

**ASSESSMENT OF POTATO LOSSES AS PERCEIVED
BY THE FARMERS**

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**ASSESSMENT OF POTATO LOSSES AS PERCEIVED
BY THE FARMERS**

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CERTIFICATE

This is to certify that the thesis entitles “**ASSESSMENT OF POTATO LOSSES AS PERCEIVED BY THE FARMERS**” submitted to the Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirement for the degree of **Master of Science in Agricultural Extension**, embodies the result of a piece of bona-fied research work carried out by **ARMAN HOSSEN**, Registration no. 09-03632 under my supervision and guidance. No part of the thesis submitted for any other degree or diploma.

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

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Dedicated To

My Beloved Parents

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ACRONYMS AND ABBREVIATIONS

BAU	Bangladesh Agricultural University
BBS	Bangladesh Bureau of Statistics
BARI	Bangladesh Agricultural Research Institute
DAE	Department of Agricultural Extension
GoB	Government of Bangladesh
<i>et al.</i>	All others
FAO	Food and Agriculture Organization of The United Nations
HSTU	Hajee Mohammad Danesh Science and Technology university
PFI	Problem Faced Index
SAU	Sher-E-Bangla Agricultural University
SAAO	Sub-Assistant Agriculture Officer

ASSESSMENT OF POTATO LOSSES AS PERCEIVED BY THE FARMERS

ABSTRACT

The purpose of this study was to assess the losses of potato as perceived by the farmers and explore the contribution of the selected characteristics of the potato growers on assessment of losses of potato in various phases. Potato growers were selected from four villages. Data were collected from 100 potato growers of Boragari, Domar and Panga-Matukpur union under domar upazila of Nilphamari district during 25th November, 2015 to 25th December, 2015. Descriptive statistics and stepwise multiple regression analysis were used to examine the contribution of the selected characteristics of the potato growers on losses of potato. The findings revealed that 41 percent of the respondents experienced high loss, while 19 percent had medium loss and 40 percent experienced low loss. Among the selected characteristics, organizational participation, level of education, and problem faced by the potato farmers had significant contribution to the losses of potato. The R^2 value of the 3 independent variables formed the equation contributing to 39.3 percent of the total variables to assess the losses of potato. It was found from Problem Faced Index (PFI) that farmers faced higher problems in 'lower market price' followed by 'diseases problem' and 'insect attack'.

CHAPTER I

INTRODUCTION

1.1 General Background

Bangladesh is predominantly an agricultural country. Agriculture remains the major pillars of the national economy. Bangladesh is highly dependent on its rural economy as 80 percent people live in rural areas (BBS, 2013). Bangladesh is a densely populated developing country of 1,47,570 sq. km area (BBS, 2013) with about 150 million people (GoB, 2013). Out of the total agriculture labor households, only 0.27% is in urban areas and 30.86% is in rural areas (BBS, 2008). Bangladesh has an overwhelming agricultural economy. Now agriculture accounts for 19.29% of its gross domestic product (GDP) in 2013, and absorbs 63% of the country's labor force.

1.1.1 World Potato Production

Potato (*Solanum tuberosum* L.) is one of the most important food crops grown in more than 100 countries in the world (www.npcspud.com/history.htm). Over one billion people consume potato worldwide and it is the staple diet of half a billion people in developing countries. Because of the dry matter, edible energy and edible protein content, potato is considered nutritionally a superior vegetable as well as a versatile food item not only in our country but also throughout the world. Potato is a perishable commodity and contains about 75% water. Nutritionally, the potato is the best known for its carbohydrate content (approximately 26 grams in a medium potato). It is a high energy food contains about 80 kcal per 100 grams of fresh potato. The potato contains vitamins and minerals that have been identified as vital role to human nutrition, as well as an assortment of phytochemicals, such as carotenoids and polyphenols. The fiber content of a potato with skin (2 g) is equivalent to that of many whole grain breads, pastas, and cereals (Potato in India , 1992). World's potato production is increasing steadily. Until the early 90's, most potatoes were grown and

consumed in Europe, North America and former Soviet Union. Since then, there has been a dramatic increase in potato production in Asia, Africa and Latin America. In the early 60's potato production was less than 30 million tons and increased to more than 165 million tons in 2007. FAO data show that in 2005, for the first time, the developing countries potato production exceeded that of developed countries. The comparative potato productions of developed and developing countries during 1991-2007 are shown in Fig. 1.1. In 2007, world's potato production was 325.30 million tons sharing developed and developing countries were approx. 49% and 51% (www.potato2008.org/eng/world/index.html).

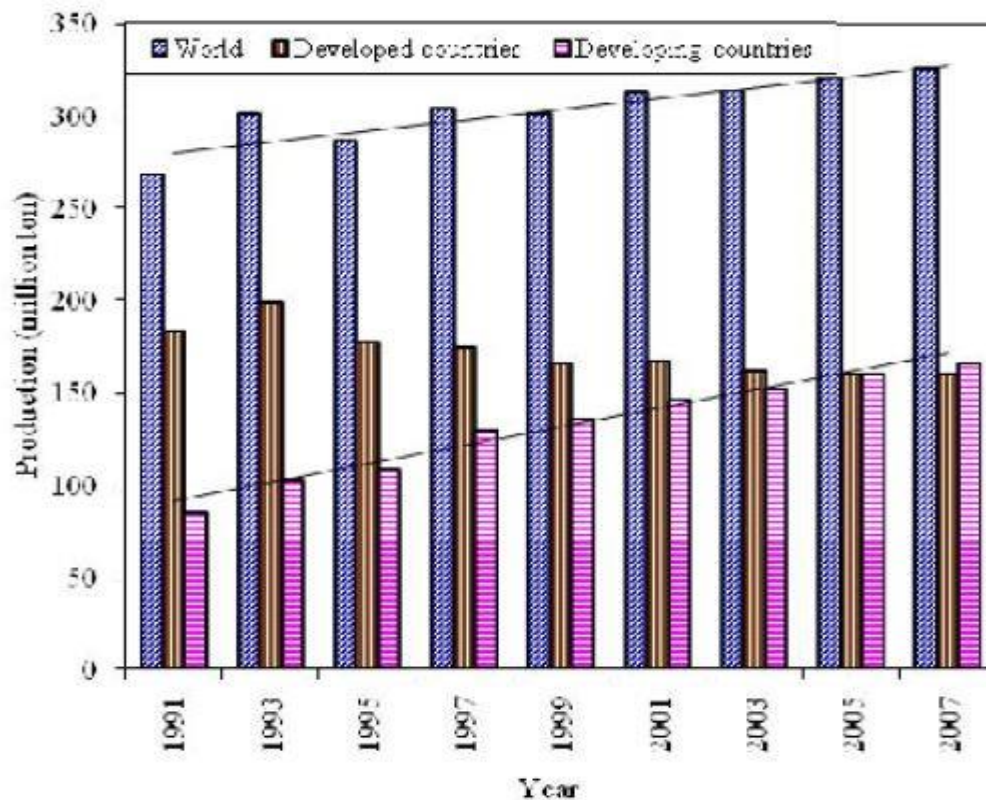


Fig 1.1: World potato production from 1991 to 2007

(source: www.potato2008.org/eng/world/index.html).

Per capita potato consumption is the highest in Europe and the lowest in Africa. The world's per capita potato consumption in different regions of the world is given in Fig. 1.2. Africa, Asia and Latin America consume less potato than

world's average consumption. Now the production trend of potato in the developing countries is increasing day by day.

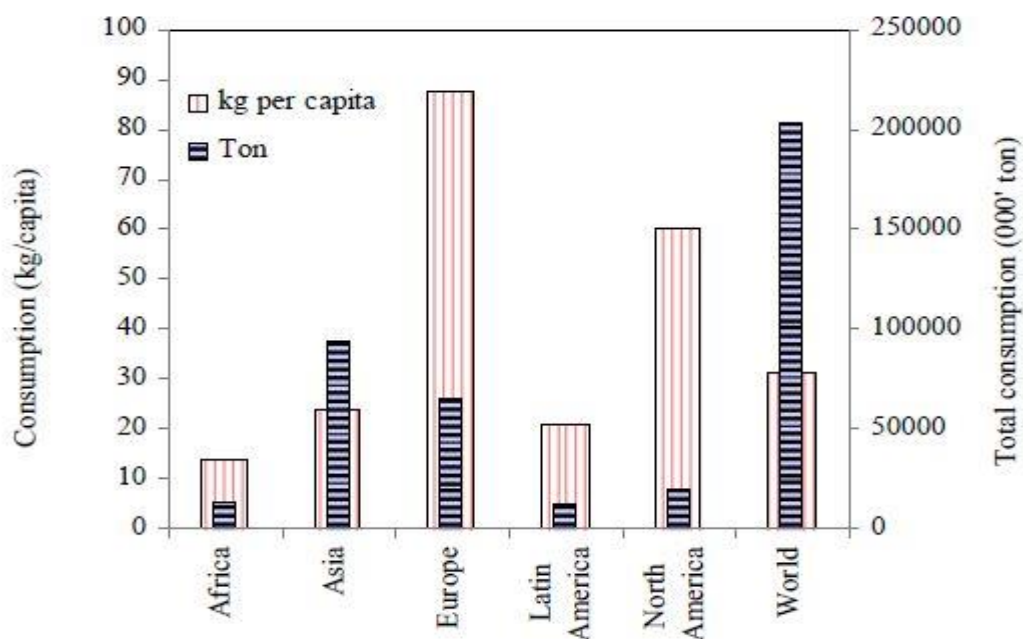


Fig 1.2: Annual per capita potato consumption in different regions of the world
(source: www.potato2008.org/eng/world/index.html).

1.1. 2 Potato in Bangladesh

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 the 19th century. By the 1920s, the first commercial production of the crop was established in the country (Islam, 1983). Agronomic research on potato dates late 1950s when limited variety trials were started by the Bangladesh Agricultural Research Institute (BARI). Research expended through the 1960 to include fertilizer applications, seed degeneration, mulching, planting techniques and storage (Ahmad, 1977). In 1967-1968 the Bangladesh Agricultural Development Corporation (BADC) launched a project for the multiplication and distribution of high quality seed potatoes (Ahmad, 1977). Now, potatoes have become an increasingly an import crop in Bangladesh. From 1955 to 1985 the annual area planted to potatoes increased from 25,900 to 111,300 ha with an average annual growth rate of 10% (Scott, 1985). The expansion of production over the same

period has been even stronger rising from 0.12 to 1.16 million tons at an average annual growth rate of 23% (Scott, 1985). The area and production of potato from 1971-1972 to 2005-2006 is shown in Fig. 1.3. For the introduction and adaptation of HYV potatoes and production technology, the area and production of potato sharply increased after nineties. Still now the area and the production of potato is following increasing trends.

