn more household income.

CHAPTER 7

FACTORS AFFECTING OF POTATO PRODUCTION

7.1 Introduction

In this chapter an attempt has been made to identify and measure the effects of some important variables of production on gross return of potato in the framework of production function analysis. For the purpose Cobb- Douglas production function model, has been chosen to determine the effects of selected variables on potato production.

7.2 Functional analysis

Production function is a relation (or mathematical relationship) specifying the maximum output that can be produced with given inputs for a given level of technology. It applies to a firm or as an aggregate production function to the economy as a whole (Samuelson and Nordhans, 1995).

Considering the effects of explanatory variables on yield of potato, nine explanatory variables namely human labour cost (X1), tillage cost (X2), seeds cost (X3), Urea cost (X4), MOP cost (X5), TSP cost(X6), irrigation cost (X7), insecticides cost (X8), manure and oil cake cost (X9) were chosen as key independent factors to estimate the quantitative effect of inputs on yield of potato respectively. All these variables have been estimated as per hectare monetary values. However other important variables such as management, land quality, soil type, sowing time and weather etc, were excluded in the analysis due to paucity of reliable data. To explore the input output relationships production function was fitted in all the locations. Of possible statistical forms, Cobb-Douglas production function, most popular in farm-firm analysis, was used as this algebraic model provides a compromise between (a) adequate fit of the data, (b) computation feasibility, and (c) sufficient degrees of freedom unused to allow for statistical testing. In other words, the Cobb-Douglas is a relatively "efficient user" of degrees of freedom (Heady and Dillon, 1961).

Another special advantage of using Cobb-Douglas production function model was that the regression under OLS in logarithm, yields coefficients which represents partial elasticity of production and if all the inputs related to the production are taken into

account, the sum of the elasticity indicates whether the production process as a whole yields increasing, constant or decreasing returns to scale. In fact, it is widely used by many researchers in their economic studies. The advantages of the model are that it is simple to calculate and the elasticity of production can directly be obtained from the coefficient.

The Cobb–Douglas function form can be estimated as a linear relationship using the following expression:

$$\ln(Y) = a_0 + \sum a_i \ln(I_i);$$

Where,

Y= Output

I_i = Input

a_i = Model co-efficient

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

$$Y = a X_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4} X_5^{b_5} X_6^{b_6} X_7^{b_7} X_8^{b_8} X_9^{b_9} e^{u_i}$$

By taking ln in both sides the Cobb-Douglas production function was transformed into the following logarithmic form because it could be solved by the OLS method:

$$\ln Y = \ln a + b_1 \ln x_1 + b_2 \ln x_2 + b_3 \ln x_3 + b_4 \ln x_4 + b_5 \ln x_5 + \dots + b_9 \ln x_9 + u_i$$

Where,

Y = Gross return (Tk/ha);

X₁ = Human labour cost (Tk/ha);

X₂ = Tillage cost (Tk/ha);

X₃ = Seed cost (Tk/ha);

X₄ = Urea cost (Tk/ha);

X₅ = MOP cost (Tk/ha);

X₆ = TSP cost (Tk/ha);

X₇ = Irrigation cost (Tk/ha);

X₈ = Insecticides cost (Tk/ha);

X₉ = Manure and oil cake (Tk/ha);

a = Constant or intercept term;

b₁, b₂, ---, b₉ = Coefficients of the respective input variables to be estimated; and

U_i = Error term.

7.3 Interpretation of the results

Table 7.1 Estimated Values of Coefficients and Related Statistics of Cobb-Douglas Production Function Model for potato.

