

**PROFITABILITY AND POST-HARVEST PROBLEMS OF POTATO
CULTIVATION IN RANGPUR DISTRICT OF BANGLADESH**

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SHER-E-BANGLA AGRICULTURAL UNIVERSITY

DHAKA-1207

JUNE, 2018

PROFITABILITY AND POST-HARVEST PROBLEMS OF POTATO CULTIVATION IN RANGPUR DISTRICT OF BANGLADESH

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A Thesis

Submitted to the Faculty of Agribusiness Management
Sher-e-Bangla Agricultural University, Dhaka,
in Partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE (MS)
IN
DEVELOPMENT AND POVERTY STUDIES
SEMESTER: JANUARY-JUNE, 2018

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CERTIFICATE

This is to certify that the thesis entitled, "**PROFITABILITY AND POST-HARVEST PROBLEMS OF POTATO CULTVATION IN RANGPUR DISTRICT OF BANGLADESH**" submitted to the faculty of Agribusiness Management, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **Master of Science (MS) in Development and Poverty Studies**, embodies the result of a piece of bona-fide research work carried out by **MD.MENHAZUL ISLAM, Registration No.11-04475**, under my supervision and guidance. No part of this thesis has been submitted for any other degree or diploma.

I further certify that any help or sources of information, as has been availed of during the course of investigation have been suitably acknowledged.

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**DEDICATED
TO
MY BELOVED
PARENTS**

ACKNOWLEDGEMENTS

All praises, thanks and gratefulness are due to the utmost Ruler of the Universe, the Almighty Allah for His grace bestowed upon the author for accomplishing this research study. With boundless love and appreciation, the researcher would like to extend his heartfelt gratitude and appreciation to all who helped him bring this study into reality.

In particular, the researcher takes the opportunity to express his gratitude, sincere appreciation and heartfelt indebtedness to his reverend research supervisor **Dr. Ashoke Kumar Ghosh**, Associate professor & Chairman, Department of Development and Poverty Studies, Sher-e-Bangla Agricultural University, for his splendid guidance, constructive criticism, constant stimulation and encouragement thorough supervision during the course of preparation of this thesis, without which this work would not have been possible.

The researcher also wishes to express heartfelt appreciation and deepest gratitude to **Md. Abdul Latif**, Associate professor, Department of Agricultural Statistics, Sher-e-Bangla Agricultural University, for his valuable suggestions, constant cooperation, inspirations and sincere advice to improve the quality of the thesis throughout the period of this research program.

I would like to express my sincere gratitude to **Md. Hayder Khan Sujan, Lecturer**, Department of Development and Poverty Studies, Sher-e-Bangla Agricultural University, Dhaka for his constant encouragement and valuable suggestions for completing this thesis timely.

I would like to express my heartiest thanks to the farmers whose kind co-operation is never description during the data collection. Heartfelt thanks and appreciations are also expressed to my beloved wife, sister and friends for their never ending inspiration throughout the research period.

I would like to express my heartiest thanks to Upazila Agriculture Officer (UAO), Pirganj Upazila and SAAOs of Pirganj Upazila in the study area for their benevolent help and cooperation during the data collection period. The researcher is especially grateful to all the respondents in the study area for their cooperation and help in accomplishing the objectives of this research work.

The researcher expresses heartfelt thanks and sincere appreciations to all other teachers of Sher-e-Bangla Agricultural University for their help and encouragement. Last but not the least, the author expresses his immense indebtedness, earnest senses of gratitude to his beloved mother and father who sacrificed all their happiness during the whole study period especially during his MS study.

Md. Menhazul Islam

June, 2019

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LIST OF ABBREVIATED TERMS

ABBREVIATION	=	ACRONYM
%	=	Percent
Agril.	=	Agricultural
BADC	=	Bangladesh Agricultural Development Corporation
BARI	=	Bangladesh Agricultural Research Institute
BBS	=	Bangladesh Bureau of Statistics
BCR	=	Benefit Cost Ratio
CIP	=	International Potato Centre
DAE	=	Department of Agriculture Extension
DAM	=	Department of Agricultural Marketing
DEPS	=	Development and Poverty Studies
et.al	=	All Others
FAO	=	Food and Agriculture Organization
FAOSTAT	=	Food and Agriculture Organization Statistics
FY	=	Fiscal Year
ha	=	Hectare
HYV	=	High Yielding Variety
Kg	=	Kilogram
MoA	=	Ministry of Agriculture
MS	=	Master of Science
m	=	million
mt	=	Metric tons
NGO	=	Non Government Organization
No.	=	Number
SAAO	=	Sub Assistant Agricultural Officer
SAARC	=	South Asian Association of Regional Co-Operation
SAU	=	Sher-e-Bangla Agricultural University
SD	=	Standard Deviation
UAO	=	Upazila Agricultural Officer

ABSTRACT

Potato is third largest food crop in Bangladesh by tonnage of production. Its acreage and production are also increasing in day after day. This study was accomplished to examine the profitability and post-harvest problems of potato cultivation in Rangpur district of Bangladesh. A total of 40 cultivators were selected from two villages of Pirganj upazila of Rangpur district. Data were collected through farm survey by using a suitable pre-tested questionnaire in February to March, 2018. Descriptive statistics and problems faced index (PFI) were used to attain the objectives. Average gross return, gross margin and net return were found Tk. 392,012, Tk. 197,866 and Tk.127,835, respectively. Benefit cost ratio was found 1.48. Land preparation, human labour, seed, fertilizer, insecticides, irrigations and harvesting cost were the key factors of potato production. The study identified some major post-harvest problems, unavailability of quality seed, storage problem, holding capacity problem, lower market price, transportation problem, lack of public procurement and load shedding. The potato cultivators opined that potato production would be economically viable if quality seeds with affordable price, processing facilities, storage facilities, marketing facilities, fertilizer or insecticides with reasonable price are ensured.

CHAPTER I

INTRODUCTION

1.1. General background

Bangladesh is an agro based country and agriculture is the principal source of income and employment. This sector directly contributes 15.50% of total GDP (BBS, 2016). Potato is an important food crop in tropical and subtropical countries. It is the fourth most important crop in Bangladesh. It is important and popular crop because of its quick economic return and multiple uses. It has a greater scope and potentiality for food security and poverty alleviation occupying a dominant position in both area and production among the vegetable growers in Bangladesh. Almost every family in Bangladesh consumes potato as a vegetable throughout the year. As a cheapest source of carbohydrates it is used, though not so extensively, as a supplement of the diet rice. Potato can play an important role as an alternative and a multipurpose food crop of Bangladesh. It has the desirable characteristics of high yield, nutritious or delicious food and palatable in taste. It is one of the most important sources of carbohydrates and contains an appreciable amount of vitamin B and C and some other materials. In Bangladesh soil and climatic condition offer high potential of potato production. Bangladesh produces potato in about 9.47 million hectares of land with an average yield of 19.93 ton ha⁻¹ (BBS, 2016). Production of potato has been increasing rapidly compared to cereal crops like rice and wheat (Azimuddin *et al.*, 2009). Potato cultivation under the institutional loan was a profitable business. Potato tuber follows only rice and wheat in world as an important food crop for human consumption. It is used as a popular vegetable by both the poor and rich people in Bangladesh. It has high nutritive value as per 100 gm of edible potato contains 97 k. calories, 1.6 gm protein, little amount of fat, 10.07 gm minerals and little amount of iron. It contains 74.7% moisture and 22.6% carbohydrate in combination with many other

items of food (Hossain and Bose, 2000). People consume potatoes in various forms such as curry cooked food, fries, potato crackers and flour to make breads, biscuits, chips, etc. in both home and abroad. From the viewpoint of nutritional requirement Bangladesh has deficit in producing nutritional crops specially the tubers and vegetables. To solve the malnutrition problem, emphasis should be given on producing more non-cereal crops like potato. Realizing the above situations, the government of Bangladesh has been maintaining a crop diversification strategy to reduce the dependency on rice by increasing the consumption and production of potato. In Bangladesh, the amount of cultivable land is gradually decreasing because of infrastructural and industrial development activities. For that reason, production strategies require to be formulated according to the demand of the situation and time so that farmers can increase food production. The cultivation of potato was a profitable business and the medium farm was more profitable than the small and marginal farms (Sarkar and Yesmin, 2014). 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 around the year. Recently, the government has been trying to diversify food habits and encourage potato consumption to reduce pressure on rice. So, potato is becoming an important food for food security in Bangladesh. Potato growing is one of the promising farming businesses to the farmers due to its higher yield, diversified use, low risk involvement and high profitability. But it is most difficult for the farmers to maintain the production cost (Awal, 2013). In Bangladesh, potato occupies a dominant position in both area and production among the vegetables growers. However, compared to other crops, cost of production of potato is relatively high. Keeping this view in mind the present study is a modest attempt to analysis the socio-economic condition and cost and return of potato production in some selected areas of Rangpur district. The specific objectives of the study are to assess

the socio-economic profile of the potato cultivators, to estimate profitability of potato production and to evaluate the problems for potato production and to suggest some measures for improvements.