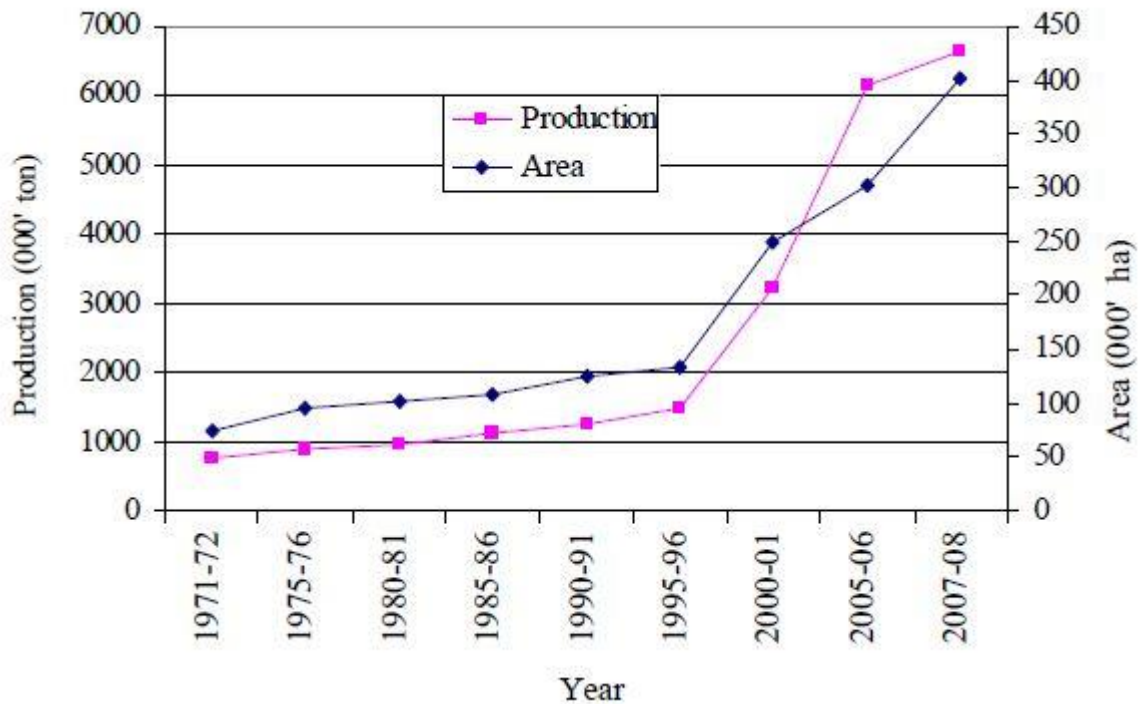


Fig: 1.3: Trend of area and production of potato in Bangladesh from 1971-1972 to 2007-2008 (Source: BBS 2008)

Nowadays, potato has emerged as a major food crop in Bangladesh and is being cultivated throughout the country. The total production of potato is 6648 thousands tons from the area of 400 thousands hectares (BBS, 2008). 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. One of the major problems faced by developing countries in general and Bangladesh in particular, is the ever increasing population. As per the current trend, the population in Bangladesh is expected to be around 172.9 million by the year 2020. In order to

further increase agricultural production, the only option is to grow high productivity crops, like potato. We have been relying heavily on the major cereal crops- rice, wheat and maize to feed the ever increasing population in our country. Such an over dependence on cereals should be reduced gradually if we have to ensure food security, in the decades to come. Potato can help to widen the food supply base and thereby help to minimize the risk of serious food shortages in the tropics and sub-tropics. Potato, which solely can play a significant role in ensuring foods security (<http://agmarknet.nic.in/profile-potato.pdf>). A developing country like Bangladesh needs not only the quantity of food but sufficient quantity and quality of a balanced nutritious food. It is a proven fact that if the food available provides balanced nutrition, the quantity of food intake is relatively low, e.g. in developed countries, where people consume balanced food and their dietary intake is relatively low in quantity. Whereas, in the developing countries the food availability is not well balanced, the quantity of dietary intake is higher because people tend to eat much cereals (mainly rice) to compensate for the poor nutrition. This results in greater demand for food and higher pressure on the limited land available to produce required quantity of food (Azimuddin *et al.*, 2009).

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). 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. In 2008, about 8 million metric tons of potatoes have been produced from 0.5 million hectares of land in Bangladesh. It is reported that thousands of tons of potatoes are going to rot due to lack of adequate and proper amount of the quality cold storage facility (http://en.ce.cn/World/AsiaPacific/200805/06/t20080506_15373277.shtml). If this losses can be minimized, it will reduce the food shortage of Bangladesh to a

great extent. Hence, potato may prove to be a useful tool to achieve the nutritional security of the nation.

1.3 Justification of the study

Though a huge amount of potato tuber is produced in every year in Bangladesh, a significant portion of them goes to waste due to its high perishability and cramped seasonality. The peak harvesting period of potato is January and February. It's a cold and winter period of Bangladesh. In this period, marketing of potato becomes difficult, as the fruits are rotten quickly once it ripens. On the contrary, Sub-standard and outdated pre and post-harvest management practices adopted by stakeholders like growers and intermediaries, inadequate and unscientific storage facilities, lack of smooth and timely transportation of agro-products to the selling points and indiscriminate use of non-recommended chemicals specially for ripening and preservations were identified as root causes of huge losses of Potato. Lack of Knowledge in the growers and latest technologies are also key-reasons behind such spoilage which leads to enormous economic losses, the researchers pointed out. During the peak season for example, about 50 percent fruits mainly pineapple, watermelon, jackfruit, tomato, potato etc. is lost due to inadequate processing facilities in Bangladesh (Hussain, 1993). It is reported that five thousand tons of potatoes produced by the farmers are going to be rotten due to lack of adequate cold storage facility (http://en.ce.cn./world/AsiaPacific200805/06/t20080506_15373277.html). This loss can be minimized and it will reduce the food shortage of Bangladesh to a great extent. Hence, potato may prove to be a useful tool to achieve the nutritional security of the nation. The potato tuber is also roughly made up of 75% water and 25% starch, and therefore is capable of losing the internal water if subjected to low external vapor pressure or relative humidity (CIP, 2009). When potatoes lose excessive moisture they shrink and may become unmarketable. Sprouting will significantly increase water loss in stored and transported potatoes. Sprouting will also diminish the nutritive quality of the potato. Therefore, sprout inhibitors are required after potatoes pass their dormant

phase (Shetty, 1998). Major causes of postharvest losses of potato mainly are water loss, (www.fao.org/docrep/008/a0185e/a01850c.htm) mechanical damage, physiological damage, diseases damages and insect damages. These losses occur during harvesting, sorting and cleaning, handling and packing, transportation, storage, distribution or marketing and processing.

In the case of post-harvest loss of potato, it is a living entity that is capable of respiring, transpiring (release water) and reproducing. Respiration is a key metabolic process that tubers undergo and this process allows the release of energy through the breakdown of stored carbon compounds, which in this case is starch. During this process the tuber generates heat, which becomes an important consideration for storage and transportation of potatoes. The need for refrigeration or cool temperatures during the post harvest life of the potato is to slow down the process of respiration and thereby maintain tuber quality. The potato tuber is also roughly made up of 75% water and 25% starch, and therefore is capable of losing the internal water if subjected to low external vapor pressure or relative humidity (CIP, 2009). When potatoes lose excessive moisture they shrink and may become unmarketable. Sprouting will significantly increase water loss in stored and transported potatoes. Sprouting will also diminish the nutritive quality of the potato. Therefore, sprout inhibitors are required after potatoes pass their dormant phase (Shetty, 1998). Major causes of postharvest losses of potato mainly are water loss, mechanical, physical and physiological damage, damages caused mainly by disease and insect attack damage (www.fao.org/docrep/008/a0185e/a01850c.htm). Therefore, these losses occur during harvesting, sorting and cleaning, handling and packing, transportation, storage, distribution or marketing and processing. Potato should be stored in a suitable environment to prevent weight loss, rot, shrinkage, sweetening, discolour and sprouting (Gottschalk and Christenbury, 1998). Additionally, seed potato needs to be stored to maintain its dormancy before planting to the next season. Storage losses are mainly caused by the processes like respiration, sprouting, evaporation of water from the tubers, spread of diseases, changes in

the chemical composition and physical properties of the tuber. These processes are influenced by storage conditions (Gottschalk, 1999). However, the storability of potatoes is already determined before the beginning of storage, by such factors as cultivar, growing techniques, diseases before harvesting, and maturity of potatoes at the time of harvesting, damage to tubers during lifting, transport and filling of the store (Rastovesky, 1987; Burton *et al.*, 1992). Good storage should prevent excessive loss of moisture, development of rots, and excessive sprout growth. It should also prevent accumulation of high concentration sugars in potatoes, which results in dark-coloured processed products. Temperature, humidity, carbon dioxide and air movement are the most important factors during storage (Harbenburg *et al.*, 1986; Maldegem, 1999).

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 perishability. Unlike in temperate regions, in Bangladesh the potato is harvested in the beginning of summer (Hussain *et al.*, 2006). Due to inadequate cold storage facilities to hold the produce for longer periods, large quantities are spoiled before they could be consumed. Consumers are also unable to develop a habit of consuming more potatoes because potato stocks disappear from the market within a few months of harvest and in later part of the year relative prices of potato are high (Hussain *et al.*, 2006). Therefore, there is a need for both short and long term storage of potato. After harvesting, a series of operations need to reach in the consumers' table termed as postharvest operations. During these operations, some losses occur called post-harvest losses (Ritenour, 2003). There are about 300 cold storages in Bangladesh with a capacity of 2.2 million tons. In the year 2008, about 27.5% of total production of potato was stored in the cold storage including seeds (Rashid, 2008). The rest were stored by the farmers using their traditional storage systems.