Explanatory variables	Values of coefficients	Standard error	t-value
Intercept/Constant	0.236	0.884	0.267
Human labor cost (X ₁)	0.103***	0.036	2.861
Tillage cost (X ₂)	0.098	0.064	1.542
Seed cost (X ₃)	0.112*	0.062	1.778
Urea cost (X ₄)	0.213**	0.088	2.421
MOP cost (X ₅)	0.042	0.139	0.303
TSP cost (X ₆)	0.112	0.093	1.204
Irrigation cost (X ₇)	0.021*	0.012	1.688
Insecticide cost (X ₈)	0.010	0.019	0.526
Manure and oil cake (X ₉)	0.043**	0.017	2.521
F-value	25.00		
R ²	0.729		
Returns to scale($\sum b_i$)	1.20		

Note: *** = Significant at 1% level

** = Significant at 5% level

* = Significant at 10% level

Source: Authors Estimation

The magnitude of the regression coefficient of human labour cost was 0.103 with a positive sign. It was highly significant at one percent probability level. It implies that one percent increase of human labour cost, keeping other factors constant, would lead to an increase in the gross return by 0.103 percent for potato (Table 7.1).

Tillage cost (X2). The regression co-efficient of tillage cost was 0.098 which was positive and statistically not significant, which indicated a positive relationship between gross return and tillage cost.

Seed cost (X3). The magnitude regression coefficient of seed cost was 0.112 for potato. It was positive and was significant at ten percent probability level. This indicates that an increase in one percent seed cost, remaining other factors constant, would result in an increase in the gross return by 0.112 percent.

Urea cost (X4). It can be seen from Table 7.1 that regression coefficient of Urea cost was 0.213 for potato. It was positive and was significant at five percent probability level. This indicates that an increase in one percent of Urea cost, remaining other factors constant, would result in an increase in the gross return by 0.213 percent.

MOP cost (X5). The regression co-efficient of MOP cost was 0.042 which was positive and statistically not significant, which indicated a positive relationship between gross return and MOP cost.

TSP cost (X6). The regression co-efficient of TSP cost was 0.112 which was positive and statistically not significant, which indicated a positive relationship between gross return and TSP cost.

Irrigation water cost (X7). It can be seen from Table 7.1 that the magnitude of the regression coefficient of irrigation water cost 0.021 for potato. It was positive and was statistically significant at ten percent probability level. This indicates that an increase in one percent of Irrigation water cost, remaining other factors constant, would result in an increase in the gross return by 0.021 percent.

Insecticides Cost (X8). The regression co-efficient of insecticides cost was 0.010 which was positive and statistically not significant, which indicated a positive relationship between gross return and insecticides cost.

Manure and oil cake cost (X9). It can be seen from Table 7.1 that the magnitude of the regression coefficient of Manure and oil cake cost was 0.043 for potato. It was positive and was statistically significant at five percent probability level. This indicates that an increase in one percent of Manure and oil cake cost, remaining other factors constant, would result in an increase in the gross return by 0.043 percent.

Coefficient of multiple determinations (R^2). It is evident from Table 7.1 that the value of the coefficient of multiple determinations (R^2) was 0.729 for potato. It indicates that about 73 percent of the total of the gross returns are explained by the explanatory variables included in the model.

Goodness of fit (F - value). The F-value was 25.00 for potato, which implies good fit of the model. That is, all the explanatory variables included in the model were important for explaining variation of potato production.

Returns to scale ($\sum b_i$): The summation of all the regression coefficients or production elasticity's of the estimated model gives information about the returns to scale that is in response of output to a proportionate change in all inputs. The sum of all the production coefficients of the equations for potato production was 1.20 (Table 7.1).

7.4 Concluding remarks

Cobb-Douglas production function model revealed that the key variables included in the model were individually or jointly responsible for variation in gross return or output of potato. The model shows that the increasing returns to scale with respect to the inputs used in potato cultivation.

CHAPTER 8

CONSTRAINTS ASSOCIATED WITH PRODUCTION OF POTATO

8.1 Introduction

Potato production in Bangladesh has got a number of problems. Farmers in Bangladesh do not get the sufficient quantities of seeds, fertilizers, pesticides, technical supports and finally the desirable prices of their products. They are economically not very capable of investing the required amount for producing crops due to low capital base. Farmers generally complain of getting insufficient support from governmental agencies. It is also complained that farmers do not get required technical and financial support from the government. In this chapter, an attempt has been made to identify constraints faced by potato production. For the sake of analytical convenience constraints were classified into three general groups.