1.2. Production of potato in Bangladesh

Potato production in Bangladesh in fiscal year (FY) 2017-18 has been estimated 97,44,412 metric tons compared to 102,15,957 metric tons in FY 2016-17 which is 4.61% less. The government statistics provider Bangladesh Bureau of Statistics (BBS, 2018) in its latest release said potato, the most consumed vegetable item of the country was cultivated on 11,79,703 acres (4,77,400 hectares) compared to 12,34,871 acres (4,99,725 hectares) of the last year. Therefore, average yield rate of potato has been estimated 221.29 maunds per acre (20.411 metric tons per hectare) compared to 222.63 maunds (20.443 metric tons per hectare) of previous year. Annual demand for the carbohydrate-rich vegetable has now stood at 7 to 7.5 million tons. That indicates a 1.5m to 2.0m tons are surplus production. However, the farmers got Tk.11 to Tk.12 per kg during harvesting season in FY 18 which was only Tk.7-Tk.8 during FY 15 and FY 16, department of agricultural marketing data showed. Production cost was between Tk.5 and Tk.6.5 per kg across the country, according to DAM. The price of potato, mainly Granola variety is now sold at Tk. 22-Tk.24 at the country's retail market. The price of per kg potato is 30-35 percent lower now compared to the corresponding period of last year, according to DAM. The country has a storage capacity of 4.2 million tons of potato in 382 cold storages, which is less than half in terms of the total production (DAM, 2015).

1.3. Statement of the problem

The purpose of the study to have an understanding of the profitability and post-harvest problems of potato cultivation. Since various input cost incurred during the cultivation period the cultivators should use efficiently of the desired input cost.

The socio-economic profile of the cultivators are likely to have an influence on the profitability and post-harvest problems of potato farmers, it is necessary to ascertain the links and assistance of such factors with respect to the problem. Therefore, considering the contributions of socio-economic and socio-psychological characteristics of the potato cultivators with their profitability and post-harvest problems would be considered relevant to the study. The present study was undertaken with the title “Profitability and post-harvest problems of potato cultivation in Rangpur district of Bangladesh.”

1.4. Objectives of the study

- a) To explore the socio-economic characteristics of potato cultivator's in the study area;
- b) To estimate the profitability of potato cultivation in the study area;
- c) To find out the extent of post-harvest problems faced by the potato farmers; and
- d) To generate some suggestions to overcome those problems of potato cultivation;

1.5. Rationale of the study

- ❖ The present study was designed to have an understanding of profitability and post-harvest problems of potato cultivation and to generate some solutions to overcome the problems faced by the potato cultivators.
- ❖ The findings of the study will, in particular, be applicable to the study area at Chaitrokol union under Pirganj upazila of Rangpur district. The findings may also be applicable to other areas of Bangladesh where socio-cultural and economic status do not differ much than those of the study areas.
- ❖ The findings of the study may also be helpful to the field worker of extension service to improve their action strategies for improving farmer's profitability and reducing the post-harvest problems.

- ❖ The findings of the study will be helpful to accelerate the development in agriculture. The study may enrich consciousness of the key role players in the society as well as the planners and policy makers to increase facilities of the potato cultivators.
- ❖ To the academicians, it may help in developing concept of the profitability and post-harvest problems of potato farmers. In addition, the findings of this study may have other empirical evidence to all aspects of profitability and post-harvest problems faced by potato cultivators which may be used to build an adequate theory of post-harvest activities.

CHAPTER II

REVIEW OF LITERATURE

Nowadays potato is considered as being the most important crop of farmers. Potato is consumed as vegetable throughout the world. However, this sub-sector is not paying regular dividend to the farmers as faces several problems, out of them shortage of quality seed and post-harvest loss are considerably more important. Potatoes are grown mostly everywhere in Bangladesh with special concentration in Rangpur district of Bangladesh. All the relevant information gathered from different related literature on the profitability and post-harvest problem of potato cultivation are presented in this section of the report.

2.1. Appraisal on profitability and post-harvest problems

Potato is one of the staple foods in Bangladesh. Bangladesh achieves the 4th position in Asia and 14th in the world potato production. The area under potato is around 3.77 to 4.54 lac ha in Bangladesh. The total production of potato was 52.77 to 100.00 lac tons and the yield was 14.01-22.03 t ha⁻¹ (FAO,2011). From 1960 to 2013 over 46 modern Potato varieties have been released and notified in Bangladesh. The major improved varieties introduced, released and notified in Bangladesh are from the Netherlands, very few from CIP (Peru), India and other countries. The potato varieties introduced from the Netherlands are highly popular in Bangladesh in terms of yield, table potato and industrial processing potatoes. Potato is playing a major role in the rural economy of Bangladesh. Farmers can earn very high financial and economic return through production potato as seed, table potato, industrial processing and exportable potato. There is enormous potentiality to increase per unit yield of potato through adoption of modern technologies and practices along with use of quality seed potato of improved varieties. With a view to adopting advanced technologies and modern practices the

utmost needs is to up-scale the technical knowledge of farmers and motivate them through training and technological supports. One of the major problems of potato sector is the Lack of knowledge of farmers on appropriate use of inputs: Majority of potato farmers of the northern districts of Bangladesh has very little knowledge regarding appropriate use of input materials and disease management practices (Uddin *et al.*, 2010). In case of potato cultivation, farmers of the northern part of Bangladesh lack proper knowledge of using input materials and seed quality management. Use of over dose or under dose of pesticides, micronutrients and chemical fertilizers and other inputs is very common to potato farmers that lead to production loss, increase cost of production and environmental pollution. Little knowledge of appropriate irrigation and harvesting technique by farmers causes wastage and post-harvest loss of potato during and after harvesting. It has also been observed that farmers' level of knowledge regarding disease management, time of planting, clean cultivation, deposition of residues on their field which might be the primary source of pathogen, spray schedule and procedure, selection of pesticides (both systemic and contact), fertilizer application, soil test, sorting, grading and storage is not enough. As a result, 5% potato on an average is getting wasted each year before the harvest. On this regards, the above facts are directing towards the demand for this intervention improving competitiveness of potato farmers by increasing productivity through adopting proper usage of quality inputs so that these farmers can reduce their production cost and effectively manage potato diseases which ultimately will result in higher profit for farmers. This study was conducted to identify the present gaps in farmers knowledge and practices and suggest how to up-scale their knowledge and capabilities as well as capacities for potato production

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.

Potato growing is one of the promising farming businesses to the farmers due to its higher yield, diversified use, low risk involvement and high profitability. But it is most difficult for the farmers to maintain the production cost (Awal, 2013).

Appropriate and efficient post-harvest technology is critical to the entire production-consumption system of potato because of its bulkiness and perishability. Several 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 (Sujan *et al.*, 2017).

Potatoes are mostly produced during the winter season from November to March, but are consumed year-round. Therefore, storage plays an important role in the creation of time and place utilities. Food and Agricultural Organization (2011) showed in a workshop entitled “Post-harvest issues of potatoes in Asia and the pacific region that storage is an important post-harvest activity in seed production. Storage under specific conditions is important to prevent excessive loss of weight as a result of drayage and to preserve germination quality.

