POTATO CULTIVATION AND ITS EFFECT ON INCOME GENERATION: A STUDY IN THAKURGAON DISTRICT

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CERTIFICATE

This is to certify that the thesis entitled, " ***Potato Cultivation and Its Effect on Income Generation: A Study in Thakurgaon District"*** *submitted to the Faculty of Agribusiness Management, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of* ***MASTER OF SCIENCE*** *in* ***Development and Poverty Studies,*** *embodies the result of a piece of bona fide research work carried out by* ***Md. Ibne Khaled Dolon****, Registration No.* ***10-03812*** *under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.*

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

Date:
Place: Dhaka, Bangladesh

Dr. Bazlul Ameen Ahmed Mustafi
Adjunct Faculty
Supervisor

DEDICATED TO
MY BELOVED PARENTS

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The Author

Abstract

The present study was undertaken to examine the farm specific profitability of potato production. The study was conducted in some selected areas of Thakurgaon district. This study was based on a sample survey and data of total 60 potato growing farmers, of which 16 small, 20 medium and 24 large categories of farmers from three villages under Thakurgaon district were selected. The study showed that socio-demographic characteristics of small, medium and large farmers differ from each other in respect of age, literacy rate, farm size, farming experience, training, household income and expenditure. The major findings of the present study revealed that potato production was found to be profitable to the farmers and contribute significantly to income. The study also identify few problems of potato production including attack of pest and lack of technical know.

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Introduction

Introduction

Potato is one of the important crops and very common vegetable in Bangladesh. Potato is one of the main agricultural crops in Bangladesh. It is both a vegetable crop as well as cash crop. In many countries it is considered as a staple food. Potato is cultivated as a staple food crop in at least 40 countries (Islam, 1987). In Bangladesh potato occupied the first position among all the vegetables in respect of area coverage and production and contributed 65.65 per cent of the total production of vegetables in Bangladesh in 2015(BBS, 2015).

In Bangladesh, production of potatoes as well as its many fold uses has increased over the last few years. In Indian sub-continent the cultivation of potato was probably started during the 17^{th} century (Ahmed, 1977). In Bangladesh the cultivation of potato was started in the late 19^{th} century (Siddique and Hussain, 1988). But the cultivation was started as a cash crop after 1920 (Hoque, 2004). A least in 100 countries it is the most important vegetable crop.

Potato is one of the most important food crops worldwide. It comes in the forefront of tuber-crops and occupies the fourth position after potato, sorghum and rice as the most edible and consumed crops in the world (Singh et. al. 2004).

Potato is very rich source of nutrient contents containing good amount of starch, carbohydrate, vitamins especially C and B1 nutrients, protein, fat and amino acids (Buckenhuskes, 2005).The crop is grown in about 140 countries, more than 100 of which are located in the tropical and subtropical zones (Beukema and Vander Zagg, 1990).

Potato was introduced in this subcontinent in the sixteenth century. It was grown then in small plots as a vegetable. Potatoes have been grown in Bangladesh since at least the 19^{th} century. By the 1920s, the first commercial production of the crop was established in the country (Islam, 1983).

Potato has become one of the major food and cash crops in Bangladesh. In 2010-11 season the area coverage (4.6 lakh hectare), production (83.5 lakh MT) and yield (18.1 t/ha) of potato were comparatively higher. Simultaneously export also increased sharply during this time. Considering the area coverage in the country, potato is the third major crop after paddy and potato. It has become a highly successful October-March winter crop in Bangladesh.

Bangladesh is now 7th among the world‟s potato producers and 4th largest in Asia (FAO report,2017). Potato is mostly consumed as vegetable in the households in Bangladesh.

Though Bangladesh has become a major potato producer in the SAARC countries, the status of this crop has remained vegetable in the country. The time has come now for all of us to understand and appreciate the role of potato that can play an important role in the present food situation of Bangladesh.

Potato is one of the main commercial crops grown all over the country. In Bangladesh, potato is mainly consumed as vegetable. Various other food items (Singara, Samucha, Chop, chips etc.) are also made from potato. Adequate supply of potato stabilizes the vegetable market all round the year (Moazzem and Fujita, 2004).

Importance of Potato in the Economy of Bangladesh

Potato is an important cash crop and a multipurpose food crop of Bangladesh (Siddique and Hossain, 1988). It is used not only in human diet but also in other purposes. Besides it is used as food and vegetable, it is highly used in industry for various purposes. It is used for making gum, starch for adhesives and other purposes, in textile and paper industries, for processing ink, dyes, toys, soap and for leather processing. Glucose and dextrose are prepared from potato for use in medical treatment. Lactic acid, alcohol and some other chemicals are now being produced from potato. In terms of nutritional potential, it ranks first among the 10 major food crops in calories production per unit area of land. It is also considered as an excellent source of vitamin B and C.

The role of potato in relieving food shortage in the country deserves special attention. In Bangladesh potato is still considered merely as a vegetable, i.e. as a complementary food with rice and potato but not as a staple food it is regarded as one of the world‟s leading food crop (Begum,2017).

It is now well recognized that to meet the demand for food for increased population, dependence on rice and potato has to be reduced and the food habit of the masses have to be diversified. The food problem is one of the most critical aspects of Bangladesh struggle to achieve economic growth, rate of inflation, poverty and nutrition, the trade balance and the Government‟s fiscal position.

Food grains are a main consumption item in Bangladesh accounting for about 35 percent of total consumption expenditure and provide more than 80 percent of the total calorie intake. Bangladesh has long been striving to achieve food self-sufficiency by setting production targets through the successive five year plan. Virtually, cereal production stood at approximately 28.7 million tons in 2012-2013 and the country attained self-sufficiency in the recent past. Potato has been perceived to play an important role in improving this situation by providing more balanced diets to increase nutritional quality of food.

Increased potato production will provide more low-priced calories food for human consumption. The adoption of potato as potato flour substitute for bread would be beneficial to the Bangladesh economy particularly in its nutritional value. It will increase supply availability for starch and processed food. It can replace important cereals such as rice and potato thereby reducing the foreign exchange requirements. It can contribute to create rural employment opportunities through the development and expansion of potato industry.

Area, Production and Yield of Potato in Bangladesh

The land and climatic condition of Bangladesh with abundant water and humid temperature is ideally congenial to the cultivation of potato. The area, production and yield of potato have increased significantly during the last three decades. Area under potato cultivation has increased about three and a half folds and production of potato has increased more than five and a half times during the same period.

Figure1 shows the area, production and yield of potato which increased significantly during the last three decades from 1979-80 to 2008-09. During the thirty years potato area increased from 96.3 thousand hectare in 1979-80 to 395.4 thousand hectares in 2008-09 while production of potato rose from 903 thousand metric tons in 1979-80 to 5268 thousand metric tons in 2008-09. The average yield per hectare for the country also increased from 9.44 metric tons to 13.32 metric ton. (Source: BBS, 2015)

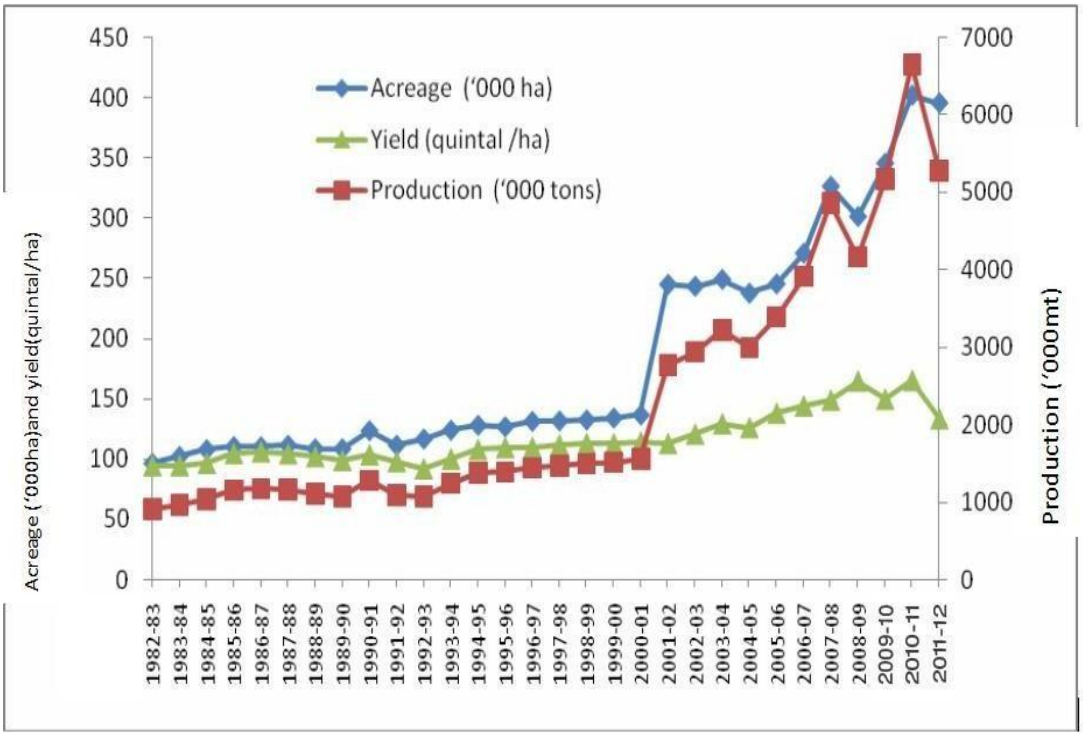

Figure 1.1: Trend of area, production and yield of potato in Bangladesh

Varieties of Potato

Different varieties of potatoes are grown in the world. These differ in appearance, tuber structure, size and color, time of maturity, cooking and marketing qualities, yield, and resistance to pests and diseases. A variety that grows well in one area may do poorly in another area. Potato varieties that are cultivated in Bangladesh are broadly categorized into two groups, local and high yielding. The so-called local varieties are in fact, not strictly native. In the distant past those were brought to this part of the subcontinent but in the absence of varietal improvement efforts, gradually degenerated, showing poor yield performance. In spite of poor yields, some of the local varieties are still being cultivated because of their taste and cooking qualities.