1. Economic and Technical problems
2. Marketing problems
3. Social and natural problems

Table 8.1 Major constraints faced by the farmers in producing and marketing of potato

A. Economic and technical problem

Nature of problems	No of potato farmers	Percentage
Lack of capital or institution credit	19	38
Lack of scientific knowledge	18	36
Insufficient irrigation	09	18
High prices fertilizer and insecticides	20	40
Lack of human labour availability	13	26

Non availability of quality seed	15	30
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Source: Field survey, 2014

B. Marketing problems

Nature of problems	No of potato Farmers	Percentage
Low market price of product during harvesting period	25	50
Storage problem	25	50
Carrying and handling problem	11	22

Source: Field survey, 2014

C. Social Problems

Nature of problems	No of potato Farmers	Percentage
Attack by pest and diseases	16	32
Damage by domestic animal	18	36
Loss of product due to theft	12	24

Source: Field survey, (2014)

8.2 Economic and technical problems

It was observed that farmers faced some economic and technical problems relating to the production of potato. The major economic and technical problems faced by the farmers in potato production are discussed below.

8.2.1 Lack of financial capital or institutional credit

Production of selected winter vegetables needs proper doses of fertilizer, irrigation water and insecticides in addition to special agronomic care and therefore potato growers need sufficient money to buy the necessary inputs. In the study area about 38.00 percent of total growers reported that they did not have adequate amount of operating capital (Table 8.1). Most of the growers did not get institutional credit and therefore, they had to borrow money from neighbors, relatives, bank and moneylenders at exorbitant rate of interest.

Financial disability and pressing need for cash money forced them to borrow money from non -institutional sources.

8.2.2 Lack of scientific knowledge and technology

Low productivity of potato is a serious problem. In the study area, most of the potato growers were illiterate and they followed traditional methods. About 36 percent of the selected potato growers reported that the productivity of potato was low due to lack of scientific knowledge about cultural practices (Table 8.1).

8.2.3 Insufficient irrigation

Water was an important input for producing potato. In the study area about 18 percent potato growers had faced this problem (Table 8.1). The selected potato grower's lack of irrigation facilities was a major constraint for potato production.

8.2.4 High price of fertilizers and insecticides

Fertilizer and insecticides are vital inputs in the production of potato. During cultivation period, the prices of fertilizers and insecticides went up due to profit making motive of both retail and wholesale dealers. It was reported that about 40 percent potato growers complained about high price rate of fertilizers and insecticides (Table 8.1).

8.2.5 Lack of human labour availability

Potato cultivation was labour intensive. Non-availability of human labour was one of the major problems faced by the potato growers. It was observed from Table 8.1 that about 26 percent of the selected potato growers faced acute shortage of human labour in potato production.

8.2.6 Non-availability of quality seeds and high price of seed/seedlings

Non-Availability of improved seeds was another limiting factor in producing potato. About 30 percent farmers reported this problem (Table 8.1). They reported that in local market HYV seeds were not available. Most of the growers purchased seeds but they

opined that in many cases, the seeds were not good quality and the price of seed was too high during the sowing/ planting period.

8.3 Marketing problems

One serious problem of potato production was the marketing problems. In the study areas, most of the farmers used to sell their product to the "Farias" at home. A few farmers sold their products at the village `hat'. There were some problems relating to the marketing of potato which is highlighted below.

8.3.1 Low market price of product at harvesting period

It was observed that the prices of potato in the harvesting period were very low. About 50 percent of the selected potato growers reported that the price of potato were low during the harvesting period and soon after the harvesting period (Table8.1). Many of the farmers were compelled to make distress sale in order to meet the urgent needs of cash for their day - to -day's household expenditures that led to increase the supply of their products in the village market at harvesting period and thereby lowering the selling price per unit.