Post-harvest losses of vegetables are high as 20-50% in developing countries (Rashid, 2008). In India post-harvest losses of potato are 17% and in Pakistan these losses ranged 15-40% (Iqbal, 1996; Ilangantileke *et al.*, 1996). But, in Bangladesh data on post-harvest losses of potato at different post-harvest operations are lacking. Therefore, it is necessary to quantify the post-harvest losses of potatoes in different post-harvest operations like harvesting, cleaning, grading, bagging, transportation, processing and storage.

Table no. 1.1 presents a picture depicting enormous losses of agricultural commodities and its implications in terms of loss of the quantities of annual losses of individual food commodities in our country.

Table No. 1.1 Extent of post harvest losses of different food produces in Bangladesh

SI. No.	Food commodity	Percent of postharvest loss	Quantity of postharvest loss proportionate to the annual production in 2005-2006 (Million MT)
1.	Cereal grains (rice and wheat)	13.6	3.71
2.	Fruits	15.0	0.44
3.	Vegetables	26.0	1.25
4.	Potatoes	21.0	0.87
5.	Pulses	14.0	0.04
6.	Oil Seeds	12.3	0.03

Source: WEP, FPMU of MOFDM/FAO

So assessing the losses of potato can be considered important alternatives for finding out the reason behind the pre and postharvest losses of this major vegetable. So that the necessary steps can be taken to minimize the losses fulfilling the above requirement. The behavior of a farmer is influenced by his personal, economic, social and physiological characteristics (Hossain, 1991).The

researcher developed a felt need to conduct this sort of research. So the researcher is eagerly interested to undertake the research entitled “**Assessment of Losses of Potato as Perceived by the Farmers**”. The findings of the study will be helpful to the extension providers and to the growers, intermediators, wholesalers, retailers, consumers and researchers of Potato. It is assumed that if the reason of losses and could be identified and minimized successfully, the deficiency of food and economic condition of our country would be improved undoubtedly.

1.4 Statement of the Problem

Among all other agricultural practices, only loss of potato has been taken as present research topic. In order to minimize farmers’ losses in potato production the researcher undertook the investigation entitled “Assessment of Losses of potato as Perceived by the farmers” in some selected areas of Nilphamari districts in order to have an understanding of the extent of losses of potato as perceived by the farmers.

Research information is required which could be helpful to the policy maker, regarding supply of inputs, technological knowledge and problem being encountered on potato production. The purpose of the study was to assess the losses of potato as perceived by the farmers regarding production, harvesting and marketing and to explore the contributions of the selected characteristics of the farmers with the losses of potato as perceived by them. In order to make the study manageable, the following research questions were taken into consideration.

1. Are there any losses of potato in production, harvesting and marketing phase as perceived by the farmers?
2. What are the severity of problems in potato production, harvesting and marketing phases as perceived by the farmers?
3. What are the characteristics of the farmers?
4. Is there any contribution of the farmers’ selected characteristics and losses of potato as perceived by them?

1.5 Specific Objectives

The following specific objectives were formulated in order to give proper direction of the study:

1. To assess the potato losses as perceived by the farmers;
2. To determine the following selected characteristics of the farmers
 - i. Age
 - ii. Level of education
 - iii. Farm size
 - iv. Annual income from potato cultivation
 - v. Family size
 - vi. Experience in potato cultivation
 - vii. Knowledge in potato cultivation
 - viii. Innovativeness
 - ix. Extension media contact
 - x. Training exposure
 - xi. Organizational participation
 - xii. Problem faced by the potato farmers;
3. To explore the contribution of the selected characteristics of the potato farmers with the losses of potato as perceived by the farmers;
4. To compare the severity of the problem as perceived by the farmers;

1.6 Limitations and Scope of the Study

The respondents of the study were exclusively selected from Nilphamari district. But the findings may be applicable in other areas of Bangladesh where the physical, socio-economic and cultural conditions are alike with those of the study area. Thus, the findings of the study may be profitably utilized by the potato production planners, extension personnel and field workers for successful prevention of potato losses. However, in order to conduct the research in a meaningful and manageable way it becomes necessary to impose certain limitations in regard to certain aspects of the study, considering the time, money and necessary resources available to the researcher. The study was conducted with the following limitations:

1. The study was confined to Domar upazill under Nilphamari district.
2. Population for the present study was kept confined within the heads of farm families in the study area.
3. There were many characteristics of the farmers in the study area but only twelve of them were selected for investigation.
4. For information about the study, the researcher depended on the data furnished by the selected respondents during their interview with him.
5. Facts and figures collected by the researcher applied to the situation prevailing during the year 2014-2015.
6. Reluctance of the farmers to provide information was overcome by establishing rapport.

1.7 Assumptions of the Study

An assumption has been defined as the supposition that an apparent fact or principle is true in the light of the available evidence (Goode and Hatt, 1952). That means the assumption is taken as a fact or belief to be true. The researcher had the following assumptions in mind while undertaking this study:

1. The respondents, included in the sample were capable of satisfying proper responses to the questions included in the interview schedule.

2. Views and opinions furnished by the respondents were the representative views and opinion of the whole population of the study.
3. The responses furnished by the respondents were reliable. The researcher was well adjusted to the social environment of the study area. So, the respondents gave their opinions without any hesitation.
4. All the data concerning the independent and dependent variables were normally and v distributed with their respective means and standard deviation.
5. The findings of the study will have general applications to other parts of the country similar personal, socio-economic and cultural conditions.

1.8 Definition of Terms

A concept is an abstract of observed thing; events or phenomenon or in other words, it is a short hand representation of variety of facts. A researcher needs to know the meaning and contents of every term that he uses. A concept is an abstract of observed thing; events or phenomenon. It should clarify the issue as well as the fact to the investigator and readers. However, for clarity of understanding, a lot of key concepts/terms frequently used throughout the study are defined and interpreted as follows:

Respondents

Randomly selected people considered to be representable of the population are known as respondents. They are the people from whom a social research worker usually gets most data required for his research. In this study the respondents were the village level potato farmers.

Farmers

The people who are involved in farming activities is called farmers. They participated in different farm and community level activities like crops, livestock, fisheries, other farming activities etc. In this study, potato growers were treated as farmers.

Age

Age of a respondent is defined as the span of life and is operationally measured by the number of years from his/her birth to the time of interviewing.

Level of education

Empirically it was defined to the development of desirable changes in knowledge, skill and attitudes in an individual through reading, writing, walking, observation and other selected activities. It was measured on the basis of classes a farmer has passed from a formal educational institution.

Family size: Family size refers to the total number of members including the respondent himself/herself, spouse, children and other dependents, who live and eat together in a family unit.

Farm size: Farm size refers to the total area on which a farmer's family carries on farming operations, the area being estimated in terms of full benefit to the farmers family. It was measured in hectare.

Annual income from potato cultivation

Annual family income of a respondent generally refers to the total earning by him and other members of his family from different sources during a year. Annual income from potato of the respondent only includes the earning from jackfruit by the respondent. It was expressed in Thousand Taka.

Assumption: An assumption is "The supposition that an apparent fact of principle is true in the light of the available evidences".

Experience in potato cultivation

Experience as a general concept comprises knowledge or skill of something or some event gained through involvement in or exposure to that thing or event. Experience refers to the nature of the events someone or something has undergone. Experience is what is happening to us all the time - as we long we

exist. However, in this study, it refers to the years of cultivating potato by the respondents.

Knowledge on knowledge cultivation

It is the extent of basic understanding of the farmers in different aspects of Potato production, harvesting and marketing etc. It includes the basic understanding of the use of s and practices for potato cultivation.

Innovativeness: Innovativeness is the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than other members of a social system (Rogers, 1995). It was measured on the basis of time dimension.

Extension media contact

Contact with extension media referred to the extent to which a respondents is exposed to the various channels of communication through which to exchange message. The nineteen media under three broad categories included in the study were :

1. Interpersonal: Block Supervisor (BS), NGO worker, local village leader, friends and relatives neighbours.
2. Group Method: demonstration internal/training, formal group meeting/training, demonstration site, field day.
3. Mass method: Radio, television agricultural programs, publication, poster, and exhibition or fair.

Training exposure

It referred to the total number of days attended by potato growers in his/her life to the training on various agricultural related subject matter.

Organizational participation

Organizational participation of an individual referred to his participation in various organizations as ordinary member, executive member or president/secretary within a specified period of time.

Problem faced

Problem means any difficult situation which requires some actions to minimize the gap , “what ought to be” and “what is”. The term problem faced refers to different a faced by the farmers in jackfruit production, harvesting and marketing.

Losses of potato

Loss refers to a reduction in the value of an investment. However, in this study, it refers to the amount or number of potato which was wasted.

Research methodology: Research methodology is the description, explanation and justification of various methods of conducting research. It may be understood as a science of studying how research is done scientifically. In it we study the various steps that are generally adopted by a researcher in studying the research problem along with the logic behind them.

Hypothesis: Defined by Goode and Hatt (1952), a proposition which can be put to “a test to determine its validity”. It may be true or false, it may seem contrary to or in accord with common sense. However, it leads to an empirical test.

Null hypothesis: The hypothesis which is picked for statistical test is null hypothesis (Ho). In this study the null hypothesis was stated that there was no relationship between the concerned variables and adoption of selected recommended rice technologies.

CHAPTER II

REVIEW OF LITERATURE

This chapter deals with the review of past research works that relates to this investigation directly or indirectly. The reviews are conveniently presented based on the major objectives of the study. The aim of this study was to have an understanding the assesment of losses of potato as perceived by the farmers and the contribution of the selected characteristics of the farmers to asses the losses of potato. Despite frantic search, the researcher found only a few literatures related to this study. The researcher came across with some expert opinions and has tried his best to collect needful information through searching relevant studies, journals, periodicals, bulletins, leaflets, internet etc. These enhanced the researcher's knowledge for better and clear understanding of the present study. But unfortunately no previous literature was found related to relationship between assessment of losses of potato and their characteristics. On this consideration, this chapter has been presented in four sections as follows:

Section 1: General Findings on Potato loss

Section 2: The Development of Conceptual Framework of the Study

2.1 General Findings on Losses of Potato or other crops

Abdullah (2013) opined that limited access to appropriate pre- and postharvest technologies in sub-Saharan Africa is one of the major causes of food losses. FAO/World Bank have estimated losses in the grain sector of over US\$ 4 billion. Perishable loss value in Africa may reach 3 to 4 times higher.