There are about 27 local varieties of potatoes cultivated in different parts of the country. They are familiar with local names. It is estimated that local varieties were cultivated in about 18, 465 acres of land, producing about 5,00,800 m tons of tubers during 2011-12 (Source: BBS, 2015).

The familiar local varieties are

i. Diamond- Mostly cultivated in Munshiganj District.

ii. *SheelBilatee*- mostly cultivated in Rangpur. The tuber is oblong, reddish. Each tuber weighs about 30 g.

iii. *LalSheel*- primarily cultivated in Bogra with tubers rounded, reddish, each having a weight of about 55 g. This variety is also known as *LalMadda* and *Bograi*.

iv. *LalPakri* - cultivated widely in Dinajpur, Bogra and Sirajganj districts with tubers reddish and round, each weighing about 30 g.

v. *Du Hajari* - mostly cultivated in the Chittagong area. Tubers appear round and pale, each weighing about 25g. Among other indigenous varieties *JhauBilatee* and *Suryamukhi* are notable.

In the last few decades, several dozens of high yielding varieties (HYV) of potato were brought to Bangladesh and tried experimentally under local conditions before being recommended for general cultivation. During the 1970s, about 16 varieties were initially selected, but subsequently 10 were dropped. Through constant evaluation of the traits, varietal performance, and considerations of other characteristics, about 10 HYV have been released for cultivation in the country. However, huge amount of potato seeds are imported every year by the Bangladesh Agricultural Development Corporation (BADC) for distribution among farmers. Bangladesh Agricultural Research Institute (BARI) has also established a farm at Debiganj in Panchagar district for production of HYV seed potatoes.

Among the high yielding popular varieties the following are notable: (a) *Cardinal*- probably most popular among the foreign varieties with oblong, reddish tubers, shallow eyes, and smooth skin. The variety has been introduced from Holland and has yield potential of 20-25 m tons per ha. (b) Diamond - another Holland variety with oval to oblong, pale yellow tubers, skin smooth, and eyes shallow. It is quite disease resistant. Per hectare yield ranges from 18-24 m tons. (c) *KufriShindhury* - tubers reddish, round, and eyes deep with rough skin. This variety was introduced from India and is comparatively less susceptible to pests and diseases. It has a yield potential of 18 to 22 m tons per ha. Other notable exotic varieties are Patronis, Alpha, Archa, Multa, Ukama, Hira, Maurin, Origo, Alisa, etc.

In recent years, the Tuber Crops Research Centre of BARI has collected many new varieties of potato from the International Potato Research Centre, Peru, and from other sources. These

are being tested under Bangladesh field conditions, to determine whether they can be recommended for cultivation in the country. The Centre has already made good contribution towards the development of some high yielding potato varieties.

Potato is widely cultivated in all the districts of Bangladesh during winter season. Of the total 3,36,740 acres (1,36,332 ha) of land used for potato cultivation during 2012- 13, 1,13,540, 2,18,445, and 4,755 acres were for local, high yielding, and Indian varieties respectively. Well-fertilized, sunny land with sufficient moisture in soil is appropriate for potato plantation. The first fortnight of November is the right time. In certain northwestern areas, farmers even plant potato in October to harvest the crop early.

Virtually all potatoes in this country are planted manually. On the basis of the soil quality and potato variety farmers determine the spacing in between the seed tubers and the adjacent rows. Row spacing is usually from 45 to 60 cm. Optimum depth of planting depends on temperature and moisture of the soil, probable weather following planting, and mode of conducting field operations later. If planting is shallow and only about 5 cm deep, the soil must be gradually ridged over the row incidental to cultivation. This ensures that the developing tubers are well covered with soil to protect them from light and pests. Mulching is frequently done over the rows with water hyacinth, straw etc. to preserve the soil moisture and to prevent the growth of weeds.

Uses of Potato

In Bangladesh, potato is primarily used as a vegetable, although in many countries of the world it constitutes the staple food and contributes more than 90% of the carbohydrate food source. Millions of tons of potatoes are processed annually in Europe into starch, alcohol, potato meal, flour, dextrose and other products. Some are processed into potato chips, dehydrated mashed potatoes, French fries and canned potatoes. Large quantities of potatoes in the Netherlands, Ireland, Germany and other countries of Europe are grown specifically for the manufacture of alcohol, starch, potato meal or flour, and for livestock feeding. Europeans

consume much larger quantities of potato than the North Americans. Asian countries consume more rice than potato for carbohydrate foods.

In Bangladesh, although the principal use of potatoes is to make potato curry along with fish, meat, and eggs, there exists a great diversity in the consumption of potatoes. Notable among potato-based food items are the boiled potato, fried potato, mashed potato, baked potato, potato chop, potato vegetable mix, potato *singara*, potato chips, French fry etc. In recent years, bakeries and fast food shops have started preparing a wide variety of potato-based food delicacies.

Justification of Present Study

In the economy of Bangladesh, Agriculture sector continues to performance a very important role. This sector attained modest growth and experienced slow transition during the four decades since independence. The goal of the sector was to replace the traditional and vulnerable agriculture by a modern agriculture capable of sustained growth.

The present study is help for find the prevailing problems and develop our understanding on potato cultivation. The present study is help in providing a picture of the benefits and costs of potato, which is help individual researchers who will conduct further studies of the similar nature and encourage in conducting more comprehensive and detailed investigation in this particular field of the study. The study is helpful for the individual farmers for effective operation and management of their farms through pointing the drawbacks and for the planners for proper planning and policy making In potato cultivation. The study may be helpful to the extension workers to learn about various problems related to potato production, to suggest the farmers for copying with those problems and impact of potato cultivation in the poverty reduction of the farmer.

1.6 Objective of the Study

The specific objectives of the study are as follows:

a) To know the socio-economic profile of potato growers.

b) To assess the contribution of potato in total income.

c) To determine the relative profitability of different categories of potato growers.

d) To identify the constraints of potato cultivation.

Limitations of the study:

i. There were the constraint of time and cash related assets, all information and other important data were gathered inside the most limited conceivable time and couldn't cover every one of the field segments of the upazilla. Thus, the revelations may not sum up for the whole potato production, promoting and handling framework in the region.

ii. The farmers do not want to believe the research because they think that their data will be used against their interest.

Chapter 2
Review of Literature

The purpose of this chapter is to provide reviews of studies, which are related with the present study. There are some studies on cultivation and their effect on income in the family in Bangladesh. But there are only a few specific studies on the marketing of potato in the country. The Bangladesh Agricultural Research Institute (BARI) and some private and foreign agencies have done a few empirical works on Potato. Brief reviews of the studies on potato cultivation and effect on income are given below.

Elias *et al*. (1980) conducted an economic study on potatoes production in some selected areas of Bangladesh. They estimated the average per acre production cost of potato at Tk. 7376 and the average gross return at TK. 9931. They obtained average potato yield of 242 mounds per acre.

Elias *et al*. (1982) studied improved technology of potato in two district of Bangladesh, Bogra and Munshigonj. They found that the yield per acre hectre was much higher Munshigonj (25009 kg) than that of Bogra (13278 kg).they estimated average net return per hectre was TK. 7211 which was higher in Munshigonj (TK. 8751) than in Bogra (TK. 4953)
.

Sabur (1986) conducted a study on marketed surplus of potatoes in two districts of Bangladesh, he found that production and marketed surplus of potatoes moved in some positive direction. He observed that the average production cost per hectare was TK. 29635.57 and net return was TK. 30947.82.

Das (1992) conducted a study on the profitability of potato cultivation and found that the average yield of potato was 4720 kg per hectare and the average gross return amounted to TK. 33040 per hectare. He calculated the per hectare net return above full-costs at TK. 11085.89.

Projection of food (major cereal) requirement made by Bhuiyan *et al.* (2002) indicates that food requirement would increase from 20.96 million t from 10.71 million ha food cultivable area in 2000 to 27.81 million t from 10.17 million ha food cultivable area in 2025. This

scenario shows that annually Bangladesh has to produce additional 0.274 million tons of food to maintain pace with the needs of population growth. The increased demand for food would have to meet with less land, less water, less labour and less pesticides due to increasing population and pressure on ever shrinking and degrading land and water resources.

Hakim (1993) conducted a comparative economic study on Cardinal and multi varieties of potatoes in Bogra district. He found that per hectare total costs were TK. 32097.25 and TK. 30818.50 for Cardinal and multi varieties respectively. The costs were estimated at TK. 15896.15 and 12701.60. Net returns per hectare on full costs basis were TK. 45196.65 and 451.65.

Rashid (1994) conducted a study on the profitability of different cropping patterns with and without potatoes in two villages in Dinajpur district. The average yields per hectare were 15550 and 4720.54 kg for HYVs and LVs of potatoes, respectively and their respective values were TK. 46084.03 and 24574.82.He also observed that the HYVs of potatoes were more profitable than other crops.

Arif (1998) conducted a study on potato product on selected areas of Comilla district. He showed that the per hectare gross returns were TK. 101858.56 , 102358.56 and 101358.56 ; gross costs were TK. 64251.10, 65179.58 and 64741.42; net returns were Tk. 37607.46, 37178.98 and 366617.14 for small, medium and large categories of farmers respectively.

Akhter et, al. (2001) conducted a survey on potato production in some selected areas of Bangladesh. This study showed that potato production is highly profitable and it could be provide cash money to farmers. In terms of profitability, potato production was more attractive than any other winter vegetables. Per unit yield and gross return of potato were found higher than other competitive crops.