8.3.2 Storage problem

Lack of proper storage facilities was the most important problem regarding selected potato marketing. In fact 50 percent of potato growers complained against the storage problem (Table 8.1). Storage of potato is not possible under ordinary condition because these vegetables are perishable. Therefore due to lack of proper storage facilities the farmers did not get fair prices of their selected winter vegetables.

8.3.3 Carrying and handling problems

Due to carrying and handling problem the growers used to sell their product to 'paikar' at the local markets and a few growers sold their products at farm gate. Table 8.1 shows that about 22 percent of the potato growers treated about carrying and handling as a problem. Farmers also reported that they could not take advantage of the higher price prevailing at

distant market due to lack of carrying and handling facilities. Adequate carrying and handling facilities at reasonable cost would improve the efficiency of potato marketing.

8.4 Social and natural problems

It was found that farmers were facing some social and natural problems in producing potato. These are discussed below:

8.4.1 Attack by disease and pest

Farmers producing potato mentioned that considerable amount of yield of potato were lost by the attack of pests and diseases. In the study area about 32 percent potato growers faced this problem (Table 8.1).

8.4.2 Crop damage by wild or domestic animal

Crop damage by wild animals was also a problem in the production of potato. Potato growers reported that damage by mice was a considerable problem to them. Farmers gathered an experience that in the early stages the plants were affected by cattle and goats. They eat the leaves of potato. About 36 percent potato growers reported that their products were attacked by wild and domestic animals (Table 8.1).

8.4.3 Loss of production due to theft

During the harvesting period, stealing of potato was a common phenomenon which discouraged the growers to grow these vegetables. In the study area, about 24 percent of selected potato growers reported that their products were stolen (Table 8.1).

8.5 Concluding remarks

It is no doubt that potato can play an important role in earning cash money and can save both import and foreign currency. Since potato are profitable vegetable and has huge domestic demand; their production should be expanded. It was observed that the farmers were facing some acute problems. The low market prices of potato and high input prices would hinder the expansion of area. In spite of the constraints in potato production, the

farmers in the study area are still now producing these enterprises. Because potato are profitable crops and their method of cultivation is easy.

CHAPTER 9 SUMMARY, CONCLUSION AND RECOMMENDATIONS

9.1 Introduction

This chapter attempts to summarize the major findings of the study. Section 9.2 presents a summary of the major findings of the study. Conclusion, policy recommendations, limitation and scope for the further study are given in Sections 9.3, 9.4, 9.5 and 9.6 respectively.

9.2 Summary of the study

Bangladesh is predominantly an agricultural country. Agriculture is the backbone of the economy of this country. Potato sub-sector plays an important role for development of Bangladesh. Potato production is important in Bangladesh for nutrition, economy and food security. Potato production can be identified as a significant one for this economy for its noteworthy contribution in raising the foreign exchange earnings and occupies an important position among the items exported from Bangladesh. In 2013/14, Bangladesh earned US\$ 402.70 million by exporting agricultural products which were 1.46 percent of total export earning (US\$ 24301.90 million). Around 43.6 percent of the total labour-force of the country is engaged in agriculture sector.

Potato compared to other food items provide low cost nutrition source. Moreover, potato grows within a production season. There is a large number of potato having different varieties, which can be grown. However, the largest numbers of potato are grown in the winter season. Potato production is generally labour intensive crops thus offer a considerable promise for increased rural employment opportunities. Climate and soil of Bangladesh is very much suitable for growing potato. Special attention has been given in the Fifth Five Year Plan (FFYP) for the production of fruits and vegetables on a year round basis and emphasized the need for its commercialization through appropriate research and development programmers.

In summary, increase in food production, rural employment generation, augmentation of income to remove malnutrition, attaining self sufficiency in food and increasing the

volume of export are basic goals of economic development programmers in Bangladesh and much of those goals can be achieved through an improvement with the introduction of short duration potato production throughout the year.