FAO (2011) stated that in case of potato production, small farmers who depend on their own production for seed in the next season have primitive or improved farm storage. Most seed storage in this case is either in farm houses or in small sheds. Some farmers improve storage conditions by providing ventilation and also using structures with diffuse light to help keep the seed potatoes. In most cases, however, the conditions are poor and result in wastage, thus reducing the total amount of potatoes left for seed to be planted in the next season.

Meyhuay (2001) studied Post-harvest Operations of potato and showed that losses during the storage are affected so much by physiologic tuber condition, mechanical damage suffered during harvest and handling, as well as by storage conditions mechanical damage (cuts and contusions) facilitates invasion and development of microorganisms that cause illnesses and rottenness. It is necessary to reduce tubers physical damage to minimize losses during storage. He also showed that the storage objective is to control these processes to maintain quality and to minimize losses tubers weight. There is not a storage method that is the most effective for potato handling. Method selection depends on technical, social, economic and financial factors.

Hossain and Miah (2009) stated that the potato is a semi-perishable commodity. Appropriate and efficient post-harvest technology and marketing are critical to the entire production-consumption system of potato because of its bulkiness and perish ability.

The production of potato is increasing in Bangladesh, but excess production is creating havoc due to a glut in the market. Although, Bangladesh is the eighth largest potato producer in the world and third biggest in Asia, potato is consumed as a vegetable here, where in many countries it is a staple food. According to Bangladesh Bureau of Statistic, over 10 million tons of potato was produced in 2017, and 5.3 million tons was kept in 390 cold storages across the country to maintain a sustainable supply all the year-long (Khandker *et al.*, 2018). At present every year two-thirds of the total produce do not find any space in the cold storage and a part of which is consumed shortly after harvest and the rest is kept in traditional storage at home under room temperature and humidity at farm level. In most cases the excess production goes to waste. The growers have to sell major part of their produces immediately after harvesting at a very low price due to lack of storage facilities and cash need of the growers. Sometimes, ignorance of the growers about the prospect of future marketing of their produce becomes

responsible for such type of selling. The growers are the most sufferers due to the existing storage problems of potato in Bangladesh and once they do not get enough economic gain, they may not retain much enthusiasm to go for potato cultivation for the following season.

Natural cold storage for potato preservation need to be invented across the country to avoid the problems with the current cold storage system. Wageningen University, the Netherlands has invented a unique method to store potato using natural cold storage system which is a combination of technology and nature (Seraj, 2017). By using the method potato crops could be preserved for six months. Natural wind and light is basically the key to the success where automation is only a means to manage. Moisture and ventilation is maintained through computer programmes. Government should urgently look forward to bring this system in our country.

The process of production starts from preparation of the land, arrangements of samplings and/seeds to loans. After the produce is harvested, the growers and/traders need preservation and processing of the produce for off-season use. The marketing of potato in various forms adds value to the product before it is consumed. In the total process, the growers play the role of primary stakeholders, and then come the traders, processing folks, exporters and finally the consumers. The potentials and strategies of enhancing its competitiveness in value chain are under hosts of constraints (Geoffrey et al., 2014). In the chain, the growers are mostly affected in realising their production cost. So, it is recommended to support the primary stakeholders i.e. the farmers in keeping the potential sector that is under imminent threat.

Potato production in Bangladesh is in transition from subsistence to commercial agriculture. Ten per cent of growers use leased land for potato production and 38 per cent use both their own and leased land. Formal farming contract systems are

in development mainly in relation to the production of potato varieties for processing, as seed potato or for export. The majority of Bangladesh's potato production is used for direct consumption (Egger, 2014)

For the last couple of years, thousands of potato farmers of Bangladesh have been facing huge losses due to various factors, including low demand and a shortage of preservation facilities. Potato preservation demands certain special care as it is very sensitive to put it in a longer period. For a healthy preservation, potato plants should be pulled out of the soil leaving the potato under the soil for 7-8 days. Thereafter, harvesting and cleaning should be done carefully so that potatoes are not injured anyway. Desired temperature and humidity must be maintained in the cold storage to prevent potatoes from getting spoiled or squeezed. Thinly knitted jute sacks to be used for potato packaging so that sufficient amount of air can pass through it. Cold storages must be clean and hygienic having separate chambers for preheating and pre-cooling. Potatoes designated for preservation should be kept in pre-cooling room at 2-4-degree temperature for 48-72 hours. Similarly, before taking out the preserved potatoes in normal atmospheric temperature the produce should be pre-heated at 15-18 degrees for 48-72 hours. Even after that the potatoes from cold storages should be kept under shadow and in relatively cool place (Hossain and Ali, 2000).

2.2. Research gap of the study

Rangpur district contribute nearly 7.5 percent of the total potato production occupying 10.7 percent of the land surface. Pirganj is one of the main potato producing area along with Mithapukur, Badarganj, Taraganj, Pirkacha and Gangachara upazila. Area covers under potato cultivation in Bogra and Rangpur districts about 67% of the total cultivated area (Uddin *et al.*, 2009). Latest information on potato production in northern part of Bangladesh is limited. So, it is necessary to quantify the potato production scenario in the area. There are lots

of researches on problem face in potato production. Many of them studied production problems of potato farmers but very few researches had been done to solely assess the post-harvest problems of potato farmers. Most of the researcher studied on marketing problem of potato and the locales were Munshiganj, Comilla etc. But, to the best of this author's knowledge, it was found that only two studies on potato problems in the north Bengal area of Bangladesh other than Rangpur.

No research was undertaken previously following the methodology which was followed by the present researcher. Most of the previous studies conducted by correlation analysis, but the present study followed profitability analysis, descriptive analysis and problems faced index. Additionally, the past studies related to problem face in post-harvest processing of potato didn't consider the spatial or geographical factors whereas the current study analyze profitability and influence of some spatial factors on post-harvest problems of potato cultivators in Rangpur district.

CHAPTER III

METHODOLOGY

Methodology plays an important role in a scientific research. A researcher should be careful in formulating methods and procedures in conducting research. Appropriate methodology enables the researcher to collect valid and reliable information and to analyze the information properly in order to arrive at correct conclusions

3.1. Selection of study areas

The study was conducted at two villages of Chaitrokol union of Pirganj upazila under Rangpur district. There were 15 unions in Pirganj upazila. Out of 15 unions Chaitrokol union was selected because plenty of potatoes are grown in this union. Out of 18 villages of this union, two (Hajipur and Daneshnagar) were purposively selected. The list of the study areas are given in Table 3.1.

A map of Bangladesh showing Rangpur district and a map of Rangpur district showing Pirganj upazila have been presented in Figure 3.1. and 3.2, respectively.

Table 3.1The study area

District	Upazila	Union	Villages
Rangpur	Pirganj	Chaitrokol	Hajipur
			Daneshnagar