Adewumi *et al.* (2013) showed from their experiment that head portorage, motor cycle, motor vehicle and pick up van of less than 3 tons were the most prominent means of transporting sweet potato in the study area. Also, the size of the farm,

cost of transportation, quantity sweet potato produced, and average distance from the farm to the market are the factors that significantly affect the choice of transportation means used by the farmers in the study area. The results also showed that the farmers who sell their produce at the market earn more profit than those that sell at the farm gate. Therefore, in order to encourage the farmers to produce more sweet potatoes it was recommended that adequate transportation system be provided.

Kakuhenzire et al. (2013) opined that seed potato accounts for 40-50% of the total cost in potato production in highlands of SSA. However, this is often the most quality-compromised input due its unavailability and high cost among smallholder farmers who resort to repeated planting of home-saved seed to solve the problem with consequent in low yields, low enterprise profitability, food and income insecurity as well.

Khan et al (2013) opined that unorganized distribution of potato and other staple food deprived a large proportion of people from getting right price. The economic disparity, poverty, lack of access to the information by the farmers and consumers, poor transportation system, absence of preservation facility are main causes. Together with inadequate credit facility and technological support have made the pricing of potato a solemn dilemma to the farmers and consumers of Bangladesh.

Lemaga et al. (2013) found from their experiment that the trainings resulted in rapid adoption of seed and ware potato production technologies and enhanced availability of and access to quality seed. Using the knowledge and technologies they acquired, seed producers obtained 2-5 times higher yields than the national average yields.

Rana *et al.* (2013) opined that acute resource paucity and unavailability of quality seed potato at affordable prices were identified as one of the important reasons. This study analyses seed potato utilization pattern and its impact on farmers' profitability in Hassan and Karnataka. The research paper provides detailed information on seed potato source, variety wise seed use rate, seed replacement rate, seed size, variety wise potato yield and adoption and impact of seed potato quality on farmers' profitability.

Medagoda (2011) observed in a study that a very low percentage of total produce is consumed as a food amounting 30 percent and greater percentages, amounting to about 70 percent is lost in the form of pre and post-harvest losses. The major constraint reported in marketing were the absence of properly organized marketing structures, lack of processing plants and the poor demand in local market for jack products. An integrated approach would improve productivity, quality and income from jack cultivation contributing to poverty alleviation in the rural sector to a considerable extent.

Muntad (2009) reported both quantitative and qualitative losses of extremely variable magnitudes occurring at all stages in the post-harvest system from harvesting, through handling, storage, processing and marketing to final delivery to the consumer, processing and marketing to final delivery to the consumer.

Patil (2008) found that 'Higher the value addition better the post-harvest management and lower will be losses'. He also mentioned some reasons for losses such as handling of raw produce through many stages of middlemen, processing is mostly controlled by urban rather than rural entrepreneurs which leads to losses in valuable by products, non availability of adequate and efficient equipment and machinery to be used in catchment areas, low level of

entrepreneurial urge in rural areas due to constraints of finance, assured market and proper training on technology and on the whole, there exists a fragmented and inefficient value chain.

Tuomisto (2007) found results from his experiment and the result from that experiment indicate that no contract model provided seed potato producers with average positive net profits, and profitability ratios for seed potato farms stayed below one. The results indicate that seed potato producers trading on a fixed-price and pre-emptive market could sell their seed potato for 13 per cent less than on a transaction market, but with equal net profits.

An investigation was carried out by Yadav et al. (2007) to assess the level of knowledge of mango orchardists regarding postharvest processing and marketing practices in Saharanpur and Bulandshahr districts of western Uttar Pradesh, India. The percentages of the orchardists had knowledge on postharvest management and grading were 52.13 and 51.06%, respectively. Most of the orchardists were not familiar with storage of fruits after harvesting (60.64%).

Kumar (2006) conducted an experiment and found that the amount of market yield is more important than the level of total yield for potato producers. The share of market yield in total yield was estimated during the monitoring carried out in 2005 in Poland. Research carried out by the Agriculture Advisory Centre took into account 615 potato plantations in 15 voivodeships. The share of the market yield in total yield accounted for ~35%. In it, ~20% of all defects were caused by pests and diseases that occurred during the vegetation period.

Karim and Hawlader (2005); Aujla et al. (2011) reported that postharvest loss of fruits and vegetables is estimated to be 30-40% in developing countries, Tanzania inclusive.

Anonymous (2005) reported that moreover, it is very regrettable that post harvest losses of fruits and vegetables are about 30% due to the lack of proper post harvest management and marketing system. In effect, it means that 30% of land, input and labor used to produce fruits and vegetables go to misuse.

Chourasia *et al.* (2004) found that the loading density of potato in stack and cold storage (534.63 kg/m³ and 366.01 kg/m³, respectively) was optimum. The percentage free space was adequate and found to be 31.54%. Therefore, centre-most potatoes achieved safe temperature (12-13 degrees C) in about 10 days and the maximum cool-down time was about 30 days. Hence, the potatoes were safe from the rotting. Also, the temperature of potatoes at the surface was always above the critical temperature for cold injury. However, large variations in storage air temperature were observed during the cool-down period, which increased the weight loss from the potatoes. The average weight loss was 5.3% after 8 months of storage.

Kumar *et al.* (2004) opined from their experiment that the overall postharvest losses on weight and number basis were estimated to be 29.35% and 23.02%, respectively. Overall gross and net economic losses were 29.40% and 16.21%, respectively.

Wills *et al.* (2004) reported that a considerable proportion of the harvested produce never reaches the consumers mainly because of postharvest losses. The estimated postharvest losses of fruits and vegetables lie in the range of 20-40%.

Mohamed *et al.* (2003) opined that the potato growers' knowledge of some technical recommendations concerning the harvesting, sorting, and packaging of potatoes intended for export; and the problems and constraints facing the respondents in applying these technical recommendations.

Batt (2002) got from their experiment that profitability is influenced by the seed quality (origin and physiological age), the market price for ware potatoes, the availability of other farm inputs, and the cost and availability of credit. Because of seasonal variations in productivity per unit area and ware market prices, farmers employ a number of risk reduction strategies in order to reduce their exposure to uncertainty.

Chourasia *et al.* (2001) concluded that the losses of potatoes in cold storage occur in all the potato-producing countries and are caused, in part, by excessive high temperatures during storage, which increase rotting, decay and loss of edible quality and nutritive values.

Manish *et al.* (2000) found that two potato cultivars, Kufri Ashoka and Kufri Sindhuri, were stored in thatched and pucca structures at Patna, Bihar, India during the summer of 1996-97, and storage losses were assessed at fortnightly intervals. Losses due to rotting were relatively higher in pucca store than in thatched store. Under these storage conditions, Kufri Ashoka had lower poorer storage quality. Smaller tubers showed higher weight loss than large tubers, the average being 31.0% in Kufri Ashoka and 15.7% in Kufri Sindhuri in pucca store.

Zheng *et al.* (1999) observed that the main factors responsible for postharvest losses were lack of proper packaging, no precooling, no proper transportation, and lack of good storage techniques. It was estimated that the postharvest losses of Chinese cabbage and oriental bunching onions after storage were 20% and 50%, respectively.

Chaudhry (1998) observed that the sum-total of losses in food grains amount to 1.44 million tons valued at Rs.3.13 billion which if converted into dollar currency units will equal to 316.15 million, US Dollars. From any international standard, it is an immense recurring loss which the developing economy of Pakistan can hardly afford to bear.

Okezie (1998) reported that postharvest food losses have been quoted as being 15-50% for horticultural products and 10-20% for grains and oil seeds.

Hossain et al. (1997) observed that the average estimated loss of tomato at farmers' level was 12%.

Rashid (1998) reported that the total value of vegetables produced in Bangladesh is around Tk. 19400 million, calculated at average retail price. About 70% of the vegetables pass through the marketing channels. If the spoilage is 10%, the loss comes to Tk. 1,462 millions. These losses are due to inadequate knowledge on harvesting, carrying, packaging, transport and storage techniques. In the vegetable marketing channels, traders suffer maximum losses, because they handle and transport more quantities from one place to another than any other intermediaries.

Hussain, (1993) found that Post-harvest losses in durable crops ranged between 10-15 percent; loss in semi-perishable crops was 15-30 percent and that of perishables, 25-40 percent. During the peak season for example, about 50 percent fruits mainly pineapple, watermelon, jackfruit, tomato etc. is lost due to inadequate processing facilities in Bangladesh.

Paull (1993) reported that estimates of postharvest losses of fruits and vegetables vary widely both in the developed and developing countries.

Kader (1992) showed that the magnitude of post-harvest losses of fresh fruits and vegetables is estimated to be 5 to 25 percent in developed countries and 20 to 50 percent in developing countries depending upon commodity.

Amiruzzaman (1990) found that the magnitude of post-harvest losses of major fruits and vegetables in Bangladesh is 25-50 percent and it is only 5-25 percent in developed countries as reported by Khader, 1992.

Singh and Chadha (1990) reported that a loss of nearly 25-40% of the vegetables occurs due to rough prepackaging and improper post harvest handling,

transportation and storage practices and the variation often depends on type of vegetables.

FAO (1989) reported that estimates of the post-harvest losses of food grains in the developing world from mishandling, spoilage and pest infestation are put at 25 percent; this means that one-quarter of what is produced never reaches the consumer for whom it was grown, and the effort and money required to produce it are lost-forever. Fruit, vegetables and root crops are much less hardy and are mostly quickly perishable, and if care is not taken in their harvesting, handling and transport, they will soon decay and become unfit for human consumption. Estimates of production losses in developing countries are hard to judge, but some authorities put losses of sweet potatoes, plantain, tomatoes, bananas and citrus fruit sometimes as high as 50 percent, or half of what is grown. Reduction in this wastage, particularly if it can economically be avoided, would be of great significance to growers and consumers alike.

Oyeniran (1988) revealed that although postharvest loss estimate figure for fruits and vegetables are difficult to substantiate especially in developing countries like Nigeria, it is however estimated that losses as high as 50 – 70 percent are common in the tropics between the production areas and consumption points.

Sharma (1987) reported that, post harvest losses of vegetables in Bangladesh as high as 43%. The average post harvest loss estimated by Khan (1991) was 26%.

Pantastico (1977) opined that the amount of post-harvest loss of fruits and vegetables each year in the Philippines has been estimated at 29 metric tons of protein which could supply the protein requirement of 1.3 M Filipinos.