The objectives of the study are given bellow:

- i. To know the socioeconomic characteristics of the potato producing farmers.
- ii. To measure the profitability of the potato producing farmers.
- iii. To determine factors affecting the gross return of the potato producing farmers.
- iv. To identify the major problems associated with potato production.
- v. To suggest some policy guidelines/recommendations.

The area selected for the study covered at Six villages namely Debiganj upazila sadar, Sonaher, Vowlaganj, Kaliganj, Dabiduba and Pamoli of Panchagarh District. Systematic Sampling method was applied to collect the data. In all 50 samples were selected through a procedure. Data were collected by comprehensive interview schedules. Simple statistical techniques as well as Cobb- Douglas production function were used to process and analyze the data to achieve the objectives of the study. In analyzing socioeconomic characteristics, age structure, composition of family size, educational status, occupation, Farm size, dependency ratio, and land ownership pattern were considered. It was found that age group of 40 to 50 years was the largest group in all the cases. The average family size of potato 5.14. In the study area about 83.33 percent of family members were employed in agriculture as their main occupation while 10.00 and 6.67 percent of the family members were employed in business and service, respectively as their main occupation. The average farm size of potato was 0.59 hectare. The average farm size indicated that most of the sample fell in the small size category. In order to determine the cost of purchased inputs, prevailing market price was used and for home supplied inputs the opportunity cost principle was used. The bank rate of 10 percent per annum was used to determine the opportunity cost of operating capital. In the production process human labour was the most important factor. On an average per hectare human labour required for potato production were 325 man-days. The per hectare costs of human labour for potato production were Tk 97500 .

In the study area farmers used power tiller for land preparation. The per hectare tillege cost for potato were Tk 5187. The tillege cost constituted 2.71 percent, of total cost of potato production. The per hectare seed costs for potato Tk 56700. The cost of seed

constituted 28.92 percent. Fertilizer is a major requirement of potato. In the study area, farmers mainly used three types of fertilizer namely Urea, TSP MOP and Gypsum . The per hectare cost of potato for Urea, TSP, MOP and Gypsum were calculated at Tk 6600, Tk 3750, Tk 3000 and Tk 200 which covering 3.44 percent, 1.95 percent, 1.56 and 0.10 of total cost respectively. The per hectare cost of manure and oil cake amounted Tk 7000 for potato production. The per hectare cost of irrigation water amounted to Tk 7000.00 for potato production. The per hectare cost of insecticides amounted Tk 3550 for, which occupied 1.85 of their respective total cost. Per hectare interest on operating capital was Tk 2392.34 for potato production, Per hectare variable costs of potato production were estimated Tk 191387. Per hectare fixed costs of potato production were Tk 2392.34. Per hectare total costs of potato production were Tk 193779.34. Per hectare net returns of potato production were Tk 105720.66. Undiscounted benefit cost ratio of potato production per hectare came out to be 1.55. Cobb-Douglas Production Function model was applied on the basis of the best fit and significant effects of resources on gross returns. For all the enterprises nine explanatory variables were taken into account to explain variations in production. The coefficient of multiple determinations, R^2 was 0.729 in case of potato production function. This indicates that 73 percent of the variation of output of potato was explained by the explanatory variables included in the model. The F- value (25.00) which indicates good fit of the model. In the study area various problems which were faced by farmers were identified. These common problems were categorized in to four major groups such as, economics, technical, marketing and social problems. Economic problems and constraints were lack of capital, high price of fertilizers and insecticides. Technical constraints were lack of scientific knowledge and method, insufficient irrigation, scarcity of good quality seeds, attack by pest and disease. Marketing problems were lack of adequate transport facilities, lack of storage facilities, lack of marketing facilities, and lack of market information. Social problems were loss of production due to theft, wastage and damage by wild or domestic animals. In order to increase the production of potato, these problems should be solved as far as possible.

9.3 Conclusion

From the results of the present study, it can be concluded that considerable scope apparently exists in the study area to increase the productivity of potato and to increase

income, employment and nutritional status of the farmers. The management practices of potato production in the study area were not found efficient enough. Farmers were not known about the application of inputs in right time with right doses. Consequently, they made over or under use of some inputs. Thus well planned management training in accordance with their problems, needs, goals and resource base can lead to viable production practices and sustainable income from potato.