Chowdhury et al. (2015) conducted a study and found that 30 percent of their investment in the current season, which has created a shocking situation for them. Again cold storage charge is Tk. 4.2-4.5 per kg across the country which is a very high rate, on the other hand nearly 420 cold storages across the country can store 3.6 million tons of potato, which is 44 percent of the total production. Dissemination of market information should be increased so that farmers can get the fair price of the potato.

Muktasha Deena Chowdhury et al. (2015) conducted a survey on potato production in some selected areas of Bangladesh. This study showed that found that in the context of production and export potato has a great prospect in Bangladesh. Potato farming is assuming a greater dimension, however bringing pressure on the government to expand its use as alternative food in the domestic sector as well as to explore it for greater export markets in overseas trade.

Begum (2017) also conducted a study about an economic study of potato production in selected areas of Sylhet district and found the large farms receive the highest amount of yield but it was the lowest for small farms. Potato cultivation is financially profitable among the farmers in the study area. Most of potato growers face same category problems but in different ways. Non-availability of quality seed and high price is the major constraint of potato cultivations for the farmers. The quality seeds as well as other inputs need to be available to the potato growers in time at reasonable price.

In Southeast Asia the potato is an important vegetable in diet diversification and an anchor in intensive cool weather horticulture systems. The potato in these countries fills a role in diet diversification and improved nutrition. Bangladesh is the third largest potato producer in Asia and is among the top 10 of the potato producing countries (source: The Daily Prothom-Alo) of the world. It ranks third in area acreage after rice and wheat and is cultivated in almost all agro-ecological regions of Bangladesh. In addition, potato ranks second after rice in production in Bangladesh.

Chapter 3
Methodology

Introduction

This chapter presents a detail description of the methods adopted at different stages of the study. Methodology is an indispensible and integral part of any research. This chapter presents the methodology followed in the study, which included the selection of the study area, selection of samples, preparation of survey schedule, method of data collection, period of survey, editing and tabulation of data and analytical techniques. The tools and methods used and followed for the study with considering the specific objectives of the study are given below.

Selection of Study Area

As the selection of the study area is an important step and it largely depends upon the objectives of the study. Therefore, careful thought was placed on the selection of the study area. In order to make an assessment of the cultivation and its effect on income generation of potato, the study was conducted in selected areas of Thakurgaon district. Thakurgaon district is the leading zone in respect of potato production in Bangladesh. The study area has some favorable characteristics like topography, soil and climate condition for producing potato.

Selection of Period of Study

Data were collected during the period from February to April, 2019 through face to face interview with potato growers. For collecting supplementary data the researcher personally visited the area. All the data collected with their suitable time and date.

Selection of Samples and Sample Technique

The potato growers of the selected areas were considered as major part of the study. A list of potato growers of the selected areas was prepared through a preliminary survey. Considering the limitation of time and fund, the sample size for potato grower was fixed at 60, taking from the selected upazilla. Out of 60 selected growers, 20 from Pirgonj Upazilla, 20 from Bliadangi upazilla, and 20 from Sadar upazilla were selected from Thakurgaon district.

Preparation of the Survey Schedule

For this purpose, interview schedule was prepared for collecting necessary data from different types of samples. An interview schedule contains questions about the Land preparation, Seed, Fertilizer, Insecticides/Pesticides, Irrigation, Weeding Harvesting, Transportation, Marketing and others variable cost of production of potato per acre of land. An interview schedule was prepared for collecting data from potato returns form one acre of land and by product returns from one acre of land. All the schedules were pretested and finally prepared after careful modifications. Interview schedules were prepared on the basis of specific objectives of this study. About 37 interview schedule were prepared for the farmers.

Data Collection

The researcher himself collected the relevant data from the selected samples through face to face interview. Before taking actual interviews the whole academic purpose of the study was clearly explained to the sample farmers. Initially, they were hesitated to answer

the questions; but when they were assured that the study was purely an academic one and it would not affect any way, they were convinced to cooperate with the researcher. At the time of interview, the researcher asked questions systematically and explained the question

whenever it was felt necessary. Farmers were requested to provide correct information as far as possible.

The task of data collection is so important after defining a research problem. Both technical and socioeconomic data are needed in the relevant research. The researcher himself will collect the data by interviewing the selected respondents. The present study was based on field level primary data which were collected from randomly selected potato growers in some selected villages of Thakurgaon district. The survey method was used in the present study. Total sample size was 60. The information was collected during the month of February to April, 2018. After collection of data a list of tables, figures were prepared on the basis of the study. The collected data were thereafter analyzed and condensed by using tabular statistical techniques to obtain the result. To calculate the economic performance of potato, the simple statistical model such as the average, percentage, total cost, total return, gross margin and benefit cost ratio etc. were used.

Tabulation and Analysis of Data

After collecting the data, it was taken to examine the data of each and every schedule to find out any changeability or omission in the data collection and to avoid irrelevant information. The data were edited carefully to eliminate possible errors contained in the schedules while recording information. Processed data were transferred to SPSS 23 and compiled with a view to facilitating tabulation. Information was collected initially in local units. After checking them these were converted into quantitative form by using suitable scoring. Necessary tables were prepared by shortening the data. The collected data were analyzed according to the objectives of the study. Inconsistencies in the data were removed. Analysis was done using the concerned software SPSS 23.

Statistical Analysis

Collected data is to be analyzed to satisfy the objectives. To carry out this process descriptive statistics like frequency, percent, summation, mean, median, mode, standard deviation etc. is to be used.

Problems Encountered in Collecting Data

Though the respondent potato growers were available in the upazilla, collection of required data was not an easy task. The researcher of the study had to face certain problems during data collections, which are noted below:

i. Education of the respondents was a pre-requisite factor for having accurate data. Since most of the respondents were not well educated they were suspicious of outsiders and therefore, they were likely to be less co-operative;

ii. Some respondents did not keep any written records of the faring activities. Therefore, the researcher had to depend upon their memory;

iii. Respondents from all categories were often unable to recall the exact information, say, income, sales volume, cost, total production etc. Reliability of data therefore, posed some confuting ;

iv. There was the limitation of time and personnel and inadequate information about potato cultivation, for this reasons data and other necessary information had to be collected within the shortest possible time;

v. Since the respondents remained busy at their work, they were not always available at home. For this, frequent visits were made to get information from them.

Chapter 4
Socio-Economic Characteristics of Potato Farmers

Introduction

This chapter presents a brief description of the socio-economic characteristics of the selected potato growers. Decision making behavior of individual is determined to a large extent by his social-economic characteristics. Socio-economic environment also largely influences development programmed. The aim of this chapter is to highlight the major socio-economic aspects such family size and composition classification of the family members, level of education, occupational status, farmer holding and utilization pattern etc. of selected farmers under study. The socio-economic background and characteristics of the farmer‟s influences the productions to a great extent. So, a description of the characteristics of farmer is necessary for analyzing the main objective of the present study. Socio-economic characteristics of the farmer‟s included their age, family size, educational status, farm size, farming experience, use of seed variety, place of sale, farmer ownership pattern of the respondent.

Type of Farmers and Age

There are as many types of farmers in the world as there are farm products demanded by consumers. Farmers bring to the table every kind of fruit, vegetable and grain crop, as well as specialty products such as silk worms, cultured pearls, rubber, coffee, ferns and countless other plants, animals or by-product of those plants and animals. In this study, there are three types of farmer selected for potato cultivation and its effect on income generation. Table 4.1 shows the types of farmer with their age in Thakurgaon district. Age of farmers plays an important role in the crop production and better management of the farming activities. There are three age group in this study. Also there are three types of farmer who cultivate potato and this effect on income generation. I take 1-33 decimal farmer of farmer as small, 33-100

decimal farmer farmers as medium, and More than 100 decimal are considered as large farmer for the study.

Table 4.1 Types of Farmer and Age of the Respondents

Types of Farmer	Age of the Respondents			
		20-35 Years	35-50 Years	Above 50 Years
	Small	28.0%	16.67%	45.45%
	Medium	36.0%	33.33%	27.27%
	Large	36.0%	50.0%	27.27%
	Overall	100	100	100