2.2 The Conceptual Framework of the Study

Conceptual framework is the representation of the study variables. Properly constructed hypothesis of any research contain at least two variables namely, “dependent variable” and “independent variable”. A dependent variable is that which appears, disappears or varies as the researcher introduces, remove or varies the independent variables (Townsend, 1953). An independent variable is that factor which is manipulated by the researcher in his attempts to ascertain its relationship to an observed phenomenon.

In view of the prime theme of the study, the researcher constructed a conceptual framework which is self-explanatory and is presented in Figure 2.1.

It was expected that the selected independent variables would be interlinked and interrelated with the dependent variable of the study.

CHAPTER III

METHODOLOGY

It is well-known that in conducting a research, methods and process are the prime factors. In order to reach valid and trustful decision appropriate methodology used in research helps a lot. This chapter delimits the locale of the study followed by source of data, research design, variables of the study, measurement of variables, categorization and statistical treatment.

3.1 Locale of the Study

The study was conducted in the Domar upazilla under Nilphamari district. A significant number of people of this upazilla are farmers. Choto Rauta and Boro Rauta village under Domar union and Boragari village under Boragari and Matukpur village under Panga-Matukpur union of Domarupazilla under Nilphamari district were purposively selected because there were intensive potato growing areas. The Upazila will be selected purposively and the Union will be selected randomly from eight unions of this Upazila. These four village constitutes the locale of the study.

3.2 Population and Sampling Design

A list was selected with the help of local leader and concerned Sub-assistant Agricultural Officer (SAAO). A total numbers of farm families in these villages were 164, which constitutes the population size, where 42 potato farmers from Choto Rauta, 39 from Boro Rauta, 47 from Boragari and 36 from Panga-Matukpur village which constitute the population of the study. According to Yaman's (1967) formula, sample size was determined as 100. In calculating sample size from the following formula, 8% precision level, 50% degree of variability and value of $Z = 2.57$ at 99% confidence levels will be choosen. Then 100 farmers were selected with the help of calculator from the total population.

The formula is shown below -

$$n = \frac{Z^2 P(1-P)N}{Z^2 P(1-P) + Ne^2}$$

Where, n = sample size

N = population size, 164

e = the level of precision, 8%

z = the value of the standard normal variable given the chosen confidence level, 2.57

p = the proportion or degree of variability, 50%

$$n = \frac{2.57^2 (0.5)(1-0.5)164}{2.57^2(0.5)(1-0.5)+164(0.08)^2}$$

$$n = 100$$

Therefore, sample size, $n = 100$

10 percent of the sample size was selected randomly from the population which will be included in the reserve list supposed to be interviewed only when a respondent in original sample will find unavailable during data collection. The distribution of selected farmers is shown in Table 3.1

Table 3.1: Distribution of population and sample of the respondents in selected potato farmers in respective union of Domar upazilla

Name of union	Name of villages	No. of Potato farmers	No. of Potato farmers included in the sample	Reserve list
Domar	Choto Rauta	42	26	3
	Boro Rauta	39	23	2
Panga-Matukpur	Matukpur	47	32	3
Boragari	Boragari	36	19	2
Total			=	100

Thus 100 potato farmers were selected as a sample. A reserve list of 10 farmers were also prepared and used only when a respondent included in the original list was not available for interview during collection of data despite several attempts.

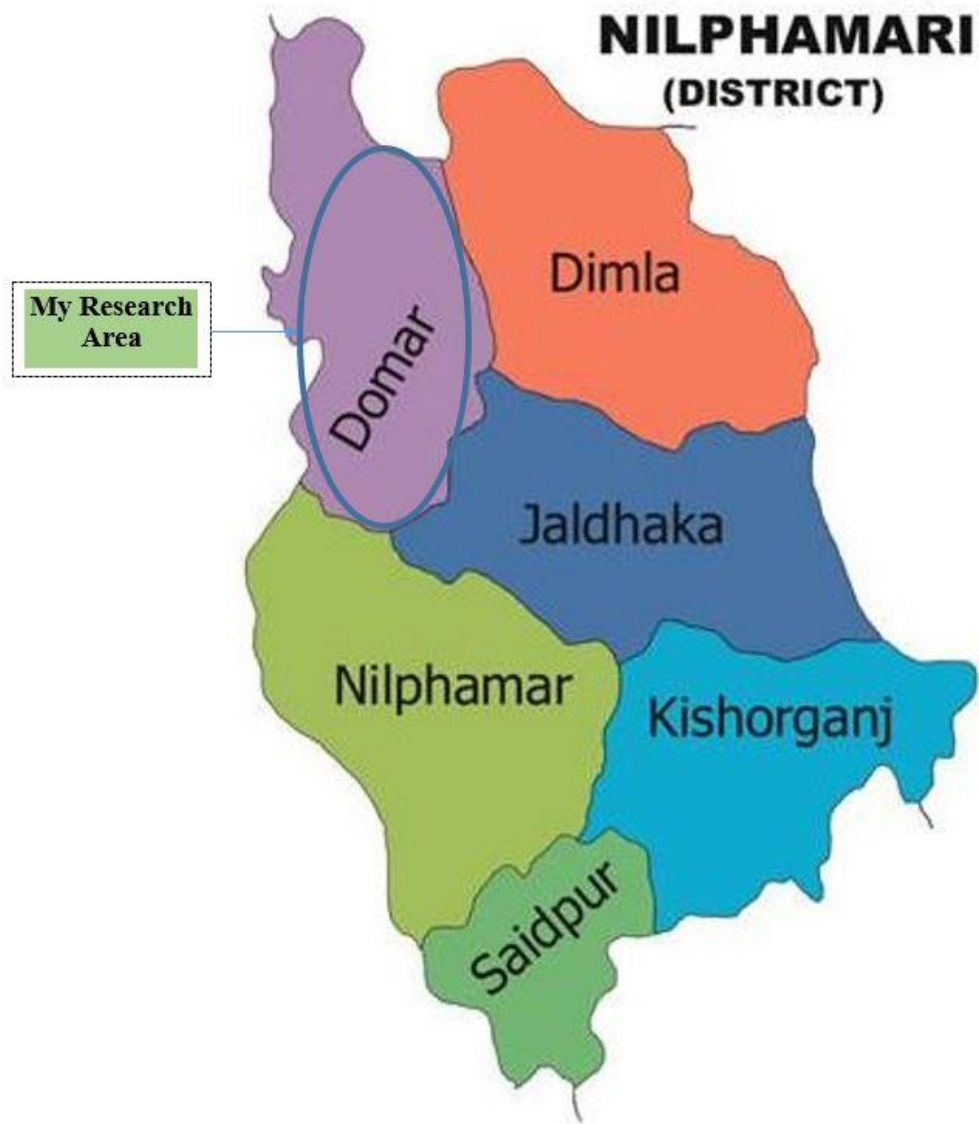


Figure 3.1: Map of Nilphamari district showing the Domar upazila

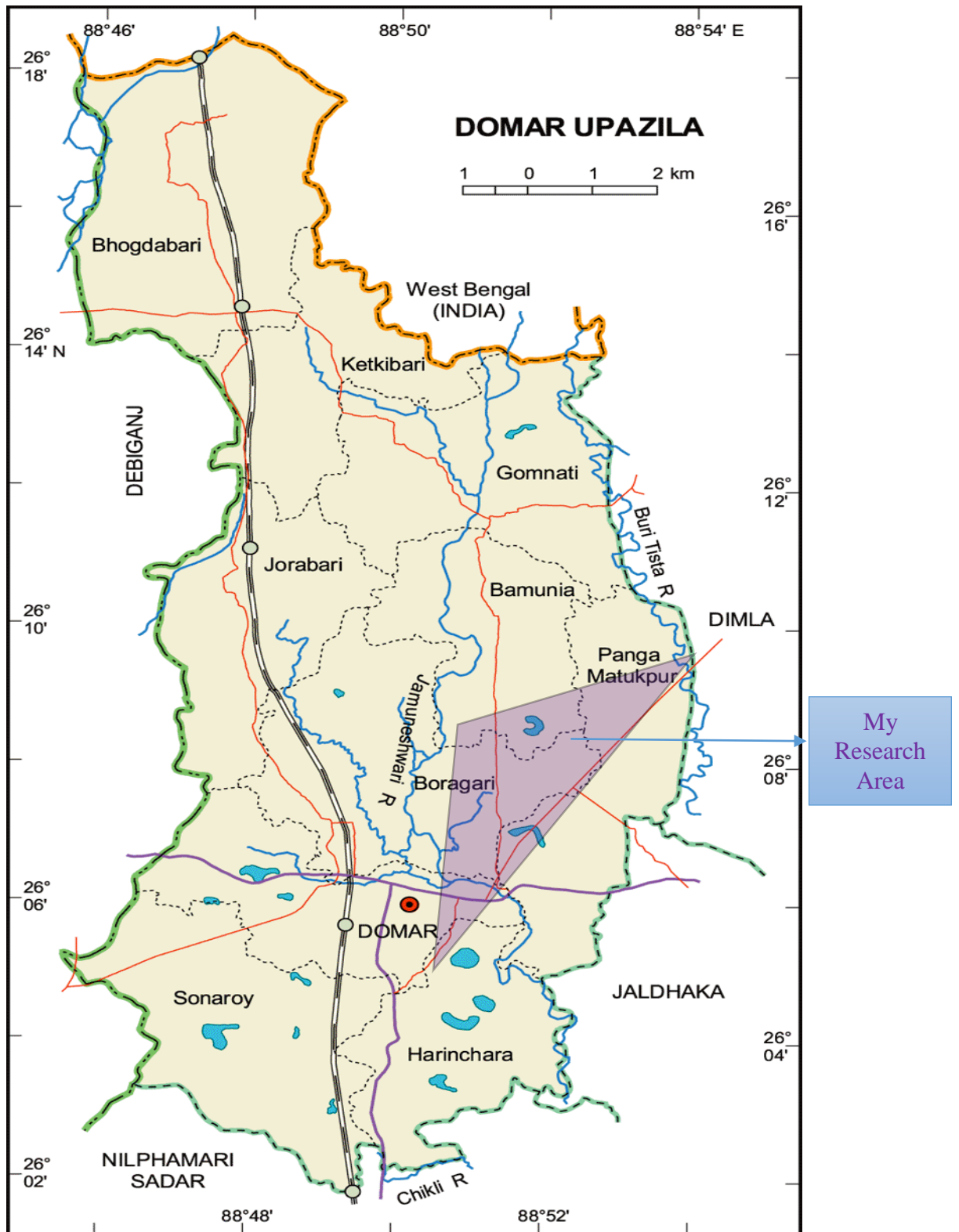


Figure 3.2: Map of Domar upazila showing the study area of Domar, Boragari and Panga-Matukpur union

3.3 Instrument for Collection of Data

In order to collect faithful data from the respondents an interview schedule was used as the research instrument. The schedule was well-planned designed and prepared in Bengali, keeping the objectives of the study in mind. The questions were systematically arranged.