Figure 3.1. Map of Bangladesh showing Rangpur district

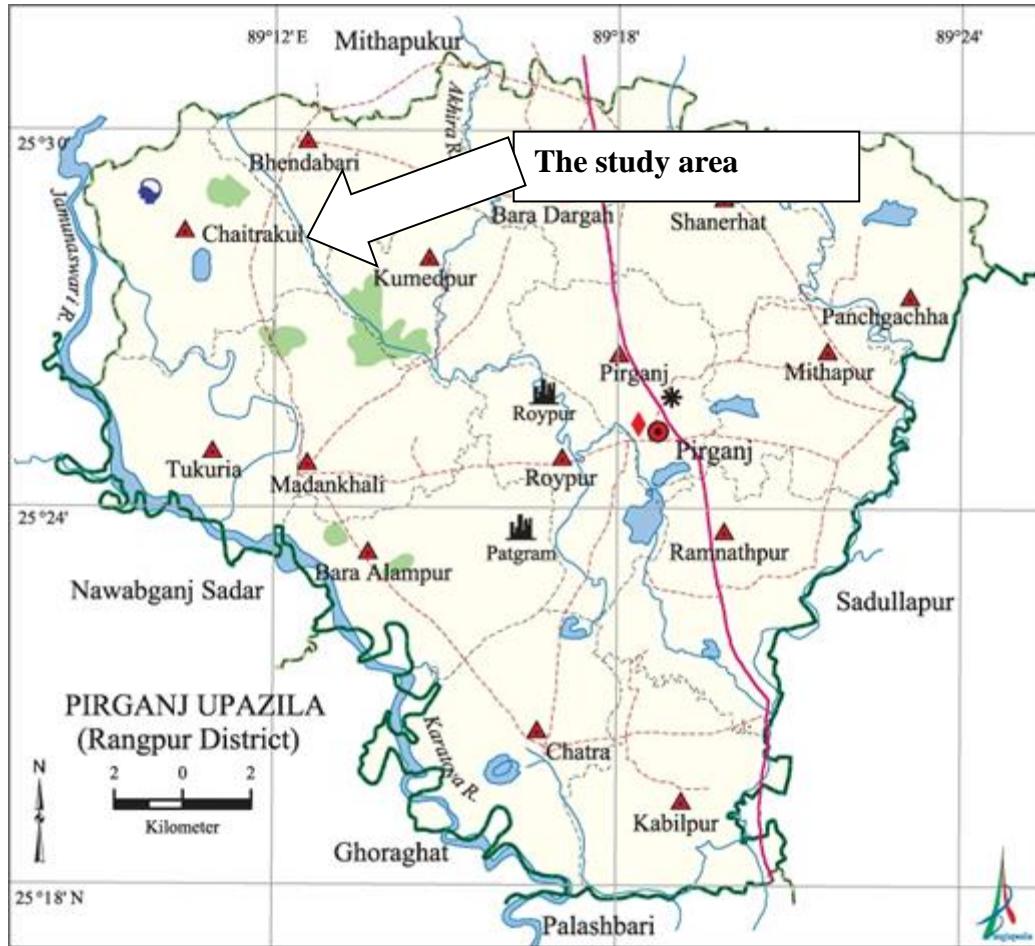


Figure 3.2. Map of Pirganj upazila under Rangpur district showing the study area

3.2. Description of the study area

Pirganj upazila (Rangpur district) area 409.37 sq km, located in between 25°18' and 25°31' north latitudes and in between 89°08' and 89°25' east longitudes. It is bounded by Mithapukur upazila on the north, Palashbari, Ghoraghat and Nawabganj sadar (Dinajpur) upazilas on the south, Sadullapur upazila on the east, Mithapukur, Nawabganj Sadar (Dinajpur) and Ghoraghat upazilas on the west. Water bodies are: Karatoya, Jamuneshwari, Akhira; Pirganj is called the upazila of beel. According to Bangla pedia, the features of the farmers and agriculture at Pirganj upazila are as follows-

- i. Main sources of income: Agriculture 74.87%, non-agricultural labourer 2.7%, industry 0.57%, commerce 9.17%, transport and communication 3.62%, service 3.65%, construction 0.76%, religious service 0.16%, rent and remittance 0.8% and others 3.7%.
- ii. Ownership of agricultural land: Landowner 57.94%, landless 42.06%; agricultural landowner: urban 55.85% and rural 58.01%.
- iii. Main crops: Paddy, wheat, maize, sugarcane, mustard, potato, vegetables.
- iv. Main exports: Paddy, wheat, potato, banana, sugarcane molasses, vegetables.

3.3. Sampling technique and sample size

A total of 40 respondents were randomly selected for collecting primary data and information for the present study. Among total respondents, 20 potato growing farmers were selected from each of the villages. They were interviewed for gathering data and information regarding profitability and different post-harvest problems like storage problem, presence of middleman, distance to cold storage, and distance to market place and lack of electricity etc. Interviews were held at their house or their field while respondents were working.

3.4. Collection of data

Data were collected personally by the researcher himself from the sample cultivators by using the pretested interview schedule. While starting the interview with any cultivators, the researcher took all possible care to establish rapport with him, so that the cultivators did not feel any hesitation to furnish proper answer. Researcher also met with the Sub Assistant Agriculture Officer (SAAO) of the respective blocks in order to explain the objectives of the study and requested them to provide necessary help and co-operation in collection of data. The local leaders of the area were also approached to render essential help. Collection of data took 30 days from 09th February to 09th March, 2019.

3.5. Analytical process

Both fixed cost and variable cost were taken into account in calculating cost of potato cultivation. Land use cost was calculated on the basis of lease value of cultivating session. The profitability of potato production was examined on the basis of gross return, gross margin, net return and benefit cost ratio analysis. The collected data were edited, summarized, tabulated and analyzed to fulfill the objectives of the study.

3.6. Profitability analysis

Different parameters of costs and return were analyzed to measure the profitability of potato cultivation on the study area. The following algebraic equation was developed to assess the costs and returns of potato production (Sujan *et al.*, 2017).

$$GR_i = \sum_{i=1}^n Q_{mi} P_{mi} + \sum_{i=1}^n Q_{bi} P_{bi}$$

Where,

GR_i = Gross return from ith product (Tk. ha-1)

Q_{mi} = Quantity of the ith main product (Tk. ha-1)

P_{mi} = Average price of the ith main product (Tk. ha-1)

Q_{bi} = Quantity of the ith by product (kg ha-1)

P_{bi} = Average price of the ith by product (Tk. ha-1)

$i = 1, 2, 3, \dots, n$

Net return was calculated by deducting all costs (variable and fixed) from gross return. To determine the net return of potato production the following equation was used in the present study:

$$\pi = GR_i - \sum_{i=1}^{40} \sum_{j=1}^n X_{ij} P_{xij} - TFC_i$$

Where,

π = Net return (Tk. ha-1)

P_y = Per unit price of the product (Tk. kg-1)

Y = Quantity of the product per (kg ha-1)

P_xi = Per unit price of the inputs (Tk.)

X_i = Quantity of the inputs (kg ha-1)

TFC = Total fixed cost (Tk. ha-1)

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

3.7. Benefit cost ratio (BCR)

The BCR is a relative measure, which is used to compare benefit per unit of cost. The BCR was estimated as a ratio of gross returns and gross costs. The formula calculating BCR (undiscounted) was as such: Benefit Cost Ratio = Gross benefit / Gross cost.

3.8. Ranking of post-harvest problems

Post-harvest problems of potato farmers were measured on the basis of eleven (11) problems. Each problem was categorized into severe, medium, low and score given with each of them was 3, 2, 1 respectively. However, no problem given score of zero.

$$PHP = SP \times 3 + MP \times 2 + LP \times 1 + NP \times 0$$

Where,

PHP = Post-harvest problems,

SP = Severe problems,

MP = Medium problems, LP = Low problems and

NP = No problem

Thus, Post-harvest problem score of cultivators was determined summing up the weights of their responses to all the eleven statements.

CHAPTER IV

SOCIO-ECONOMIC PROFILE OF THE POTATO CULTIVATORS

Different cultivators possess different characteristics. The selected characteristics of the cultivators were age, education, experience in potato cultivation, farm size, family size, annual household income, income from potato cultivation, distance to nearest wholesale market, distance to cold storage and borrowing status. These ten characteristics of the cultivators might be greatly influenced by the post-harvest of potato have been described below-

4.1. Age distribution of the potato cultivators

The age of the potato cultivators varied from 25 to 60 years with an average and standard deviation of 42.80 and 9.54 respectively. According to the recorded age, potato cultivators were classified into three categories ‘young’, ‘middle’ and ‘old’ aged as classified by MoYS (2012). The distribution of the cultivators in accordance of their age is presented in Table 4.1.

Table 4.1 Age distribution of the potato cultivators

Category	Basis of categorization (years)	Observed ranges (years)	Potato cultivators		Average age (years)	SD
			Number	Percent		
Young	≤ 35	25-60	10	25.00	42.80	9.54
Middle	36-50		21	52.50		
Old	≥ 50		9	22.50		
Total			40	100.0		

Table 4.1 reveals that the middle-aged cultivators comprised the highest proportion (52.50%) followed by young (25.00%) and old (22.50%) aged category. Data also indicates that the young and middle aged category constitute 77.50 percent of the total cultivators.

4.2. Educational level of the potato cultivators

Educational Level of the Potato Cultivators varied from 0 to 16 years with an average and standard deviation of 7.60 and 4.44 respectively. According to the level of education potato cultivators are classified into four categories illiterate, primary education, secondary education, and above secondary arbitrarily. The distribution of the cultivators in accordance to their level of education is presented in Table 4.2.