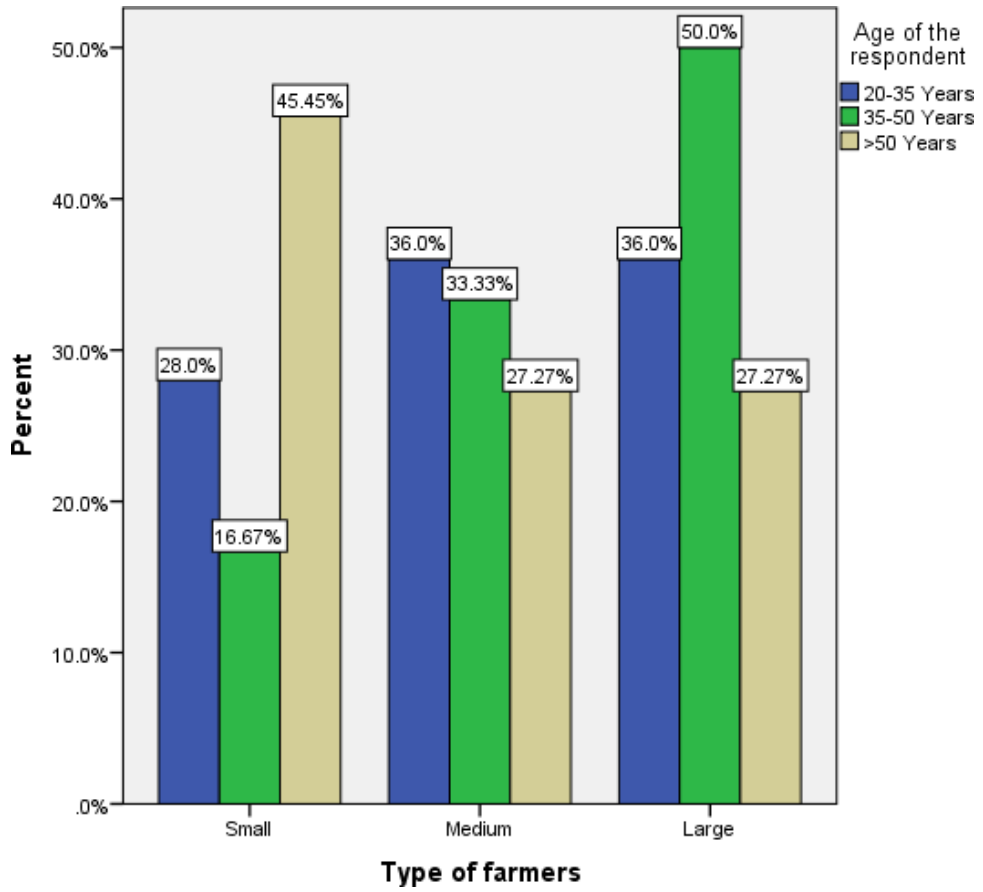

Figure 4.1 Type of Farmer and Age of the Respondents

From the table, it can be shown that the 28% of the respondent age 20-35 years are small farmer, 36% of the respondent has medium farmer and 36% of the respondents are large farmer. Again the age group 35-50 years has 16% are small, 33.33% are medium and 50% are large farmer. More than 50 year age are found that they are 45.45% are small, 27.27% are medium and large. It means most of the small farmers are above 50 years, most of the medium farmers are more than 20-35 years and most of the large farmers are 35-50 years.

Educational Status

Education has its own merits and it contributes to economic and social development, as education is the backbone of a nation. It plays a vital role in the acquisition of information about the innovation in various production processes of agriculture. In order to adopting improved technology and scientific knowledge regarding farming education plays a significant role. Educated farmers can have better access to the relevant technical information for improved production and can make rational economic decisions. It makes a man more capable to manage scare resources and hence to earn maximum profit. There are four groups in educational status. In our country many of the farmer are illiterate and depends only on their life experience.

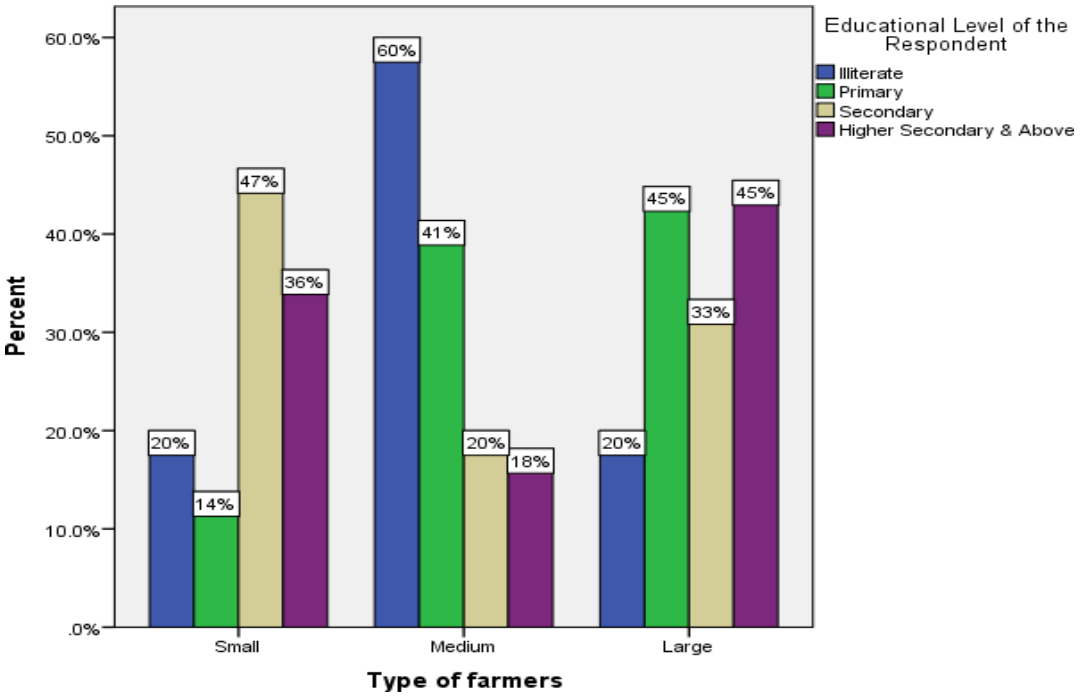

Figure 4.2 Educational Level for different types of Farmer

From the figure 4.2, I see that only few farmer have secondary and higher secondary & above degree. Most of the farmer only completed their primary level. It is observed that illiterate farmer is 20% are small farmer, 60% are medium farmer and 20% are large farmer. Farmer who completed their primary level are 14% are small farmer, 41% are medium farmer and 45% are large farmer. And farmer who completed their Secondary level are 47% are small farmer, 20% are medium farmer and 33% are large farmers.

Family members of Different Farmer

The family size and its composition are related to both occupation and income. In this study, a family has been defined as a group of persons living together and taking their meals from the same kitchen under the administration of the head of the family. The family members include the owner of the farm and his wife, brother and his wife, unmarried sister, sons, unmarried daughters, father and mother. Besides, persons who have been employed in farm family for household works like servants, care takers etc. are included in the family members in this study.

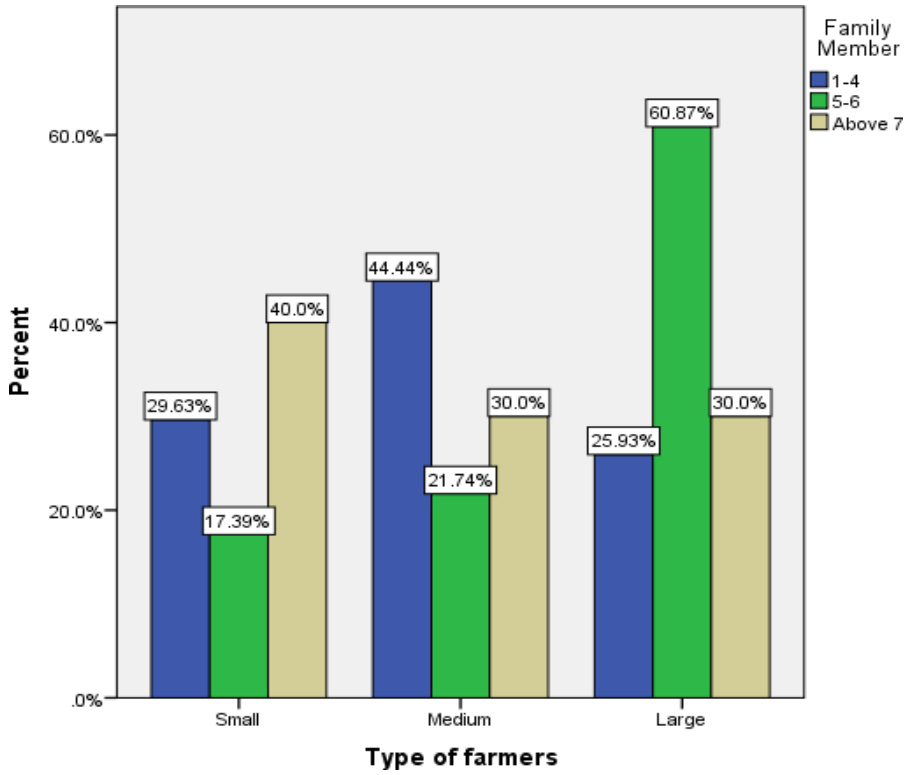

Figure 4.3 Family member of different farmer

From the figure 4.3 most of the family has (5-6) members. I see that family member (1-4) are small farmer is 13 percent of the respondents. Farmer have medium farmer which family size (1-4) is 20 percent, (5-6) is 8 percent, and above 7 is 5 percent. Again the third types of farmer which has above 100 decimal farmer, their family size 12 percent for (1-4) member, 23 percent for (5-6) member, and above 7 is about 5 percent of the respondents.

Farming Experience

Farm experience is an important factor to ensure farm productivity. Farmers who have more experience in farm operations generally attain higher levels of technical efficiency. Technical inefficiencies of the production are significantly related to farming experience of the farmers. It is recommended that the player becomes familiar with the farming skill. It is also great to note that every player has their own methods of running to patches and training this skill. It is best for you to figure out the best path, the best seeds to plant, what you want to plant, what you can afford. Many players change their routine based on new transportation and items that come into the game. Focus on what works for you.