3.4 Pre- testing of the Interview Schedule

12 farmers were selected for pre-tested the interview schedule and then final shape was given to the interview schedule according to the findings of pre-test. The pre-testing facilitated the researcher to examine the suitability of different questions and status of the instrument in general. The final revised version of the instrument was prepared on the basis of suggestions and comments of the appropriate authority. An English version of the interview schedule is attached at Appendix-A respectively.

3.5 Time and Procedure of Data Collection

Data were collected by the researcher himself during 25 November 2015 to 25 February, 2016. To get valid and appropriate information, the researcher made all possible efforts to explain the purpose of the study to the respondents. Interviews were conducted with the respondents in their homes nad fields. While starting interview with any respondent, the researcher took all possible care to establish rapport with him so that he did not feel hesitate to furnish proper responses to the questions and statements in the schedule. The questions were clearly explained wherever the respondent felt any difficulty in understanding properly. Before data collection Agriculture Extension Officer (AEO) and Sub Assistant Agriculture Officer (SAAO) of the Domar Upazilla under Nilphamari District extended necessary help and cooperation in connection with data collection.

3.6 Variables and their Measurement

Selection of variables play an important role in any social research which is descriptive in nature. In this connection, the researcher looked into the literature to increase his understanding about the nature and scope of the variables involved in the research studies. A variable is any characteristic which can assume varying or different values in successive individual cases (Ezekiel and Fox, 1959). A well organized piece of research usually contains at least two important variables, *viz.* an independent and a dependent variable. An independent variable is that factor which is manipulated by the experiment in its attempts to ascertain the relationship to an observed phenomenon. A dependent variable varies as the experiment introduces, removes or varies the independent variables (Townsend, 1953).

3.6.1 Measurement of independent variables

Twelve characteristics of Potato farmers were selected as independent variables of this study. Procedure followed in measuring the independent characteristics are briefly discussed below:

3.6.1.1 Age

Age of the respondents was measured in terms of actual years from their birth to the time of interview.

3.6.1.2 Level of Education

Education was measured as the ability of an individual respondent to read and write or the formal education received up to a certain standard. A score of one (1) was given for each year of successful schooling. If a respondent passed the S.S.C examination, his education score was given as 10, if passed the final examination of class seven (VII), his education score was given as 7. If a respondent did not know how to read and write his education score was given as '0' (zero).

3.6.1.3 Farm size

Farm size refers to the total cultivated area either owned by a farmer or obtained from others on share cropping system or taken from others as mortgage/borga where he/she used to do his/her farming operations during the period of this study. The farm size of the respondent was computed by using the following formula:

$$F_s = A_1 + A_2 + 1/2 (A_3 + A_4) + A_5$$

Where

F_s = Farm size

A_1 = Homestead area out pond and garden

A_2 = Own land under own cultivation

A_3 = Own land given to/taken from others on borga

A_4 = Own land given to/taken from others on lease

A_5 = Other (Fruit garden, pond etc.)

3.6.1.4 Annual income from potato cultivation

This variable is measured by the total income by a respondent and other members of his or her family from agricultural sources. Family income was measured in “thousand” taka per year. A score of one (1) was given for each one thousand taka.

3.6.1.5 Family size

Family size of a farmer was determined on the basis of the total number of members in his/her family. The family members included himself/herself, spouse, sons, daughter and other dependents. The scoring was made by the actual number of family members expressed by the respondents. For example, if a respondent had five members in his/her family, his/her score was given as 5.

3.7.1.6 Experience in vegetable cultivation

Potato farming experience of the respondent was measured by the number of years a respondent engaged in vegetable cultivation. The measurement included from the year of starting of first vegetables cultivation till the year of data collection. A score of one (1) was assigned for each year of experience.

3.6.1.7 Knowledge on Potato Cultivation

Potato cultivation knowledge score of a respondent was computed on the basis of his/her responses against 25 questions. Knowledge in potato cultivation of a respondent was measured by asking questions related to various aspects of potato cultivation starting from land preparation to marketing stage of potato. It was measured in scores. According to nature of answering, the respondent got 3, 2, 1 or 0 (zero). For correct responses to all the 25 questions, a respondent could get a total score of 60 while for wrong responses to all the 14 questions he/she could get 0 (zero). Thus, the knowledge score of the respondents could range from 0 to 60. Zero (0) indicating no knowledge and 60 indicating very high knowledge.

3.6.1.8 Innovativeness

According to Rogers (1995) it is the degree of adoption of a new technology to which an individual or other unit of adoption is relatively earlier than the other member of the social system. Innovativeness of a respondent was measured by computing an innovativeness score on the basis of his/her extent of use of 12 selected modern agricultural practices. Scores were assigned on the basis of time dimension in the following manner.

Extent of adoption	Assigned Score
Never used	0
Within 4 and above years	1
Within 3 years	2
Within 2 years	3
Within 1 year	4

Innovativeness score of a respondent was obtained by adding his/her score for all the items. Therefore, the possible innovativeness score of the respondents could range from 0 to 48, 0 indicating no innovativeness and 48 indicating very high innovativeness.

3.5.1.9 Extension media contact

The extension media contact score was computed for each respondent on the basis of his/her extent of contact with 16 selected extension media. Following scores were assigned for each of 16 media:

Extent of Contact	Assigned Score
Not at all	0
Rarely	1
Frequently	2
Regularly	3

Thus, the communication media exposure scores of a respondent could range from 0 to 48 where '0' indicated no contact and '48' indicated very high extension media contact.

3.6.1.10 Training exposure

Training exposure was measured by the number of days, that a respondent had received training in his or her life before the interview. It was indicated by the total number of days of training received by a respondent under different training programs.

3.6.1.11 Organizational participation

Organizational participation of the respondent was measured on the basis of the nature of his/her participation and duration of his participation in different

organizations during the time of interview. Organizational participation score was computed in the following manner for participation in each organization.

Participation score was computed by the following manner:

Extent of Participation	Assigned Score
No participation	0
Low participation	1
Medium participation	2
High participation	3

Thus, the organizational participation scores of a respondent could range from 0 to 36, where '0' indicated no participation and 36 indicated very high organizational participation.

3.6.1.12 Problem faced by the potato farmers

Problem faced in potato production of respondent farmers will be measured on the basis of the nature of problem that they will face in post-harvest activities of potato. Fifteenth items of problems will be asked to the respondents with the following four alternative responses with the following assigned scores:

Extent of Problem	Assigned Score
No problem	0
Little problem	1
Medium problem	2
High problem	3

Score of problem faced in potato cultivation of a respondent will be computed by adding all the scores obtained by those responses from all the twelve problem items. Thus, the problem faced in potato cultivation of the potato growers can be range from 0 to 45 where '0' indicates no problem and '45' indicates highest problem in potato cultivation.

Measurement of Problem Faced index (PFI) in assessment of losses of potato:

The problem Faced Index (PFI) will be computed by using the following formula:

$$\mathbf{PFI = (P_h \times 3) + (P_m \times 2) + (P_l \times 1) + (P_n \times 0)}$$

Where,

PFI = Problem Faced Index

P₀ = Number of farmers who did not face problem at all, P₁ = Number of farmers who faced low problem, P_m = Number of farmers who faced medium problem, P_m = Number of farmers who faced high problem, P_h = Number of farmers who faced very high problem.

3.6.2 Measurement of dependent variable

Twelve different loss items at 5 phases from production phase to marketing phase of potato production were considered for measurement of potato losses at farmer's level in this study. Losses of potato were measured by asking perception on these fourteen different items of potato losses to each respondent individually. It was recorded based on the perception of the farmers and expressed in percentage by dividing the amount of total losses with total production. Percentage of losses of potato was calculated in terms of total production of potato. Finally, losses of potato were measured by adding the percentage of losses of all items. Losses of five different phases were determined separately for better understanding.

3.7 Statement of the Hypotheses

As defined by Goode and Hatt (1952) a hypothesis is "a proposition which can be put to test to determine its validity. It may seem contrary to, or in accord with common sense. It may prove to be correct or incorrect. In any event, however, it leads to an empirical test."

3.8.1 Research hypotheses

In the light of the objectives of the study and variables selected, the following research hypotheses were formulated to test them in. The research hypotheses were stated in positive form, the hypotheses were as follows:

“Each of the selected characteristics of the farmers had contribution to the loss assessment of potato as perceived by the farmers.”

3.8.2 Null hypotheses

In order to conduct statistical tests, the research hypotheses were converted to null form. Hence, the null hypotheses were as follows:

“Each of the selected characteristics of the farmers had no contribution to the loss assessment of potato as perceived by the farmers.”

3.9 Data Processing

3.9.1 Editing

The collected raw data were examined thoroughly to detect errors and omissions. As a matter of fact the researcher made a careful scrutiny of the completed interview schedule to make sure that necessary data were entered as complete as possible and well arranged to facilitate coding and tabulation. Very minor mistakes were detected by doing this, which were corrected promptly.

3.9.2 Coding and tabulation

Having consulted with the research supervisor and co-supervisor, the investigator prepared a detailed coding plan. In case of qualitative data, suitable scoring techniques were followed by putting proper weight age against each of the traits to transform the data into quantitative forms. These were then tabulated in accordance with the objective of the study.

3.9.3 Categorization of data

Following coding operation, the collected raw data as well as the respondents were classified into various categories to facilitate the description of the

independent and dependent variables. These categories were developed for each of the variables by considering the nature of distribution of the data and extensive literature review. The procedures for categorization have been discussed while describing the variables under consideration in chapter IV.