9.4 Policy recommendations

The policy recommendations may be advanced which are likely to be useful for policy formulation:

- (a) In view of actual field position and experience gained so far, it is realized that public and private interventions required for (i) ensuring balanced used of fertilizers; (ii) encourage to irrigate in the field if it is needed ; and (iii) training the farmers by extension service people in using appropriate doses and combinations of fertilizers.
- (b) Availability of appropriate quantity of irrigation water in time of need and its management is the main factor behind the growth of potato. So adequate measures should be taken to improve irrigation water management.
- (c) Operating capital is a problem for the resource poor farmers of the study area. Institutional credit program should be lunched aiming at particularly the small and medium farmers. The commercial banks should be encouraged to provide loans at a low interest rate to enable farmers to operate their farming on commercial basis.
- (d) Farmers could not get reasonable prices for their vegetables. Marketing costs are high because of inadequate information, infrastructure, high price risks, etc. So, steps should be taken to ensure; (i) fair price; (ii) quality of products; (iii) floor price; and (iv) stability of production.
- (e) Quality seeds of improved varieties in right quantity are recognized to be one of the key elements for enhancing production. Emphasis should be given on creating facilities and infrastructure supported for hybrid seed production, marketing and development.
- (f) Establishment of cold storage and food processing industries at the potato growing area can be helpful to the farmers to preserve and process potato during peak period.
- (g) Insurance facility may be provided as the loss of potato production.

(h) Government policy such as train 1 or 2 compartment may be used for the management purpose of the potato during the harvesting season. It is very cheap and safe management purpose for potato distribution process.

9.5 Limitation

The present study suffers from a number of limitations. The limitations of the study are as follows:

- i. Inadequate fund and time availability for the study was an important limitation. Due to shortage of fund and time the study could not cover wide areas for collection of necessary information from the farmers; only 50 farmers were selected for the purpose of the study.
- ii. The researcher had to depend on the memory of the farmers for collecting necessary information because many of them did not keep any written record or kept record partially.

Despite a few limitations, the findings of the present study may provide some valuable information for the farmers, extension workers and researchers.

9.6 Scope of further research

Although the present study provides some useful information for researchers, policy makers as well as farmers, it is not free from criticisms. The weaknesses of the present study, of course, open up scopes for further research which are outlined below:

- i. It could be mentioned here that the future researchers could take up a broad - based study with large samples;
- ii. A further study can be undertaken by taking into account different farm sizes to assess the impacts on income generation through other vegetable cultivation.

References

- BBS (2015), Yearbook of Agricultural Statistics of Bangladesh, Bangladesh Bureau of Statistics, Statistical Division, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka.
- BBS (2014), Yearbook of Agricultural Statistics of Bangladesh, Bangladesh Bureau of Statistics, Statistical Division, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka.
- BBS (2012), Yearbook of Agricultural Statistics of Bangladesh, Bangladesh Bureau of Statistics, Statistical Division, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka.
- BBS (2011), Yearbook of Agricultural Statistics of Bangladesh, Bangladesh Bureau of Statistics, Statistical Division, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka.
- BBS (2010), Yearbook of Agricultural Statistics of Bangladesh, Bangladesh Bureau of Statistics, Statistical Division, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka.
- BBS (2009), Yearbook of Agricultural Statistics of Bangladesh, Bangladesh Bureau of Statistics, Statistical Division, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka.
- BBS (2006), Yearbook of Agricultural Statistics of Bangladesh, Bangladesh Bureau of Statistics, Statistical Division, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka. 88
- BER (2015), Bangladesh Economic Review, Economic Advisory Section, Department of Finance, Ministry of Finance, Bangladesh.
- BER (2012), Bangladesh Economic Review, Economic Advisory Section, Department of Finance, Ministry of Finance, Bangladesh.
- BER (2011), Bangladesh Economic Review, Economic Advisory Section, Department of Finance, Ministry of Finance, Bangladesh.
- BER (2010), Bangladesh Economic Review, Economic Advisory Section, Department of Finance, Ministry of Finance, Bangladesh.