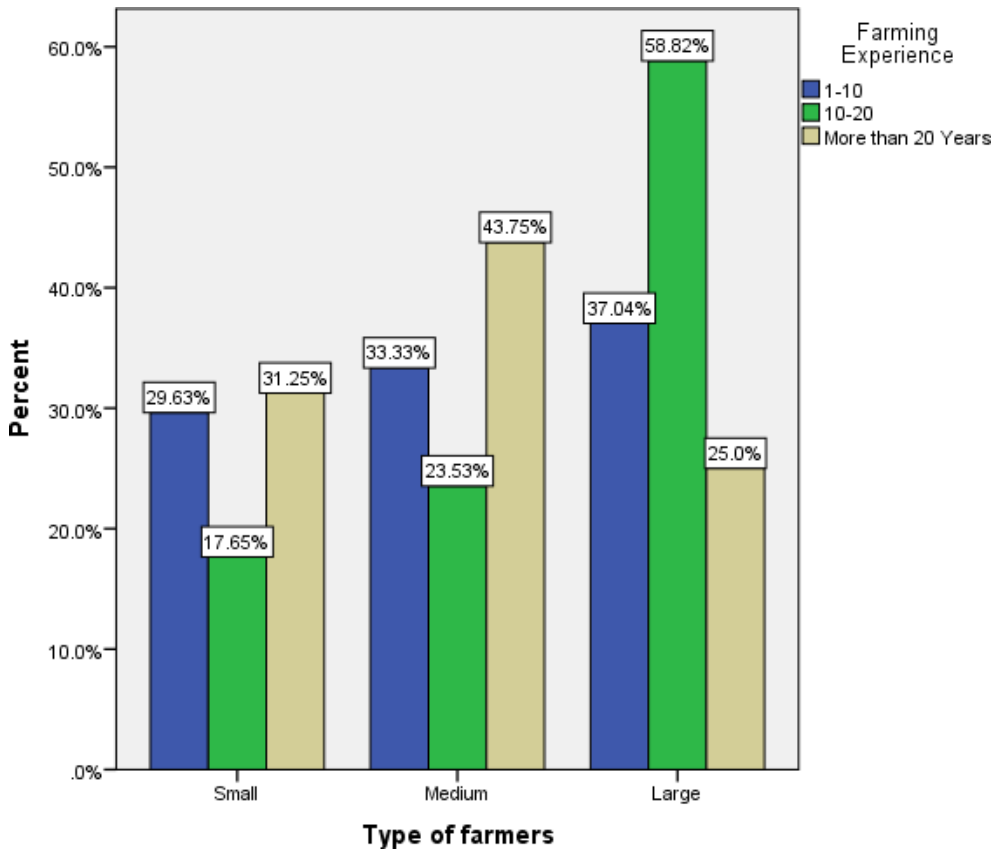

Figure 4.4 Farming Experience of different farmer

From the Figure 4.4, most of the family farming experience is 1-10 years. I see that farming experience (1-10) are small farmer is 29.63 percent, (10-20) years of experience have 17.65 percent and more than 20 years‟ experience have 31.25 percent of the respondents. Farmer have medium farmer which farming experience (1-10) is 33.33 percent, (10-20) is 23.53 percent, and above 20 is 43.75 percent of the respondent. Again the third types of farmer which has above 100 decimal farmers, their farming experience 37.04 percent for (1-10) member, 58.82 percent for (10-20) member and above 20 is about 25 percent of the respondents.

Place of Sale of Different Farmers

All the sample farmers reported that low price was a major problem in potato marketing. In the study areas, there was no shed to protect the producers and their potato from rain or sunshine and the producers had to sell their produce standing in the open place. Transportation cost was very high in the study area. The primary and secondary markets were

not directly connected with the villages. Due to high transportation cost and poor communication facilities, the farmers were bound to sell potato in local markets at low prices.

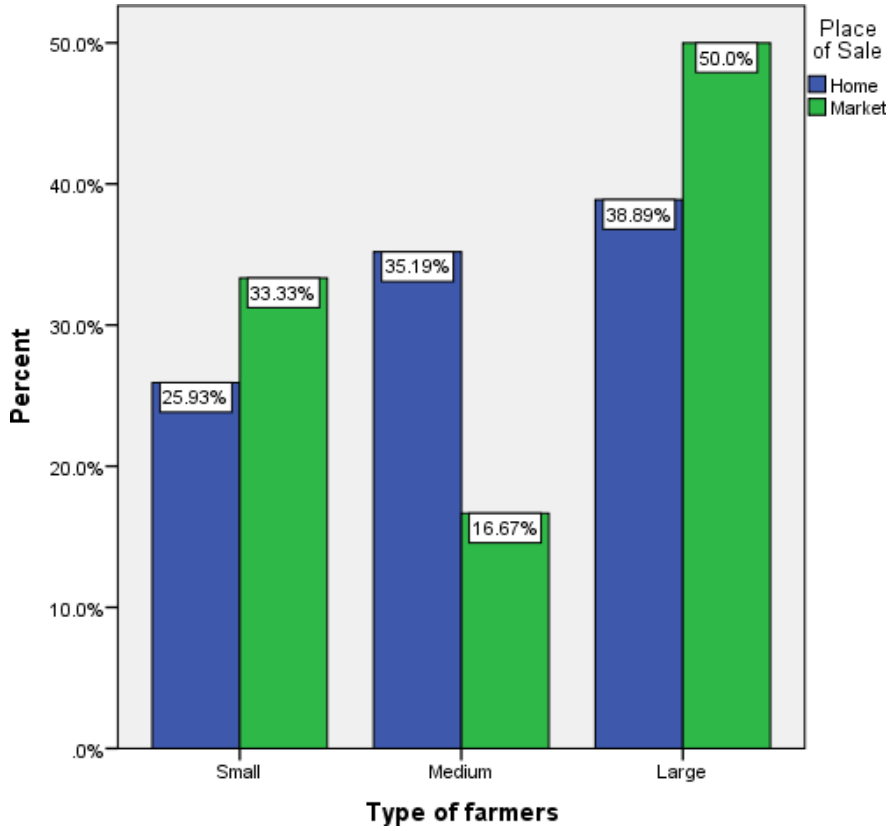

Figure 4.5 Place of sales of different farmer

Place of sale is an important issue for producing and farming potato. When the place is only for home farmer cultivate less potato rather than when they want to sell in the market they cultivate more potato for sale. From the Figure 4.5 I see that 25.93 percent small farmer sold their potato in their home and 33.33 percent small farmer sold their potato in the market. Medium farmers sell their potato 35.19 percent in their home and 16.67 percent in market. Large farmers sell their potato 38.89 percent in their home and 50 percent in market.

Chapter Summary

This chapter analyzed the socio-demographic attributes of different farm categories. The findings of the analysis, presented from section 4.1 to 4.6, clearly indicate that socio-demographic characteristics of (1-33) decimal as small, (33-100) decimal as medium and above 100 decimal farmer as large farmers differ from each other in respect of age, literacy

rate, family composition, family size, occupation, asset ownership, farming experience, extension contact, training, microfinance, household income and expenditure.

Chapter 5

Profitability of Potato Cultivation

This chapter deals with the estimation and analysis of costs, returns and profitability of growing potato. An attempt has been made in this chapter to determine and compare the per acre total costs, gross return, gross margin, net return and benefit cost ratios (undiscounted) of potato production in the selected areas. All these costs and returns were calculated for duration of four month operation of growing potato.

For agricultural production, cost of inputs is an important element and to expense incurred in organizing and carrying out the production processes. Farmers‟ decision about production is mainly influenced by the cost of inputs. Inputs used in the study areas were both purchased and family supplied. Farmers had to pay cash for the purchased inputs like land preparation, seeds, organic and inorganic fertilizers, insecticides, irrigation charge etc. It was easy to calculate the costs of these items. On the other hand, no cash was actually paid for home supplied. The input items were valued at the existing market price in the area during survey period or the prices at which the farmers bought the inputs. For the convenience of analysis, the cost items were classified into two groups: (a) variable cost and (b) fixed cost.

Variable Cost

Variable costs are the costs of using the variable inputs. These costs vary with the level of production. In potato production various input costs like seed costs, human labor cost, animal power/mechanical power cost, cost of organic and inorganic fertilizer, irrigation cost, costs of pesticides and vitamin etc. are considered as variable costs. Costs of using these inputs are discussed below:

Table 5.1 Cost of Production of Potato per acre according to Farm Size.

Cost Items	Type of Farm/Acre			
	Small	Medium	Large	Mean
Variable Cost				
Land Preparation	5275	5220	5283	5260
Seed	4625	5100	4416.67	4713

Fertilizer	8775	8945	9120.84	8946
Insecticides/ Pesticides	7250	7700	7250	8023
Irrigation	2625	2525	2645.83	2265
Weeding & Earthling up	1275	1250	1158.33	1227
Harvesting	5125	5550	5333.33	5336
Transportation	2000	1550	1875	1808
Marketing	687.5	800	625	704
Others	1562.5	1625	1729	1638
Fixed Cost				
Land cost of production	39500	33200	31500	34733
Total Cost	78700	73465	70937	74367

Land Preparation Cost

Human labor was required for almost all of the operations of potato production such as land preparation, sowing/broadcasting, weeding, fertilizing, insecticiding, harvesting, threshing, cleaning, drying, etc. There were two sources of supply of human labor in the study areas, one was home supplied labor and another was purchased labor. Family labor included the farmer himself and his family members (children and wife). Women were mostly engaged in harvesting, cleaning and drying activities. Human labor was measured in terms of man-day unit which consisted of 8 hours of work by an adult man. For child and women, man equivalent hours were estimated. In this present study of cost of production of potato per acre of land depends on land preparation. Land preparation need labor cost, seed sowing cost, soil test etc. From the survey I see that there are on an average 5260 TK (Table 5.1) cost for preparing their land.

Seed Cost

Usually the farmers used both home supplied and purchased seeds of potato. Opportunity cost principle was applied for home supplied seeds and was determined at the ongoing market rate in the study area and on the other hand, costs of purchased seeds were calculated on the basis of actual price paid by the farmers. There was a variation in the cost of seed per acre. It was seen that on average, seed cost per acre was prevailed in the market at Tk. 4713 for all farmers.

Fertilizers cost

Manure is useful for increasing organic matter of soil to eventually increase crop yield. The sampled farmers in the study area applied manure in their potato field during land

preparation. Most farmers used both cowdung and ash to increase the soil fertility. A large quantity of manure was supplied from the farmers‟ home. While some farmers bought cowdung from the milk producers. In the study area cost of organic fertilizer were calculated at the prevailing per acre land. Almost all the farmers used chemical fertilizer and all kinds of fertilizer are bought from the market at the prevailing market price. Urea, TSP, MoP, Gypsum, Zinc Sulphate and DAP were the most commonly used fertilizer in the study area. In this study we found that average fertilizer cost of production of potato per acre of land was 8946 tk (Table 5.1).