Table 4.2 Educational level of the potato cultivators

Category	Basis of categorization (years)	Observed ranges (years)	Potato cultivators		Average Education (years)	SD
			Number	Percent		
Illiterate	0	0-16	7	17.50	7.60	4.44
Primary education	1-5		7	17.50		
Secondary education	6-10		18	45.00		
Above Secondary	>10		8	20.00		
Total			40	100.00		

Table 4.1 reveals that the cultivators under secondary education category comprised the highest proportion (45.00%).Where above secondary category (20.00%).On the other hand both the illiterate and primary education category shows (17.50%) and old. Data also indicates that the secondary education and above secondary education category constitute 65.00 % of the total cultivators.

4.3. Distributions of the potato cultivators based on their potato cultivating experience

The potato cultivating experience of potato cultivators varied from 5 to 30 with an average mean and standard deviation 14.45 and 7.19 respectively. According to the Potato Cultivating Experience potato cultivators are classified into three categories Low

experience, Medium experience, and High experience arbitrarily. The distribution of the cultivators in accordance potato cultivating experiences presented in Table 4.3.

Table 4.3 Distributions of the potato cultivators based on their potato cultivating experience

Category	Basis of categorization (years)	Observed ranges (years)	Potato cultivators		Average Mean	SD
			Number	Percent		
Low experience	≤ 35	5-30	10	25.00	14.45	7.19
Medium experience	36-50		21	52.50		
High experience	≥ 50		9	22.50		
Total			40	100.00		

Table 4.1 reveals that the cultivators having medium experience category comprised the highest proportion (52.50%).Where low experience category shows (25.00%).On the other hand high experience category shows (22.50%). Data also indicates that the low experience and medium experience category constitute 77.50% of the total cultivators.

4.4. Distributions of family size of the potato cultivators

The family size of the potato cultivators of potato cultivators varied from 4 to 10 with an average family size and standard deviation 6.58 and 1.63, respectively. According to the family size of potato cultivators are classified into three categories small family, medium family, and large family arbitrarily. The distribution of the cultivators in accordance family size is presented in Table 4.4.

Table 4.4 indicates that medium family size of the potato cultivators constitute highest proportions (52.50%).Whereas small family size of the potato cultivators constitute (25.00%). It may be conclude that small and medium family size of the potato cultivators comprises majority (77.50%) of total cultivators.

Table 4.4 Distributions of family size of the potato cultivators

Category	Basis of categorization (members)	Observed ranges (members)	Potato cultivators		Average family size	SD
			Number	Percent		
Small family	Up to 4	4-10	04	25.00	6.58	1.63
Medium family	5-6		18	52.50		
Large family	Above 6		18	22.50		
Total			40	100.0		

4.5. Distribution of the potato cultivators based on their farm size

The farm size of the potato cultivators varied from 0.25 to 4 with an average farm size and standard deviation of 1.22 and 0.94 respectively. According to their farm size, the cultivators were classified into four categories. These categories were landless farm, small farm, medium farm and large farm. The distribution of the potato cultivators according to their farm size is presented in Table 4.5.

Table 4.5Distribution of the potato cultivators based on their farm size

Category	Basis of categorization (acre)	Observed ranges (acre)	Potato cultivators		Average Farm size	SD
			Number	Percent		
Landless	< 0.50	0.25-4	8	20.00	1.22	0.94
Small	0.50-2.49		28	70.00		
Medium	2.50-7.49		4	10.00		
Total			40	100.00		

Note: Landless is with 0.0 - 0.49 acres of land, small is with 0.50 - 2.49, medium is with 2.50 - 7.49 and large is with and above 7.50 acres of land (DAE, 1999).

Table 4.5 indicates that the small farm size constitutes the highest proportion (70.00%) whereas landless farm (20.00%), and 10.00% was medium farm size. We can conclude that majority (90.00%) of the potato cultivators were landless and small farm size.

4.6. Distributions of the potato cultivators based their annual household income

The potato cultivators based on their annual household income varied from 60 to 400 with an average household income and standard deviation of 170.90 and 93.67 respectively. According to their annual household income, the potato cultivators were classified into three categories low, medium and high annual income arbitrarily. The distribution of the potato cultivators according to their annual household income is presented in Table 4.6.

Table 4.6 Distributions of the potato cultivators based their annual household income

Category	Basis of categorization ('000'tk)	Observed ranges ('000'tk)	Potato cultivators		Average household income	SD
			Number	Percent		
Low income	60-99	60-400	11	27.50	170.90	93.67
Medium income	100-199		13	32.50		
High income	Above 200		16	40.00		
Total			40	100.00		

Table 4.6 indicates that the cultivators including high annual household income category constitute the highest proportion (40.00%).Where medium income category (32.50%).On the other hand low income category shows (27.50%).Data also indicates that the high income and medium income category constitute 72.50 % of the total cultivators.

4.7. Distributions of the potato cultivators based their income from potato cultivation

The Potato cultivators based on their income from potato cultivation varied from 20 to 200 with an average income and standard deviation of 86.65 and 55.55 respectively.

According to their income from potato cultivation, the potato cultivators were classified into three categories low, medium and high annual income arbitrarily. The distribution of the potato cultivators according to their income from potato cultivation presented in Table 4.7.

Table 4.7 Distributions of the potato cultivators based their income from potato cultivation

Category	Basis of categorization ('000'tk)	Observed ranges ('000'tk)	Potato cultivators		Average income	SD
			Number	Percent		
Low income	20-39	20-200	10	25.00	86.65	55.55
Medium income	40-110		16	40.00		
High income	above100		14	35.00		
Total			40	100.00		

Table 4.7 indicates that the cultivators including medium income from potato cultivation category constitute the highest proportion (40.00%). Where high income category (35%). On the other hand low income category shows (25.00%). Data also indicates that the medium income and high income category constitute 75.00 % of the total cultivators.

4.8. Distributions of the potato cultivators based the distance from nearest wholesale market

The potato cultivators based on the distance from nearest wholesale market varied from 3.5 to 4.5 with an average distance and standard deviation of 4 and 0.32 respectively. On the basis of distance to the market, the potato farmers were classified into three categories lowest, medium and higher distance to the market arbitrarily. The distribution of the potato cultivators according to their distance to the nearest market is presented in Table 4.8.

Table 4.8.Distributions of the potato cultivators based the distance from nearest wholesale market

Category	Basis of categorization (km)	Observed ranges (km)	Potato cultivators		Average distance	SD
			Number	Percent		
Low distance	2.5-3.5	3.5-4.5	08	20.00	4.00	0.32
Medium distance	3.6-4		24	60.00		
High distance	Above 4		08	20.00		
Total			40	100.00		

Table 4.8.indicates medium distance from the nearest wholesale market constitute highest proportion (60.00%).Whereas low distance constitute (20.00%) and high distance constitute (20.00%).

4.9. Distributions of the potato cultivators based the distance from nearest cold storage

The potato cultivators based on the distance from nearest cold storage varied from 18 to 21 with an average distance and standard deviation of 20.05 and 0.078 respectively. On the basis of distance to the cold storage, the potato farmers were classified into three categories lowest, medium and higher distance to the cold storage arbitrarily. The distribution of the potato cultivators according to their distance to the cold storage is described in Table 4.9.

Table 4.9 indicates that the potato cultivators belongs to medium distance from the nearest wholesale market constitute highest proportion (65.00%).Whereas low distance constitute (7.50%) and high distance constitute (27.00%).

Table 4.9 Distributions of the potato cultivators based the distance from nearest cold storage

Category	Basis of categorization (km)	Observed ranges (km)	Potato cultivators		Average distance	SD
			Number	Percent		
Low distance	15-19	18-21	03	7.500	20.05	0.078
Medium distance	19.5-20		26	65.00		
High distance	Above 20		11	27.50		
Total			40	100.00		

4.10. Distributions of the potato cultivators based their borrowing status

The potato cultivators based their borrowing status varied from 30,000 to 200,000 with an average loan and standard deviation of 106.67 and 55.16 respectively .On the basis of the potato cultivators based on their borrowing status the potato cultivator are classified as Non-borrower and Borrower arbitrarily. The distribution of the potato cultivators according to their borrowing status are presented in table 4.10.