3.10 Statistical Analysis

The statistical measures such as range, mean, standard deviation, percentage, rank order were used for describing both the independent and dependent variables. Tables were also used in presenting data for clarity of understanding. Initially, Pearson Product Moment correlation was run to determine the relationship between the selected characteristics of the potato farmers with their losses in potato cultivation. To find out the contribution of selected characteristics of the potato farmers to their losses in potato cultivation, step-wise multiple regression was used. Five percent (0.05) level of probability was used as the basis for rejection of a null hypothesis throughout the study. Co-efficient values are significant at 0.05 level is indicated by one asterisk (*), and that at 0.01 level by two asterisks (**) and at 0.001 level or above by three asterisks (***)). For determining the severity of the problems, rank order was made based on the descending order of the Problem Faced Index (PFI).

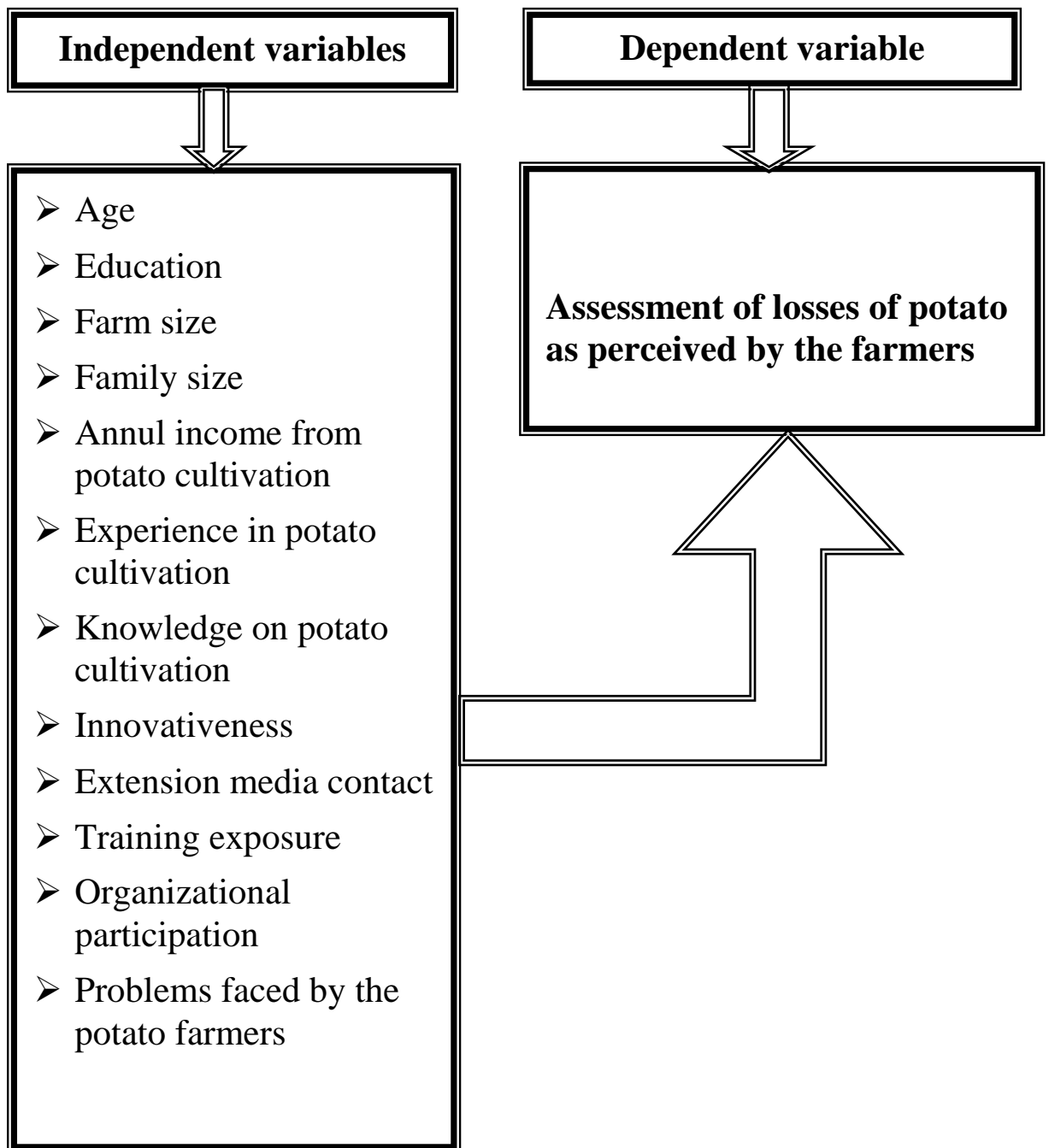


Figure 2.2: Conceptual Framework of the Study

CHAPTER IV

FINDINGS AND DISCUSSIONS

The findings of the study and their interpretation have been presented in this chapter. These are presented in three sections according to the objective of the study. The first section deals with the contributions of the selected characteristics of the respondent to assess the losses of potato faced by them, while the third section deals with the problems faced association with potato cultivation.

4.1 Socio-demographic profile of the respondents

Behavior of an individual is determined to a large extent by his personal characteristics. There were various characteristics of the rural people that might have consequence to the losses of potato as perceived by them. But in this study, only twelve characteristics of them were selected as independent variables, which included their i) Age ii) Level of education iii) Farm size iv) Annual income from potato cultivation v) Family size vi) Experience in potato cultivation vii) Knowledge on potato cultivation viii) Innovativeness ix) Extension media contact x) Training exposure xi) Organizational participation xii) Problems faced by the potato farmers. Measuring unit, range, mean, standard deviations of those characteristics were described in this section. The salient features of the different characteristics of the respondents have been presented in 'Appendix B'. These characteristics have been clearly and elaborately discussed under the following sub-headings:

4.1 Details features of the farmers' selected characteristics and their contributions on the losses of potato as perceived by the farmers:

4.1.1 Age

Age of the respondent farmers was found to range from 13 to 68 years. The average age was 42.28 years with the standard deviation 11.238. Based on their age, the farmers were classified into three categories as shown in Table 4.1

Table 4.1: Distribution of the Potato farmers according to their age:

Categories	Farmers		Mean	Standard deviation
	Number	Percent		
Young (up to 35)	29	29.0	42.28	11.238
Middle aged (>35-50)	44	44.0		
Old (above 50)	25	25.0		
Total	100	100.00		

Data furnished in Table 4.2 indicate that the highest proportion 44.0 percent of the respondents fell in the middle age, while 29 and 25 percent belonged to young and old age categories respectively. However, data also revealed that 69 percent of the respondents in the study area were middle to young aged. Therefore, they encounter less loss due their long term experience in potato cultivation. On the other hand, it could be said that young aged farmers experience high level of loss as they have less or no experience.

4.1.2 Level of Education

The education score of the respondents ranged from 0 to 16 with the average of 4.63 and standard deviation 4.357. Based on their score, the farmers were classified into four categories as shown in Table 4.3. The data indicate that the majority (45.0 percent) of the farmers had primary level of education while 27 percent farmers had secondary level of education, 22 percent had no education and 6 percent higher level of education. Education develops mental and psychological ability of average person to understand, decide and adopt new practices and ideas. Hence, it is expected that education is one of the important

factors in conquering the challenge to reduce loss of potato at various stage of production to marketing level.

Table 4.2: Distribution of the Potato farmers according to their level of education:

Categories	Farmers		Mean	Standard deviation
	Number	Percent		
No education (0)	22	22.0	4.63	4.357
Primary (1-5)	45	45.0		
Secondary (6-10)	27	27.0		
Higher secondary (>10)	6	6.0		
Total	100	100		

Education helps the farmers to face the adverse condition and adjust with unfavorable condition through reading leaflets, booklets, books and other printed materials in this case. Education helps the farmers to broaden their outlook and expand mental horizon by helping them to develop deep understanding of what is going on in the potato field, storage, and at the time of marketing. Comparatively educated person is relatively more careful about the loss of potato and take necessary steps to prevent these losses.

4.1.3 Farm size

The farm size of the farmers in the study area varied from 0.13-1.23 hectares (ha.). The average farm size was 0.082 ha with the standard deviation 0.1067. Based on their farm size, the respondents were classified into three categories as shown in Table 4.3.

Table 4.3: Distribution of the Potato farmers according to their farm size:

Categories	Farmers		Mean	Standard deviation
	Number	Percent		
Marginal farm (.01- 0.2)	49	49.0	0.082	0.1067
Small farm (0.21-1.0)	36	36.0		
Medium farm (1.01-3.0)	15	15.0		
Total	100	100.00		

The Table shows that the highest proportion (49 percent) of the respondents belonged to marginal size, compared to having 36 percent small, and 15 percent medium farm respectively. The majority of the farmers had marginal farms. Thus most (85 percent) of the farmers were in the categories of marginal and small farm. The small and medium sized farm heads always try to increase their productivity through their indigenous farming resources. They communicate with other progressive farmers and extension agents about their farming problems. On the hand, landless or marginal farmers are dependent on different earning quests and they are not aware about their needs.

4.1.4 Annual income from potato cultivation

Annual income score of the respondents ranged from 0.3 to 30.2 (in thousand) with an average of 7.032 and standard deviation 6.1222. On the basis of the annual income, the respondents were classified into three categories as shown on Table 4.4.

Table 4.4: Distribution of the Potato farmers according to their annual income from potato cultivation :

Categories	Farmers		Mean	Standard deviation
	Number	Percent		
Low income (up to 60)	40	40.0	7.032	6.1222
Medium income (61-110)	28	28.0		
High income (>110)	32	32.0		
Total	100	100.00		

Data presented in Table 4.5 indicate that the highest proportion (40.0 percent) of the respondent to had low annual income, while 28.0 percent medium income and 32.0 percent had high income. As a result, the most (68 percent) of the respondents in the study area were low to medium income earners. It can be mentioned that the farmers of low to medium income category meets highest loss while high income category faces lowest loss.

4.1.5 Family size

The family size of the respondents ranged from 2 to 9 with an average of 4.94 and standard deviation 1.420. The data in Table 4.6 indicate that majority of the respondents fell into small (39.5 percent) family category, while 27 and 4 percent had medium and large family size respectively. However, 96 percent of the respondents had small to large family size.