Cost of pesticides

Potato growers used different kinds of pesticides like Malathion, Basudin, Diaginon, Sumitheon, Dusban, Ripkord, Furadan, Sunfuran, Dinecron, Meghappos, Nogos etc. to keep their crop free from disease. Therefore, cost of pesticides was calculated on the basis of actual amount of money paid by the farmers. On an average, (ignoring farm size groups) per acre cost of pesticides was calculated at Tk. 8023 (Table 5.1).

Cost of irrigation

Irrigation is an essential input for cultivating potato. Most of the farmers had to pay mechanical irrigation water charges and they used manual labor for irrigation. In the study area, the rate of irrigation cost was Tk. 2265 per acre (Table 5.1).

Correlation between Different Variable Cost

Correlation is the linear relationship between two variables. From the study we find the relation between different variable cost with there significant level. Table 5.2 shows the correlation between different variable cost are given below:

Table 5.2: Correlation between Different Variable Cost

Correlations						
		Land Preparation cost	Seed cost	Fertilizer cost	Insecticides/ Pesticides cost	Irrigation cost
Land Preparation cost	Pearson Correlation	1	-.033	.573**	.388**	.611**
	Sig. (2-tailed)		.800	.000	.002	.000
Seed cost	Pearson Correlation	-.033	1	.509**	.356**	-.370**
	Sig. (2-tailed)	.800		.000	.005	.004
Fertilizer cost	Pearson Correlation	.573**	.509**	1	.389**	.300*
	Sig. (2-tailed)	.000	.000		.002	.020
Insecticides/ Pesticides cost	Pearson Correlation	.388**	.356**	.389**	1	-.244
	Sig. (2-tailed)	.002	.005	.002		.060
Irrigation cost	Pearson Correlation	.611**	-.370**	.300*	-.244	1
	Sig. (2-tailed)	.000	.004	.020	.060	

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

From the table 5.2 we see that the correlation between land preparation cost and seed cost, seed cost and irrigation cost, insecticides cost and irrigation cost are negative. That‟s means, when the seed cost increase then land preparation cost decrease, seed cost increase then irrigation cost decrease, again when the irrigation cost increase insecticides cost will be decreases. Other costs are positively correlated, that means when one cost increase then another cost will be also increases.

Fixed Cost

Fixed costs are those which do not change in magnitude as the amount of output changes and are incurred even when production not undertaken. Fixed costs are included land use costs, interest on operating capital, costs of tools and equipments etc. Costs of using these inputs are discussed below:

Land rental value

Land use cost varies from one place to another depending on the location, soil fertility, topography of the soil etc. In the study area, it was calculated on the basis of cash rental value of per acre land for the cropping period of 4 months. This amount was Tk. 34200 for all categories of farmers. Moreover land use cost was almost same for all categories of farmers in the study areas.

5.3.4 Total fixed cost

Figure 5.1 reveals that on an average, total cost of potato cultivation was Tk. 74367 per acre. The highest fixed cost was incurred by the small farmer farmers (Tk. 78700/acre) followed by medium farmer farmers (Tk. 73465/acre) and large farmers (Tk. 70937/acre) respectively. Major portion of fixed cost was occupied by land use cost for all categories of farmers.

Total Cost

The total cost was calculated by adding up total variable costs and total fixed costs. Figure 5.1 represents the gross cost of potato production. In the present study per acre gross costs for producing potato were estimated at Tk. 98800, Tk. 93955 and 91413 for three types of farmers respectively and the average gross cost was Tk. 94722.67 for all categories of farmers. Figure 5.1 shows the various cost items for all categories of potato farmers.

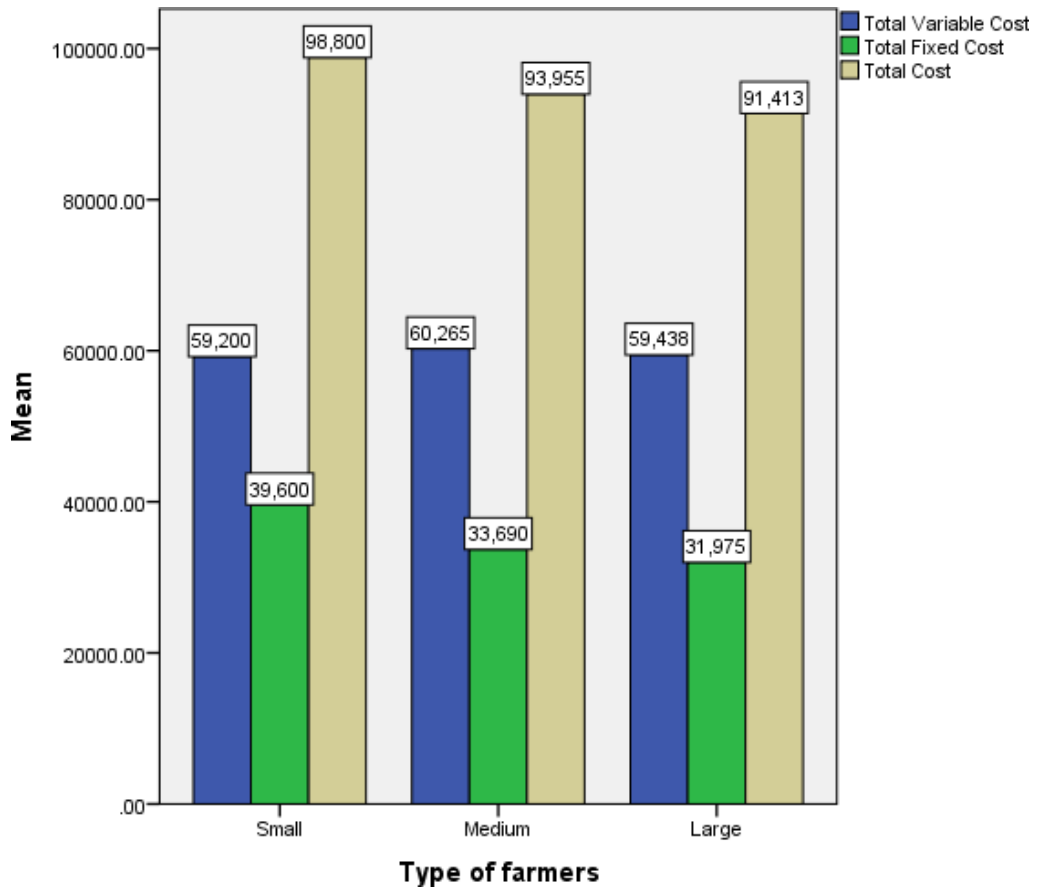

Figure 5.1 Total Cost, Total Variable Cost and Total Fixed Cost for all Categories of Farmers.

Net return

To estimate the net return from potato production total cost was deducted from gross return. Total cost is the sum of total variable cost plus total fixed cost mention above. Table 5.2 reveals that per acre average net return for all sizes of potato producers were Tk. 55200. Net returns were estimated at Tk. 36050, 45256 and 60215 for different farmers, respectively. Here, net return was not that much high because of comparatively higher total fixed cost of all the farmer categories.

Table 5.2 Different returns from one acre of land

Return & profit		Farmer Category	
Returns	Small	Medium	Large
Potato Returns	91575.25	90225.5	84516.5
By Product Returns	5621.5	5420.25	4060.5
Total Returns	97196.75	95645.75	88577
Total Cost	78700	73465.5	70937.67
Profit	18496.75	22180.25	17649.33

Potato Returns

Returns of potato are very important in cultivating potato in their different land. The entire farmer wants good quality of potato with maximum production. Table 5.2 shows that the total return and profit for the different type of farmers.

By Product Returns

By product is a secondary product. By product are minor products obtained incidentally in the process of manufacturing the main product. The relationship between main product change with changes in economic or industrial condition or with advancement of science. Table 5.2 shows that the average by product returns from one acre of land were 5621.5, 5420.25, 4060.5 Tk for small, medium, and large farmer respectively.

Use of Income from Potato Production

Incomes from potato production are important for their family. Farmer cultivate potato for earn some amount of money which make them reliable for family cost. In use of income from potato production on household annual expenditures per season are given below:

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Table 5.3 Use of Income from Potato Production

Contribution of Potato Income in Consumption	Farmer Category		
	Small	Medium	Large
Use of income from potato in food	7545	9450	6489
Use of income from potato in House Spending	3468	4050	4956
Use of income from potato in Fuel	1037.5	980	1066.67
Use of income from potato in Health Purpose	2500	2450	2833.33
Use of income from potato in Education	1050	1150	1245
Use of income from potato in Clothing	1203	2130	2315

The average use of income from potato in food, non-food, housing spending, energy, health purpose, education and clothing were given in the table 5.3. From the table 5.3 we see that most of the return form potato production was use as food, and 2nd use of potato was household spending.

Income Contribution

Farmer wants to use their income in different consumption. All of them use this income foe different purpose. They spend their money in house spending, fuel, health purpose, education, clothing and many other things where they fail to maintain their family.

Table 5.4: Contribution of potato income in consumption

Income head	Farmer Category		
	Small	Medium	Large
Agricultural Income	84065	99785	126950
Non-agricultural Income	15254	42670	78420
Potato Income	18496.75	22180.25	17639.33
Total Income	117815.8	164635.3	223009.3
% of Potato income in Total Income	15.6	13.4	7.9

It is evidence from the Table 5.4 that 15.6% small farmer use their profit in consumption, 13.4% medium farmer use their profit in consumption, and last of all only 7.9% large farmer use their profit in consumption.