Table 4.10 Distributions of the potato cultivators based their borrowing status

Category	Basis of categorization	Observed ranges ('000 Tk.)	Potato cultivators		Average Loan	SD
			Number	Percent		
Non-borrower	No loan	0	28	70.00	0	0
Borrower	Bank	Borrowers	30-200	12	106.67	55.16
	NGO	Borrowers				
Total			40	100.00		

Table 4.10.indicates that non-borrowers category constitute highest proportion (70.0%) whereas borrowers constitute (30.0%).It may also conclude that majority of the potato cultivators are non-borrower.

CHAPTER V

PROFITABILITY OF POTATO CULTIVATION

Profitability is one of the important factors of the potato cultivators. Most of the potato cultivators one only depended on this crop. For this reason the cultivators should remain conscious in every stage. This chapter describes input use pattern, cost of potato cultivation, and profitability analysis.

5.1. Input use pattern of potato cultivation

Potato cultivators have to made different cost during land lease, land preparation ,buying seed, irrigation, using fertilizer, insecticide, weeding and earthling up, harvesting and marketing. The average cost of land preparation was Tk. 27,734 per hectare. The average amount of seed and fertilizer used on cultivation were 22,278 kg per hectare, respectively. The seed rate used by the farmers was 70% higher than the recommended seed rate of 1.5 t ha⁻¹ (Satter *et al.*, 2005). The chemical fertilizers like TSP, MoP, urea, gypsum, were used at a rate of 898 Kg, 607 Kg, and 213kg per hectare.

Table 5.1 Input use pattern of potato cultivation

Sl. No.	Items	Unit	Amount (Unit/ha)	% of total cost
01.	Land preparation cost	Tk./ha	27,734	14.30
02.	Seed	Kg./ha	22,278	11.50
03.	Fertilizers	Kg./ha	45,106	23.23
	Urea	Kg./ha	420	-
	TSP	Kg./ha	18, 28	-
	MoP	Kg./ha	12, 35	-
04.	Insecticides cost	Tk./ha	15,561	8.01
05.	Irrigation cost	Tk./ha	10134	5.21
06.	Weeding and Earthing-up	Man-days/ha	19, 082	9.81
07.	Harvesting cost	Tk./ha	39053	20.11
08.	Transportation and Marketing cost	Tk./ha	8,803	4.53
09.	Others cost	Tk./ha	6394	3.30
	Total		194,146	100.00

5.2 Cost of potato cultivation

For determining the cost of potato, Land preparation, seed manures, fertilizers, insecticides and irrigation were calculated per hectare basis. The fixed cost of potato cultivation included cost of land use and interest rate on operating capital. Average bank rate was around 12 percent. One third parts of the interest cost included as interest on operating capital for potato production due to it's for four month only. The cost of land use was calculated on the basis of per acre lease value of land then it converted into hectare .Per hectare lease value of land was around Tk.88, 951 per year of which half parts were included as cost potato production for its shorter duration. The total cost included fixed and variable cost. The cost of potato cultivation was estimated to be 2, 90, 862 and Tk. 1, 94,146 per hectare on total cost and variable cost basis respectively. Detail result described on table 5.2.However, cost of tuber seed is an important constraint in potato production. Islam et al. (2000) also found the tuber seed cost as 35 to 40 percent of total cost of production. Scarcity of quality seed in sowing time is the major causes for higher seed cost and government intervention on fertilizer market by providing subsidy on fertilizer is the major cause for lower fertilizer cost of potato production. On the other hand Bajracharya and Sapkota (2017) found FYM constituted highest (45.32%) portion of the cost of production followed by seed and human labor in Baglung district of Nepal.

Table 5.2 Cost of production for potato cultivation

Sl. No.	Items	Amount (Tk./ha)	% of total cost
A.	Variable cost	1, 94, 146	66.75
	Land preparation	37,734	12.97
	Seed	22,278	7.60
	Fertilizers	45,106	15.50
	Insecticides	15, 561	5.30
	Irrigation	10,134	3.49
	Weeding and Earthing-up	19, 082	6.56
	Harvesting	39, 053	13.42
	Transportation and Marketing	8, 803	3.02
	Others	6, 394	2.19
B.	Fixed cost	96, 716	33.25
	Land use cost	88,951	30.58
	Interest on operating capital	7,765	2.67
	Total cost (A+B)	2,90,862	100.00

5.3. Profitability of potato cultivation

The yield of Potato was 29.5 tons per hectare which was higher than the national average yield (19.13 tha^{-1}) (BBS, 2015). Estimated average from gate price was Tk. 14.32 per kg. The gross return and the gross margin of potato cultivation were Tk. 392,012 and Tk. 197,866. The net return of potato cultivation was Tk. 127,835 per hectare. The average yield of potato was found to be $27,255 \text{ kg ha}^{-1}$. The total return is the value of potato in money terms. This was calculated by multiplying hectare total quantity of products by their respective market prices. Although extra amount variable inputs were used by the potato cultivators, the average undiscounted benefit cost ratio (BCR) of potato was 1.48 which is indicated that using Tk.1 as investment, farmers can earn 1.48 (Table 5.3). So, it can be said the profitability of potato cultivation was satisfactory in the study area.

Table 5.3 Profitability of potato cultivation

Sl. No.	Items	Formula	Unit	Amounts
01.	Yield of Potato	Y	kg/ha	27,255
02.	Price	P	Tk./kg	14.32
03.	Gross return	GR	Tk./ha	392,012
04.	Total variable cost	TVC	Tk./ha	194,146
05.	Total cost	TC	Tk./ha	264,177
06.	Gross margin	GR-TVC	Tk./ha	197,866
07.	Net return	GR-TC	Tk./ha	127,835
08.	Undiscounted BCR	GR/TC	-	1.48

CHAPTER VI

POST-HARVEST PROBLEMS OF POTATO CULTIVATION

Potato now a day considered as being the most important crop of cultivators. However, this sub-sector is not paying regular dividend as faces several problems. Potato are grown mostly everywhere in Bangladesh with special concentration in Northern zone of Bangladesh. This chapter includes post-harvest problems and their ranks

6.1. Rank order of the post-harvest problems of potato cultivators

The potato cultivators were interviewed to express about problems they faced during post-harvesting period. Almost all the cultivators express same nature of problems but in varied degree. There are 11 dimensions of Post-harvest problems of potato cultivators is presented in according to the rank order in Table 6.1.

Table 6.1.Rank order of the post-harvest problems of potato cultivators in the study area

Sl. No.	Post-harvest problems	Severe (3)	Medium (2)	Low (1)	No (0)	PFI score	Rank
1.	Unavailability of quality seed	29	10	1	0	108	1 st
2.	Storage problems	22	16	0	2	98	2 nd
3.	Low market price	22	11	7	0	95	3 rd
4.	Holding capacity	17	9	7	9	82	4 th
5.	Lack of processing facilities	10	11	19	0	71	5 th
6.	Lack of technical knowledge	5	20	9	6	64	6 th
7.	Rot in home	0	19	19	2	57	7 th
8.	Transport problem	1	19	11	9	52	8 th
9.	Presence of middleman	0	12	25	3	49	9 th
10.	No procurement by govt.	4	14	15	7	45	10 th
11.	Electricity problems	0	13	13	14	39	11 th

Table 6.1. shows that the post-harvest-problems faced by the potato cultivator's highest problem among the cultivators were unavailability of good seed. Numbers of cold storage are available to preserve potato for sale purpose but specialized cold storages only for storing seed is very hardly found. According to problem faced index (PFI) unavailability of good seed ranks in 1st position followed by storage problem ranks(2nd), low market price ranks (3rd), holding capacity problem ranks (4th) , lack of processing facilities ranks (5th), technical knowledge ranks (6th), rot in home ranks (7th), transport problems ranks (8th) , presence of middleman ranks (9th), no procurement by government ranks (10th) and electricity problems ranks (11th) during potato growing session 2018-2019.