- BER (2008), Bangladesh Economic Review, Economic Advisory Section, Department of Finance, Ministry of Finance, Bangladesh.
- Bishop, C.E. and Toussaint, W.D. (1996), Introduction to Agricultural Economic Analysis. Willy, New York.
- Dillon, J.L. and Hardaker, J.B. (1993), Farm Management Research for Small Farmers Development, Food and Agriculture Organization of United Nations, Rome, Italy.
- EPB, (2005), Annual Report, Information Division, Export Promotion Bureau, Bangladesh, Dhaka.
- Fahmida, A. (2006), Some selected winter vegetables production in area of Trishal Upazila in Mymensingh District, MS Ag Econ thesis Bangladesh Agricultural University, Mymensingh.
- FAO (2010), State of Food Insecurity in the World 2010, Rome, Italy.
- FAO, (1997), Production Yearbook, Food and Agriculture Organization of United Nations, Rome, Italy.
- GOB, (2007), Bangladesh Economic Review, Economic Division, Ministry of Finance, Government of the People's Republic of Bangladesh, Dhaka. 89
- Haque, S. (2001), An economic study of crops and vegetables production activities on the marginal land in selected area of Mymensingh District. MS Ag Econ thesis, Bangladesh Agricultural University, Mymensingh.
- Hossin, (2004), A comparative economic analysis of some selected high yielding varieties of winter vegetables in an area of Bangladesh. MS Ag Econ thesis, Bangladesh Agricultural University, Mymensingh.
- HIES (2005), Report of the Household Income and Expenditure Survey, Bangladesh Bureau of Statistics, Government of the People's Republic of Bangladesh, Dhaka
- HIES (2006), Report of the Household Income and Expenditure Survey, Bangladesh Bureau of Statistics, Government of the People's Republic of Bangladesh, Dhaka.
- Heady, E.O. and Dillon, J.L. (1961), Agricultural Production Function, Iowa State University Press, Ames, Iowa.

- IRRI (International Rice Research Institute), (2007), World Rice Statistics, 2005-2006, IRRI, Manila, Philippine.
- Islam, S.M.F. and Karim, M.R. (1997), Assess the comparative profitability of selected winter vegetables like potato, cauliflower and tomato, *Bangladesh Journal of Agricultural Research*, 20 (1): 85-90.
- Krishi Dairy, (2011), Agricultural Information Service, Ministry of Agriculture, Khamarbari, Dhaka, Bangladesh.
- Miah, M.T.H. (1987) Assess the Performance of Crops and Potato Producing on the Marginal land and Resource Efficiency of the Farmers, M Ec dissertation, University of New England, Armidale, Australia.
- Nahar, S. (1998), An economic analysis of vegetables production in a selected area of Mymensingh district, MS Ag Econ thesis, Bangladesh Agricultural University, Mymensingh
- Population Census Report (2011), Bangladesh Bureau of Statistics, Statistical Division, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka.
- Rahman, M.M. (1993), A Cooperative `study of HYV potato and wheat production in some area of Jamalpur District. MS Ag Econ thesis, BAU, Mymensingh.
- Rahman, S. (2000), Women's employment in Bangladesh agriculture: composition determinants and scope , *Journal of Rural Studies* 16 (2), 497-507.
- Roy, A. (1993), Relative profitability of potato-based cropping patterns in Bangladesh. MS AgEcon. thesis, Bangladesh Agricultural University, Mymensingh.
- Samuelson, P. A. and Nardhaus, W. D. (1995), *Economics*, 18th edn, Tata McGraw-Hill Publishing Company Limited, New Delhi.
- Shaikh, M.A.Q. (1997), *Agricultural Research and Development in Bangladesh: Present and Future*, Agribusiness Bulletin, July 2006, 1997, Dhaka, Bangladesh.
- Suraiya, Z. (2008), An economic analysis of some selected summer vegetables in purbadhala Upazila of Netrokona District. MS Ag Econ thesis, Bangladesh Agricultural University, Mymensingh.
- Mawla (1998), Some selected winter vegetables in a selected area of Norshingdi District, MS Ag Econ thesis, Bangladesh Agricultural University, Mymensingh.