Chapter 6
Problems of Potato Cultivation and Suggestions

Potato production in Bangladesh is beset with a number of socioeconomic and bio-physical factors. The focus of this chapter is to identify the constraints confronted by the potato farmers in the study areas and to find out probable solution of them. With those objectives in view, the farmers were interviewed accordingly. Diverse replies were received regarding the constraints and their solutions. Farmers‟ opinions on the status of the said constraints were recorded such as less, medium and severe problems, respectively. According to their opinions, the constraints and probable solutions were analyzed and discussed in this chapter.

Problem face in potato production and marketing

Farmers‟ in the study areas were mentioned a number of problems which affected potato production. The summary of different problems is presented in Table 6.1 and discussed below:

Table 6.1 Constraints of Potato Production as Mentioned by the Farmers

Problems	Responses	Order
Lack of good quality seeds	81.25	1
Poor germination of seeds in the field	62.60	2
Lack of proper knowledge	54.75	3
Inefficient marketing systems and low product price	54.25	4
Lack of proper utilization of irrigation facilities	50.00	5
Declining soil fertility	40.50	6
Disease and pest infestation	35.65	7
Natural calamities	13.65	8
Lack of loan facilities	12.50	9
Lack of storage facility	5.95	10

Absence of good quality seeds: Good quality seeds assume a significant job in higher generation. The ranchers utilized seeds of various evaluations. They were more often than not acquired seeds from the nearby markets which were not a decent quality seed as their

germination rate was poor. In spite of the fact that every one of the ranchers were found to deliver high yielding assortments of potato, 81.25 percent of them referenced that they had lacking of good quality seeds in the market and this imperative positioned first among the issues (Table 6.1).

Poor germination of seeds in the field: Poor germination of seeds in the field was second positioning requirement referenced by 62.60 percent of the ranchers. On a normal, ranchers utilized 124 kilogram seeds for each acre against a proposal of 120 kilogram for every hectare. This is a result of because of poor germination, ranchers needed to apply higher seed rate and consequently creation cost went up.

Absence of legitimate learning: Knowledge is a useful asset to build profitability of any harvest. About 54.75 percent of the potato developing ranchers in the investigation regions referenced that they needed appropriate learning with respect to different parts of potato generation. The information hole wins in each phase of potato creation particularly for the appropriation of current potato generation innovation. The majority of the ranchers had learning hole about new assortments, seed medications, soil test, ideal sowing information and suggested manure the executives which were basic for yield increase. This issue positioned third among the issues referenced by the ranchers. It might be referenced that just about 54.75 percent of the respondents got preparing on any part of potato.

Inefficient marketing systems and low product price: Modernization of agriculture involves higher investment as well as more risk, namely, physical loss through natural calamities and price risk. Thus, markets and marketing policies play a crucial role in modernizing subsistence agriculture. A successful production programme requires, apart from modern variety seeds and improved production technologies, a satisfactory deliver system of inputs and positive and effective pricing and marketing policies for the output. Bangladesh agriculture is dominated by very small farmers (average farm size is less than 1 ha). The small size of farms, for their lack of sustaining power, causes the sale of the major crop share immediately after harvest. All types of farmers, especially the smaller farmers, buy back the same crops (rice and potato) in the off-season at a much higher price for their consumption and seeds. Naturally, the product prices of potato are low during and immediately after harvest. Higher prices prevail during the off-season of that crop. Farmers do not get the appropriate prices of their products due to an unorganized marketing system. Price of any product is very important for making decision on the next time crop production.

Inefficient marketing systems and the price of potato was very low mentioned by 54.25 percent of the respondents and its rank was the 4th among the problems.

Lack of proper utilization of irrigation facilities: Lack of irrigation facilities or proper utilization of available irrigation facilities was another constraint for sustainable development of potato production systems mentioned by 50.00 percent of the respondents. This problems arises mainly due to ownership of irrigation channel and equipment, excessive irrigation charge during peak periods and mechanical trouble of irrigation equipment.

Declining soil fertility: Farmers in the study areas were concerned about the declining soil fertility. About 40.50 percent of the respondents mentioned that declining soil fertility hampered potato production. Reports are already available that fertility of our soils has deteriorated over the years and the productivity of some crops have either stagnated or declined. Declining of soil fertility is further aggravated due to deficiency of more and more micronutrients in the soil. Farmers also mentioned that they got less yield from same amount of fertilizers used than before due to declining soil fertility.

Disease and pest infestation: With the expansion of modern variety adoption, pest management to „seed to seed" is getting increasing importance. Attack of diseases/pests is a problem of potato in Bangladesh mentioned by 38.35 percent of the respondents. Farmers generally cannot differentiate between pests and predators. They are unskilled in using knowledge based pest management techniques in an economically optimal manner. As a result, the sustainable productivity of potato is being threatened.

Natural calamities: It was found that potato farmers faced some acute problems relating to the nature in their production process. Natural calamities like *kalboishakhi*, drought hail storm, excessive rainfall, caused substantial damage to the crop in the field. Farmers said that excessive rainfall during the harvesting period reduces both the quantity and storability of potato. On an average, only about 13.65 percent of the farmers faced untimely/unnecessary rainfall during potato growing period. This problem arises when rainfall occurred immediately after giving irrigation to the potato plot. However, this was not a remarkable problem for potato cultivation.

Lack of loan facilities: Potato is a capital intensive enterprise and its needed large amount of money for cultivation but many of the farmers could not afford it. For this reason they have to take loan. In the study areas, Rajshahi Krishi Unnayan Bank (RKUB), Grameen Bank (GB)

and Palli Daridro Bimochan Foundation (PDBF) provided credit for the purpose of agriculture and they charge a higher amount of interest rate. The producers also faced problems in obtaining bank loans for different terms and conditions and sometimes they do not get loans in due time at peak season. Therefore, the farmers have to borrow money from other sources such as money lender (local name *Mahajan*) with high interest rate. In the study areas, about 12.5 percent of potato farmers were in problem due to complicated credit system and it was the 9th ranked problem.

Lack of storage facility: After harvesting of cereal crops, it needs space to dry for storage. Due to lack of proper knowledge, farmers could not store their produced potato in proper place resulted storage loss. On the other hand, they could not keep grains for selling later on when market price would go up. It is indicated from Table 6.1 that about 5.95 percent potato producing farmers stated lack of storage facility as the 10th ranked constraint in the study areas. For this constraint, they were bound to sell potato just after harvesting. Therefore, they did not get the appropriate prices of their products.

Suggestions to Overcome the Constraints

The farmers in the study areas were requested to give suggestions to overcome the constraints identified earlier in potato production. Their suggestions are discussed below in brief:

Availability of inputs at subsidized rate: Good quality seeds, fertilizers and pesticides are important inputs for producing potato. So, these inputs should be available to the farmers at subsidized rate. Government should take due steps against impure fertilizers and poor seeds.

Provision of training on potato production: Training is an important tool to enhance knowledge and skill. Farmers approached for providing training on proper number of ploughing and laddering, optimum seed sowing time and method, application of recommended manure and fertilizers, efficient use of irrigation and method, judicial use of insecticides, proper number of weeding, thinning and soil earthing up as well as harvesting of crop etc. Formal training should be provided to the farmers by the Government authorities and the responsibilities of local agriculture officers should be monitored periodically by some higher authorities.

Availability of institutional credit: Farmers need cash money at the time of cultivation. So, institutional credit facilities should be made available at the right time to the potato farmers for increasing the volume of production. Government should provide such facilities through various institutional and non- institutional sources at low interest rate on easy terms and conditions.

Introduction of storage facility: Farmers in the study areas did not receive higher price due to lack of storage facility. Farmers requested for introducing storage facility. The local Government authority may develop low cost storage facilities at the primary and secondary markets. This would provide adequate storage facilitates to the farmers.

To improve marketing facility: In the study areas most of the farmers reported that they were faced serious problem due to lack of marketing facilities. A dependable transport is yet another prerequisite for the successful operation of the marketing system. Transport facilitates the movement of goods from places where they were less useful to places where they were in much demand. They furthermore suggested that market information and weather forecasts should be made at right time. On the basis of priority, village roads should be developed at least brick bedded road so that rickshaws or motor vehicles could move easily. It would also help in reducing the transportation cost. Market facilities such as pucca floor, tinshed, drainage, water supply, electricity supply, etc. should be arranged by the appropriate Government authorities to facilitate proper markets of potato in the study areas. Also, Government should ensure a stable price to stop market price fluctuation.

Chapter Summary

The above talks mistakely show that ranchers are confronting a decent number of issues in potato generation. In this respects, the ranchers set forward various recommendations to beat the previously mentioned limitations. Accordingly, it might be reasoned that potato hectare just as its creation could be expanded to an enormous degree if the previously mentioned issues could be settled.

Chapter 7

Summary, Conclusion and Recommendation

In the light of discussions made in the earlier chapters, a summary of the results, some conclusions on the basis of empirical findings and policy implications to improve the existing inefficiency of potato production in Bangladesh is presented in this chapter.

Summary of the Study

Agriculture, being the mainstay of Bangladesh economy, contributes about 13.60 percent to the GDP and provides employment to 39.07 percent of its alive national labour force. (BBS,2018) Crop as a major sub-sector (in terms of GDP contribution about 10.74 percent) of agriculture have a crucial importance in the economy of Bangladesh. This sector plays a significant role in supplying nutrition, creation of rural employment, poverty alleviation, earning foreign exchange and more importantly socioeconomic stability in the rural areas.

Bangladesh is turning to be a sick society due to huge malnutrition with a vast majority of people living below the poverty line. High population growth with declining death rate together with low growth in agricultural productivity adversely affects the living standard in the country. The present food production situation is not sufficient to meet domestic requirement. And the food deficiency will become more in the subsequent years due to rapid and higher population growth rate compared to food production.