CHAPTER VII

SUGGESTIONS TO OVERCOME THE PROBLEMS OF POTATO CULTIVATION

Potato cultivators of the selected area were faced with various post-harvest problems .If the problems can be reduced to a great extent the potato cultivators of the study area may be highly benefited .This chapter includes suggestion to overcome the existing problems .

7.1. Suggestion to overcome the post-harvest problems

The potato cultivators of the study area are faced with various post-harvest problems. Probable suggestions to overcome the existing problems were collected by their opinions. If there is permanent procurement system by the Government, farmers are not loosed from the potato production. This is why the suggestion of initiative of Government procurement was come from the farmers as first rank basis. Also production is mainly depended on timely input supply. In potato season, farmers have to move here and there to buy or collect the inputs. Sometimes they are misguided or not get quality input. Day by day the storing cost is increasing. In harvesting time, the price is very low. It is common culture in Bangladesh and potato growers are suffering. Also due to shortage of cold storage they have to sell potato with low price. Farmers feel to need advance training on potato cultivation. With consider to the above field situation, the rank wise important suggestions by the farmers were supply quality seed, increasing cold storage facilities, price fixation at harvesting period and arranging training etc. The suggestions are described in (Table 7.1.) according to their ranks;

Table 7.1Suggestion to overcome the problems faced by the potato cultivators according to their opinion

Suggestions	Score	Ranks
Supply of quality seed	25	1 st
Increasing cold storage facilities	24	2 nd
Establish market price	23	3 rd
Easy term loan facilities	21	4 th
Controlled fertilizer and pesticide price	20	5 th
Easy term agricultural equipment supply	19	6 th
Improve transport facilities	18	7 th
Rich and improve marketing facilities	17	8 th
Arranging training	15	9 th
Introduction of govt. potato buying policy	11	10 th
Virus attack	10	11 th
High price of pesticide	9	12 th
Multipurpose of potato food processing	7	13 th

Table 7.1. Indicates that most of the potato cultivators suggest quality seed to increase their yield. In the above table, there supply of quality seed ranks (1st), increasing storage facilities ranks 2nd position, establish market price ranks (3rd), easy term loan facilities ranks (4th), controlled fertilizer & pesticide price ranks (5th), followed by multipurpose of potato food processing ranks 13th position .Besides, these suggestion government and respective authority like BADC can play an important role in reducing problems and increasing profitability.

CHAPTERVIII

SUMMARY, CONCLUSION AND RECOMMENDATIONS

This chapter displays the summary of the findings, conclusion and recommendations of the study. The summary of the study shows the findings in brief. The major points of the thesis can be identified quickly by conclusions. Recommendation draws the attention of the respective authority to establish some strategy for improving the cultivation pattern of potato cultivators

8.1. Summary of the findings

Rangpur is the highest potato growing area of Bangladesh. Every year a large amount of potato is produced Rangpur region. Pirganj upazila is one of the most potato growing area of Rangpur district. Two villages of Pirganj upazila were selected as the study area of this research to distinguish the socio-demographic profile of the potato cultivators, to determine the profitability of that potato cultivation and to identify the post-harvest problems of potato cultivation.

Besides explorative study on all the secondary sources, 40 potato cultivators were randomly selected for conducting field survey to collect primary data. A structured questionnaire was developed on the basis of background information, expert's appraisal and pre-test questionnaire.

Data obtained by administering interviews with the interview with potato cultivators were coded appropriately and entered into a database system using Microsoft Excel. Finally obtained dataset were analyzed using Microsoft Excel. Descriptive statistics (percentage, mean, range, standard deviation etc.) were used to describe the socio-demographic profile and benefit cost ratio was used to analyze the profitability of potato production.

The socio-demographic profile of the potato cultivators reveals that the middle-aged cultivators comprised the highest proportion (52.50%) followed by young (25.00%) and old (22.50%). Data also indicates that the young and middle aged category constitute 77.50% of the total cultivators. Among the potato cultivators majority 17.50% had at least primary education. The small and medium family size of the

potato cultivators comprises majority (77.50%) of total cultivators in the study area. Majority (70.00%) of the potato cultivators were small farm size high income and medium income category constitute 72.50 % of the total cultivators.

The cultivators including medium income from potato cultivation category constitute the highest proportion (40.00%) and non-borrowers category constitute highest proportion (70.00%) whereas borrowers constitute (30.00%). It may also conclude that majority of the potato cultivators are non-borrower.

Profitability analysis of the study shows that around ten different inputs were used for potato cultivation practices. Among those inputs 33.25% fixed cost, followed by land preparation cost (12.97%), harvesting cost (13.42%), and fertilizer cost (15.50%).

Different problems faced by the potato cultivators of this region and suggestions for improvement were explored by offering open ended questions regarding the problems of potato cultivators and suggestion for improvements. Among different problems unavailability of quality seed ranks 1st, storage problems ranks (2nd), low market price (3rd), holding capacity ranks (4th), lack of processing facilities (5th), lack of technical knowledge ranks (6th), rot in home ranks (7th), transport problems ranks (8th) , presence of middleman ranks (9th), no procurement by govt. ranks (10th) and electricity problems ranks (11th) position.

Among the different suggestions proposed by the potato cultivators are supply quality seed, increasing storage facilities arranging training & workshop, supplying disease free seed, increasing the availability of improved technology, increasing cold storage facilities, govt. intervention in determining reasonable price, availability of credit facility, ensuring availability of fertilizer, and easy term agricultural equipment etc.

8.2. Conclusions

The demographic profile of the potato cultivators indicates the prevalence of young and medium aged potato cultivators with medium sized (5-6 members) family. Having primary level educational status most of them are small potato cultivators. Majority of them earned medium to high annual income from their potato cultivating practices. Low experience and medium experience category constitute 77.50% of the total cultivators. Medium sized family constituted highest proportions (52.50%) of the potato cultivators whereas small sized family constituted only 25.00% of them.

The study mainly investigates the profitability and the post-harvest problems for potato cultivation. The mean family size of the potato growers is higher than the national average of Bangladesh and most of the farmers have secondary and higher secondary education. The highest cost item was the land use cost with compare to other items. Potato cultivation is financially profitable among the farmers in the study area. Most of potato growers face more or less same categories problem but in different way. Unavailability of quality seed, Storage problem, lack of processing facilities and higher input price are the major problems of potato cultivations. The quality seeds as well as other inputs need to be available to the potato cultivators in time at reasonable price.

8.3. Recommendations

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

- ❖ Major portion of the cost of potato production were constituted by seed cost. Potato cultivators in the study area urged for disease free improved seed at a reasonable price. Respective authority may take initiatives to supply quality potato seeds in a subsidized price.
- ❖ After the harvesting period storage of potato is very crucial for the potato cultivators, because they do not get reasonable price at the harvesting period. Storage of a huge amount of potato at household level is quite impossible. For this reason National and regional potato storing capacity should be enhanced by establishing more cold storage.
- ❖ Due to lack of processing facilities market price of potato at harvesting or peck season fall sharply. This price fluctuation affects the potato cultivators severely. To ensure a stable market price for potato respective authority can take initiative to establish or enhance the potato processing facilities in the national or regional level.
- ❖ A significant portion of potato cultivators mentioned the unavailability of capital and larger cost for collecting capital from the existing sources. Majority of them urged for supplying loan with a lower interest rate. Government may take measures to facilitate credit availability with lower interest rate.

8.4. Limitation of the study

Taking into consideration the time, respondents, communication facilities and other necessary resources available to the researcher and to make the study manageable and meaningful it become necessary to impose certain limitations.

- The study was confined to one union named Chaitrokol of Pirganj upazila under Rangpur district, which may fail to represent the actual scenario of the whole situation as people develop their strategies according to the concrete situation they face.
- It is difficult to get accurate information from the respondent about cost of production and profitability as because of many of them are not appropriately literate.
- Data on at least two intervals were required for analyzing the impact of potato cultivation but it was not possible to collect data on two intervals due to shorter period of research time.