- Hossain (1997), Comparative economic analysis of some selected high varieties of winter vegetables such as potato, cucumber, cauliflower and cabbage production in an area under Baraigram thana in the district of Natore, MS Ag Econ thesis, Bangladesh Agricultural University, Mymensingh.
- Badiuzzaman(1993), Identification and evaluation of optimal patterns for an irrigated area in Madhupur Thana in Tangail district, MS Ag Econ thesis, Bangladesh Agricultural University, Mymensingh.
- Haque (1993), The comparative profitability of sweet potato and groundnut with particular reference to small farmers in six villages under Kuliachar thana of Kishoreganj district, MS Ag Econ thesis, Bangladesh Agricultural University, Mymensingh.
- Hakim (1993), A comparative economic analysis of cardinal and multa variety of in Kotwali thana in Bogra district, MS Ag Econ thesis, Bangladesh Agricultural University, Mymensingh.
- Sejuty (1993), A study on two alternative cropping patterns: Potato+Boro (HYV) + Aman and Wheat +T.Aman +T.Aus in two villages namely Dumuria and Thangao in Chandina thana of Comilla district, MS Ag Econ thesis, Bangladesh Agricultural University, Mymensingh.
- Basak (1992), A study for potato production in three villages of Gabtoli thana in Bogra district,MS Ag Econ thesis, Bangladesh Agricultural University, Mymensingh.
- Yang, W.Y. (1965), Method of Farm Management Investigation, Food and Agriculture, Organization of the United Nations, Rome. examination Committee.

Appendix
Interview schedule for

PROFITABILITY ANALYSIS OF POTATO CULTIVATION: A
STUDY AT DEBIGANJ THANA UNDER PANCHAGARH
DISTRICT

1) Identification of the respondent

Sample ID NO:.....

Name:

Fathers Name:

Village:

2) Family composition of the farmer

SL NO	Relationship with household head	Age (y)	Years of schooling	Main occupation	Remarks
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

3) Pattern of land ownership

Land utilization	Own land (Decimal)	Leased in (Decimal)	Leased out (Decimal)	Total area (Decimal)
Homestead area				
Area under Potato				
Area under pond				
Fallow land (if any)				
Others (specify)				

4) Cropping pattern of the farmers

April-May	May-June	June-July	July-August	Aug-sep	Sep-Oct	Oct-Nov	Nov-Dec	Dec-Jan	Jan-Feb	Feb-Mar	Mar-Apr

5) Cost and return of the Potato

(Please provide information on one of your biggest plot)

Plot size:.....Decimals Name of variety:.....

Date of showing..... Date of harvesting.....

Items	Quantity (Units)	Unit (Price) TK	Total cost TK
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Gross cost			
Power tillers			
Seed / seedlings			
Land preparation labour			
Sowing labour			
Weeding labour			
Harvesting and Threshing labour			
Urea			
TSP			
MOP			
Cowdung/ Manure			
Irrigation cost			
Pesticide			
Other(Specify)			
Total			

Gross returns

Main products	Quantity (units)	Price(TK)	Total cost(TK)
By- product			
Total			

Please specify the family supplied labour percent%

6) What are the major problems/ constrains you are facing during the Potato cultivation?

A) Financial problems

.....
.....
.....

B) Technical problems

.....
.....
.....

C) Marketing problems

.....
.....
.....

D) Social problems

.....
.....
.....

7) What are the probable solution of these problems?

.....
.....
.....

Signature of the interviewer:..... Date:.....