The present production of rice in no way can meet the total food needs especially nutrient requirements of Bangladesh. Potato can supplement rice and play a vital role from the viewpoint of food self-sufficiency. It is highly nutritious and high energy food source. The popularity of potato as a food is gaining momentum year after year and it has reached such a point that very few people in Bangladesh refuse this cereal on the dining table. Potato area and production continuously fluctuated over the time.

Potato has become now an important cereal crop in Bangladesh due to its higher yield, nutritional value and versatile uses. Demand for potato in Bangladesh is augmenting day by day due to increasing population and rapid expansion of poultry and livestock industries.

High production of potato depends on the expansion of high yielding variety of seed, improved management and timely supplying of inputs. The rate of adoption of modern technology and sustainability of potato production depend largely on its economic profitability. Profitability is certainly an important consideration to the farmers‟ for selection of crops and adoption of new technologies. The returns from the potato crops and the productivity of inputs or resources determine the ability of farmers to acquire, utilize and sustain a certain type and quantity of resources which in turn will be used for further increase of productivity.

The efficient use of resources is an important indicator of increased production in agriculture. Like other food grains, potato output could be raised by utilizing the productive inputs, such as land, labour, capital and organizing the management of production efficiently. Efficiency utilization of present level of inputs may be advised for higher productivity. As there is a limited scope for further increase of potato area, production can be increased by increasing the productive efficiency of potato using existing technologies. Understanding the determinants of economic inefficiency of potato production is very important for both farmers and policy makers to increase the productivity and profitability of potato production. Therefore, to keep pace with the future demand of the growing population, the current trend of potato production and productivity should be raised and to increase yield level for maintaining food security of the population without substantial and unaffordable imports, and also an appropriate research and production plan should be undertaken to boost up the potato production in Bangladesh.

The main aim of the study is to identify and explain possibilities for improving productivity and profitability of potato by increasing the productive efficiency of potato farmers in Bangladesh. The present study was undertaken in Thakurgoan district of Bangladesh with the specific objectives to document the socio-demographic profiles, to determine the cost and relative profitability of producing potato under different farm sizes and to estimate the farm specific technical, allocative and economic efficiency of potato production.

The present study was undertaken in purposively selected Pirgonj upazilla, Baliadangi upazilla and Sadar upazilla of Tahkurgoan district for discussion and necessary data collection. A total of 60 farmers were selected from the collected lists by simple random

sampling methods, whereas taking 20 small, 20 medium and 20 large farmers, respectively from each village. Primary data were collected by the researcher himself from potato farmers of the selected district through direct interview method with the help of pre-tested interview.

The collected data were then entered into the computer and data analysis was done by using the concerned computer software packages like Microsoft Excel and Statistical Package for Social Science (SPSS). A combination of descriptive and statistical techniques as demanded by the study was used to achieve the objectives and to get the meaningful results. Various descriptive statistical measures (i.e., sum, average, percentages, ratios, standard deviation etc.) were employed to examine the objectives. For sustainable production of potato under potato based cropping patterns, some technologies related to tillage, crop management, nutrients and water management practices were analyzed. In these issues, growth rate of potato area, production and yield, total factor productivity index, sensitivity analysis, employment opportunity, economic benefit, farmer‟s intension for further potato cultivation, food and nutrition security, etc. are discussed for analyzing the final objective.

In this study, an attempt has been made to identify the socio-demographic profiles of the sample farmers. It was observed from farm category, 22.50 percent sample farmers were illiterate and 77.50 percent literate. Household income was spent on different head such as food, clothing, health care, education, housing and furniture, agriculture, electricity and miscellaneous cost in the study areas. Farmers spent a major portion of income on their food items (29.53%) and agricultural activities (31.57%). The average agricultural farming experience was recorded as 20 years of which potato farming experience was about 13 years in all categories of farmers. These differences indicated that irrespective of farm category, farmers go for potato cultivation after gathering some farming experience other than potato. About half of the respondents (42.50%) had no contact with extension personnel.

However, only about 9.17 percent had weekly contact and the rest of the contact had irregular. To determine the profitability of potato production, the inputs were valued either at their market prices prevailing in the study areas during the study period or at the price at which those were bought for computing all the cost items. Farmers in the study areas used purchased as well as home supplied inputs.

Conclusions and Recommendations

The study revealed some valuable information regarding potato production. The overall findings of this research suggested that potato production is a profitable enterprise. In spite of its profitability most of the farmers were not interested in potato production due to its high production cost especially human labour cost relative to other crops. If the problems are removed and potato growers are given incentives then the production of potato could help in improve income, employment generation and poverty alleviation of the rural poor‟s. Moreover, there are bright prospects for the development of potato due to its high nutritive values and rising demand in home and abroad. Therefore, meeting local consumption, it can be exported in the international market.

Conclusions and recommendations were drawn on the basis of the results and discussions made in earlier chapters. Based on the findings of the study, these are stated below in brief:

i. Expansion of potato output by increasing area has now become extremely limited because of scarcity of land. In such situation, improvement of potato output should be vertical and concerted efforts of the researchers is essential to develop new high yielding varieties responsive to high input and management practices.

ii. Extension contact has a positive impact in increasing production of potato and farmers having frequent contact with extension personnel produced higher yield. About half of the farmers in the study areas had no contact with extension personnel and the rest of the farmers had irregular contact. Hence, farm level extension service should be strengthened so that farmers‟ consciousness regarding improved production and management practices is ensured.

iii. It was observed that about 73 percent farmers had no formal training regarding agricultural as well as potato production. Further, it was noted that potato training receiver obtained higher yield than that of non-receiver, i.e., training had positive relation to yield. To develop interest among the farmers to participate in training sessions, some incentives might be arranged such as quality input supply at cheap rate, short term credit facility, etc. Both government and non-government organizations should take initiatives to

provide training to the farmers on the different aspects of potato production.

iv. Micro finance has influential effect not only on the farmers‟ technical efficiency but also on economic efficiency. Farmers who have access to credit can purchase inputs at right time and low price. In the present study, a few farmers have received this facility. So, institutional credit should be made more flexible for the potato producers. Besides, the interest rate for credit should reasonably be low.

Policy Implications

Based on the results of the study, the following policy recommendations are made for increasing the production and financial returns as well as sustainable development of potato production in Bangladesh.

i. Steps should be taken to motivate the farmers to mix cropping in their potato included cropping patterns to maintain soil fertility in the long run and increase the crop yield.

ii. Newly released high yielding varieties of potato should be popularized. High quality seeds of those varieties must be available to the farmers in time at cheap rate. Farmers‟ seed storage programme, and BADC seed production and distribution programme should be strengthened by marketing more efficiently and making BADC semi-autonomous. Tuber Crops Research Centre (TCRC) must have strong research and training program on potato. Motivation efforts must go on.

iii. Spot scarcity, adulterated and high price of fertilizers affected their application in the potato field. In this regard concerned authority should take necessary steps so that sufficient fertilizers are made available to the farmers in time and with fair price.

iv. To control the pest and disease, supply of insecticides should be available and special emphasis should be given on integrated pest management practices.

v. Different Government agencies like DAE and non-government agencies should run strong extension programme in order to increase area under potato production and diversified uses of highly nutritious potato should be encouraged to the farmers through books, papers, leaflets and other mass media.

vi. GOs and NGOs should arrange multi-disciplinary training on potato production to enrich farmers‟ knowledge and skill.

vii. Research and extension need to be closely coordinated to learn what farmers are doing, to develop alternative resource conserving tillage options (e.g., bed planting) for increasing and sustaining potato yields, and to facilitate a smooth transfer of technical knowledge from researchers to farmers for the better earnings to their production and economic development. Therefore, the Government should recast the system so that more effective contact is ensured between extension personnel and potato growers and it can disseminate new technologies more quickly and effectively.

viii. Collection and dissemination of marketing information should be needed for the producers through radio broadcast and daily newspaper during before starts the harvesting period. Finally, Government potato grain procurement programme should also be strengthened.

ix. The scheme of crop insurance may be introduced to cover the potato production activity which involves climatic risks

Limitations of the Study

The present study would determine the productive efficiency of farmers, and the nature and extent of sustainable potato production at the farm levels. In order to conduct the research in a manageable way the researcher considered.

i. Most of the farmers did not keep record of their farming business. Then the researcher had to depend on the memory of the farmers. To overcome this problem,

several visits were made by the researcher himself to ensure the collection of reasonably accurate data from the field.

ii. The productive efficiency study of all cereal crops would be better than that of a single crop. Due to lack of time and resources, the inclusions of all cereal crops were not possible as they would increase measurement errors. Non-farm activities were not included. For this, the observed inefficiencies in producing potato would have to be interpreted with caution. Identification of exact qualification of family labour was a difficult task. Because the procedures often could not estimate distinctly the use of family labour for different purpose properly. In the present study, the researcher had carefully asked the period of time spent by family members in different operations of potato production.

iii. In this study, only one important potato growing area of Bangladesh was selected due to the practical situation. Covering all regions of Bangladesh would increase the accuracy and reliability of the study for comprehensive development policy about production efficiency and sustainability of potato production in the long run.

iv. Profitability of potato production is certainly influenced by the degree of efficiency of the marketing of inputs and outputs. The result of the study would be more enriched, if the study would include marketing aspects of input and output.

Scope for Further Study

A number of areas are identified where further economic study may be conducted to develop and fine-tune policies dealing with the cereals as a whole or some of it. The weaknesses of the present study, of course, open avenues for further research which are given below:

i. A broad based study on the profitability of potato production should be undertaken with and without intercropping of potato.

ii. A comparative study can also be undertaken to assess the relative profitability of different potato varieties and other competing crops.

iii. An aspect requiring further study is the variety of potato currently being used by the farmers. It suggested that carrying out a detailed topographic survey for the development of potato variety.

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