REFERENCE

- Akhter, S.M., Anwar, M., and Asaduzzaman, M. (2001). Potato production in some selected areas of Bangladesh .TCRC, BARRI, Joydebpur, Gazipur, Bangladesh.
- Awal, M.A. (2013). An Economic Analysis of potato and Carrot Production in selected Areas of Mymensingh District. Unpublished MS Thesis, Submitted to the Department of Agricultural Economics (Production Economics), Bangladesh Agricultural University, Mymensingh.
- Azimuddin, M., Alam, Q.M. and Baset M.A. (2009). Potato for Food Security in Bangladesh. *Int. J. Sustain. Crop Prod.* 4(1):94-99.
- Bajracharya, M., and Sapkota, M. (2017). Profitability and productivity of potato (*Solanumtuberosum*) in Baglung district, Nepal. *Agriculture & Food Security*, 6, 47. doi:<https://doi.org/10.1186/s40066-017-0125-5>
- BBS, (2011). (Bangladesh Bureau of Statistics). 2011. Year book of Agricultural Statistics of Bangladesh, Statistics Division, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka, Bangladesh.
- BBS, (2016). Yearbook of Agricultural Statistics of Bangladesh, Bangladesh Bureau of Statistics, Statistics Division, Ministry of Planning, Government of peoples Republic of Bangladesh.
- BBS, (2018). Yearbook of Agricultural Statistics of Bangladesh, Bangladesh Bureau of Statistics, Statistics Division, Ministry of Planning, Government of peoples Republic of Bangladesh.
- DAE (1999). Agricultural Extension Mannual. Department of agricultural extension, Ministry of Agriculture. Government of the people's Republic of Bangladesh.
- Egger, U. (2014), Potato Processing in Bangladesh: The Rolling Stone,pp. 1:1-20,<http://www.katalyst.com.bd/docs/Potato%20case%20study.pdf>,November 15, 2016.
- FAO, (2011). Food Wastage Footprint Impacts on Natural Resources. Summary report, Rome.
- FAO, (2013). Food Wastage Footprint Impacts on Natural Resources. Summary report, Rome.

- Geoffrey, S.K., Hillary, N.K., Antony, K.M., Mariam, M. and Mary, M.C. (2014). Challenges and Strategies to Improve Tomato Competitiveness along the Tomato Value Chain in Kenya, *International Journal of Business and Management*, Volume 9, Number 9, pp. 205-212
- Hossain, M. and Bose, M.L. (2000). Growth and Structural Changes in Bangladesh Agriculture; Implication of Strategies and Policies for Sustainable Development in M. A. S. Mandal ed. Changing Rural Economy of Bangladesh, Bangladesh Economic Association, Dhaka, 1-20.
- Hossain, M.M. and Ali, M.S.N. (2000). Preservation of Potato and Management (In Bengali), Bangladesh Potato Council,
- Hossain, M.A. and Miah, M.A.M. (2009). Post-harvest losses and technical efficiency of potato storage system in Bangladesh, Final Report CF # 2/08; National food policy capacity strengthening program
- Islam, S.M.F., Anwar, M.M., and Manos, B. (2000). Potato production system in Bangladesh: Resource use, productivity, efficiency and comparative profitability of true potato seed technology over traditional tuber technology. *ActaHortic*, 536, 261-268 doi: 10.17660/ActaHortic.2000.536.30.
- Khandker, Saifullah and Basak, Ashish. (2018). Scope for Potato Processing Industry in Bangladesh. (2018, February 2). Daily Sun. Retrieved November 4, 2018, from <http://www.daily-sun.com/post/286321/Scope-for-Potato-ProcessingIndustry-in-Bangladesh>
- Meyhuay, M. (2001). In: AGSI/FAO, Mehia, D., Lewis, B. (Eds.), Potato: Post harvest Operations. Instituto de Desarrollo Agroindustrial (INDDA), Rome, Italy. Retrieved from: <http://www.lamolina.edu.pe>
- MoYS. (2012). The Population Category in Bangladesh. Ministry of Youth and Sports, Government of the People's Republic of Bangladesh. Retrieved from: <http://www.moysports.gov.bd/>.
- Sarkar, M.M.A. and Yesmin, F. (2014). Profitability of potato cultivation in some selected areas of Rangpur district in Bangladesh. *Int. J. Sustain. Crop Prod.* 9 (1):11-15.
- Satter, M.A., Rahman, M.M., Rashid, M.H., Ali, M.S. and Alam, M.S. (2005). KrishiProjuktiHatboi(Hand book on agro technology), 3rd ed, BARI, Gazipur.

Seraj, S. (2017). Natural cold storage for potato preservation. (2017, September 28). The Daily Star. Retrieved November 4, 2018, from <https://www.thedailystar.net/country/natural-cold-storage-potato-preservation-1468687>

Sujan, M.H.K., Islam F., Azad M.J. and Rayhan, S.J. (2017). Financial profitability and resource use efficiency of boro rice cultivation in some selected area of Bangladesh. *African Journal of Agricultural Research.*12(29): 2404-2411. doi:10.5897/AJAR2017.12443.

Uddin, M.A., Yasmin, S. Rahman, M.L. Hossain, S.M.B. and Choudhury, R.U. (2010). Challenges of Potato Cultivation. In: Bangladesh And Developing Digital Databases Of Potato. *Bangladesh J. Agril. Res.* 35(3): 453-463.

Wikipedia. (2019). Maps of Bangladesh.

APPENDIX-1

English Version of the Interview Schedule

Department of Development and Poverty Studies
Sher-e-Bangla Agricultural University, Dhaka-1207.

Interview schedule for data collection for the research on

“Profitability and Post-harvest Problems of Potato Cultivation in Rangpur District of Bangladesh”

Serial No. :

Name of the respondent :

Address :
.....

Please answer the following questions. Information given by you will be kept confidential and only be used for research work.

1. Age

What is your age? ----- Years.

2. Education:

What is the level of your education?

- a) I don't know how to read and write ()
b) I don't know how to read and write but can sign only ()
c) I studied upto class

3. Family size :

How many members in your family?

4. Family labour:

How many members of your family are involved in this work? -----

5. Farm size:

Please state your land

Sl. No.	Type of land be used	Land area	
		Local unit (decimal)	Acre
1	Homestead		
2	Own land under own cultivation		
3	Own land given to others		
4	Land taken from others		
6	Others (write down specific)		
	Total		

6. Land under potato cultivation

(Please mention the amount of land in acre that you use for potato cultivation)

Land

7. Seed variety:

Which variety you use to potato cultivation?

- i) Cardinal
- ii) Granula
- iii) Local variety

8. Annual family income

Please indicate your annual family income (in Taka)

Sl. No.	Source of income	Amount of income (in Taka)
1	Agriculture	
2	Livestock (cattle, goat etc.)	
3	Poultry (duck, poultry etc.)	
4	Fisheries	
5	Service	
6	Business	
7	Other (Please specify)	
Total		

09. Distance to marketplace

(Please mention the distance of market place from your farm or home)

Distance..... km

10. Distance to cold storage

(Please mention the distance of cold storage from your farm or home)

Distance km

11. Where you sale your potato?

- i) Market
- ii) Home

12. How much total produce you get?mound

13. How much selling price of potato per 40 kg/1 mound?taka

14. Annual family income from potato production

Describe your annual family income from potato production

Sl. No.	Source of income	Amount of income (Taka)
1.	From tuber	
2.	From residues as (FYM)	
3.	From seed	
Total		

15. Cost of potato cultivation:

Item	Unit	Per unit Price	Total value
Fixed cost			
Land preparation			
Seed			
Irrigation			
Fertilizer	TSP		
	MOP		
	Others		
Insecticide			
Weeding & earthling up			
Harvesting			
Marketing			
Others			

16. How many years you are related to potato cultivation? years.

17. Post-harvest problems of potato farmers:

Mention the extent of the following problems you face during marketing?

Sl. No.	Problems	Severe (3)	Medium (2)	Low (1)	No Problem (0)
a)	Storage problem				
b)	Low market price				
c)	Presence of middleman				
d)	Lack of technical knowledge				
e)	Transportation problem				
f)	Holding capacity problem				
g)	Electricity problem				
h)	Rot in home				
i)	Lack of processing facilities				
j)	(If any)				
k)	(If any)				
l)	(If any)				

18. Suggestions to overcome the problems

- a).....
- b).....
- c).....
- d).....
- e).....
- f).....

Thanks for your co-operation