Table 4.5:Distribution of the Potato farmers according to their family size:

Categories	Farmers		Mean	Standard deviation
	Number	Percent		
Small family (up to 5)	69	69.0	4.94	1.420
Medium family (6-7)	27	27.0		
Large family (above 7)	4	4.0		
Total	100	100.00		

4.1.6 Experience in Potato cultivation

The score of experience in potato cultivation by farmers ranged from 2 to 7 with a mean and standard deviation of 5.44 and 1.008, respectively. Based on the experience in potato cultivation, the respondent farmers were classified into four categories namely ‘low experience (2-3)’, ‘medium experience (3-4)’ and ‘high experience (above 4)’. The distribution of the respondents according to their experience in potato cultivation are presented in table 4.6

Table 4.6: Distribution of the respondents according to their experience in Potato cultivation:

Categories (year)	Respondents number	Percent	Mean	Standard deviation
Low experience (2-3)	11	11.0	5.44	1.008
Medium experience (3-4)	36	36.0		
High experience (above 4)	53	53.0		
Total	100	100		

Table 4.6 indicates that the farmers belonged to high experience in vegetable cultivation category constituted the highest proportion (53 %) followed by medium experience (36 %), and low experience (11 %). The results indicate that the famers experience in potato cultivation was medium to high experience.

4.1.7 Knowledge on Potato cultivation

Scores of knowledge on assesment of losses of potato could range from 0 to 60 while the observed scores ranged from 14 to 49 with the average 27.72 and standard deviation of 10.126 as shown in Table 4.8. Data contained in the table indicate that the highest proportion (42.0 percent) of the farmers had low knowledge while 32 percent had high and 26 percent had medium knowledge. Findings show that majority of the farmers possessed low level of knowledge on

various phases of potato cultivation. Knowledge on potato cultivation at various stage would help farmer to minimize production loss at various level starting from production phase to marketing phase. So, it can be mentioned that this findings may be conducive for better understanding the role of knowledge in potato cultivation and other aspects of it.

Table 4.7: Distribution of the Potato farmers according to their Knowledge on potato cultivation:

Categories	Farmers		Mean	Standard deviation
	Number	Percent		
Low (14-23)	42	42.0	27.72	10.126
Medium (24-32)	26	26.0		
High (above 32)	32	32.0		
Total	100	100.00		

4.1.8 Innovativeness

The observed innovativeness scores of the respondents ranged from 8 to 28 against the possible range of 0 to 40. The average and standard deviation were 16.22 and 4.964 respectively. Based on the innovativeness scores were classified into three categories as shown in Table 4.8.

Table 4.8: Distribution of the Potato farmers according to their Innovativeness:

Categories	Farmers		Mean	Standard deviation
	Number	Percent		
Low (upto 14)	33	33.0	16.22	4.964
Medium (15-18)	35	35.0		
High (above 18)	32	32.0		
Total	100	100.00		

Data presented in table indicate that overwhelming majority (35 percent) of the respondents had medium innovativeness as compared to 32 percent low and 33 percent high innovativeness. Data also revealed that majority (68 percent) of the

respondents were under medium to low innovativeness. The innovativeness also refers to proneness of an individual to accept new ideas and practices.

4.1.9 Extension Media Contact

The score of extension media contact by farmers ranged from 12 to 32 against the possible range of 0-51 with a mean and standard deviation of 23.67 and 5.997, respectively. Based on the extension media contact, the respondents were classified into four categories namely ‘low contact (12-21)’, ‘medium contact (22-326)’ and ‘high contact (above 26)’. The distribution of the respondents in accordance with their media contact are presented in Table 4.9.

Table 4.9: Distribution of the respondents according to their extension media contact

Categories (score)	Respondents Number	Percent	Mean	Standard deviation
Low contact (12-21)	34	34.0	23.67	5.997
Medium contact (22-26)	29	29.0		
High contact (above 26)	37	37.0		
Total	100	100		

Table 4.9 indicates that the farmers belonged to high contact category constituted the highest proportion (37 %), medium contact (29 %) and low contact (34 %). The results indicate that majority of the farmers had medium to high (71%) extension media contact. That is why, it can be guesses that maximum farmers experienced medium to low losses in producing potato.

4.1.10 Training exposure

Training exposure score of the respondent farmers ranged from 0 to 7 against possible range with a mean and standard deviation of 0.61 and 1.569, respectively. According to training experience score of the respondents, they were classified into three categories viz. ‘no training (0)’,

‘low training (1-2)’, and ‘medium training (>2 days)’. On the basis of their observed scores and the distribution has been presented in Table 4.10.

Table 4.10: Distribution of the respondents according to their training exposure:

Categories (No of days)	Respondents number	Percent	Mean	Standard deviation
No training (0)	73	73.0	0.61	1.569
Low training (1-2 days)	22	22.0		
Medium training (>2 days)	5	5.0		
Total	100	100		

Table 4.11. indicates that the no training experience constitutes the highest proportion (73 %), low level training exposure (22 %) and medium training (5 %). Results revealed that the maximum percentage of respondents was in the category of no to low level training experience (95 %).

4.1.11 Organizational participation

The observed organizational participation score of the respondents ranged from 1 to 14. The mean score was 6.69 with the standard deviation 3.786. Based on the organizational participation scores, the respondents were classified into three categories as shown in Table 4.12. Data contained in table revealed that the highest 45 percent of the respondents had low organizational participation as compared to 32 percent medium participation and 23 percent having high participation. The study reveals that most (77 percent) of the respondents in the study area were in low to medium organizational participation categories.

Table 4.11: Distribution of the Potato farmers according to their Organizational participation :

Categories	Farmers		Mean	Standard deviation
	Number	Percent		
Low participation (1-5)	45	45.0	6.69	3.786
Medium participation (6-8)	32	32.0		
High participation (above 8)	23	23.0		
Total	100	100.00		

4.1.12 Problem faced by the potato farmers

The problem faced by the potato farmers ranged from 10 to 36 against the possible range with a mean and standard deviation of 19.99 and 7.385, respectively. Based on score of problem faced by the potato farmers, the respondents were classified into three categories as shown in Table 4.13.

Table 4.12: Distribution of the respondents according to their problem faced by the potato farmers:

Categories (score)	Respondents number	Percent	Mean	Standard deviation
Low problem (10-16)	34	34.0	19.99	7.385
Medium problem (17-23)	28	28.0		
High problem (above above 23)	38	38.0		
Total	100	100		

Data contained in Table 4.13 revealed that among the respondents, the highest proportion (38 %) of the farmers belongs to the group of high problem and followed by 28 % in medium problem and 34 % in low problem. Therefore, it was found that an overwhelming majority of the respondent farmers had medium to high problem.

4.2 Dependent Variable

As noted earlier (Chapter 3), assessment of losses of potato as perceived by the farmers was considered as the dependent variable of the study. The assessment of losses of potato scores of the farmers ranged from 8 to 29 against the possible range of 0 to 100. The average and standard deviation were 18.79 and 6.328 respectively. Based on the observed scores, the farmers were classified into three categories as shown as Table 4.13.

Table 4.13: Distribution of the respondents's loss as perceived by the farmers

:

Categories	Farmers		Mean	Standard deviation
	Number	Percent		
Low loss (8-16)	41	41.0	18.79	6.328
Medium loss (17-21)	19	19.0		
High loss (above 22)	40	40.0		
Total	100	100.00		

Data contained in the table 4.13 indicates that highest proportion (41 percent) of the farmers had low losses, where 40 percent and 19 percent had high and medium losses of potato as perceived by the farmers. This findings revealed that the around 40 percent respondents of the experimental area under Domar upazilla under Nilphamri District were experienced, knowledgable, trained and bear higher level of education and organizational participation. On the contrary, near about 40 percent respondents had very poor knowledge and experience in potato cultivation and they did not show much interest in training and organizational participation as they were lagard and late adopter in the case of innovativeness. And the rest respondents which are bearing almost 20 percent of the respondents show medium level of experience, knowledge, organizaional participation, training and innovativeness.

4.3. Contribution of the selected characteristics of the respondents on assessment of losses of potato

For this study twelve characteristics of the respondent were selected and each of the characteristics was treated as independent variable. The selected characteristics were age (X_1), level of education (X_2), farm size (X_3), annual income from potato cultivation (X_4), family size (X_5), experience in potato cultivation (X_6), Knowledge on potato cultivation (X_7), Innovativeness (X_8), extension media contact (X_9), training exposure (X_{10}), organizational participation (X_{11}) and problems faced by the potato farmers (X_{12}). Assessment of losses of potato as perceived by the farmers (Y) was the only dependent variable of this study.

Full model regression analysis was initially run with the 12 independent variables. But it was observed that the full model regression results were misleading due to the existence of interrelationships among the independent variables. Therefore, in order to avoid the misleading results and to determine the best explanatory variables, the method of stepwise multiple regressions was administrated and 102 independent variables were fitted together in step-wise multiple regression analysis. Table 4.13 shows the summarized results of step-wise multiple regression analysis with 12 independent variables on assessment of losses of potato as perceived by the farmers. It was observed that out of 12 variables only 3 independent variables namely extension media contact (X_9), level of education (X_2) and problem faced by the potato farmers (X_{12}) were entered into the regression equation. The other seven variables were not entered into regression equation. The regression equation so obtained is presented below:

$$Y = 34.244 - 0.417X_9 - 0.281X_2 - 0.184 X_{12}$$

Table 4.14: Summary of step wise multiple regression analysis showing the contribution of selected characteristics of the respondents on assessment of losses of potato as perceived by them:

Variables entered	Standardized Partial 'b' Coefficients	Value of 't' (with probability level)	Adjusted R ²	Increase in R ²	Variation explained in percent
Extension media contact (X ₉)	– .417	– 4.735 (.000)	0.311	0.311	31.1
Level of education (X ₂)	– .281	– 3.422 (.001)	0.369	0.058	5.8
Problems faced by the potato farmers (X ₁₂)	– .158	– 2.183 (.032)	0.393	0.024	2.4
Total				0.393	39.3

R-square = 0.411
Adjusted R-square = 0.393
F-ratio = 22.360
Standard error of estimate = 4.931
Constant = 34.244

The R² values were found 0.411 and the corresponding F-ratio was 22.360 which were significant at 0.000 levels. For determining unique contribution of each of the three variables the increase in R² value was determined on assessment of losses of potato as perceived by the farmers. These three variables combined explained 39.3 percent of the total variation on assessment of losses of potato as perceived by the farmers. Extension media contact alone contribute 31.1 percent of the variation followed by level of education (5.8 percent) and problems faced by the potato farmers (2.4 percent), on assessment of losses of potato as perceived by the farmers.

4.3.1. Contribution of extension media contact on assessment of losses of potato as perceived by the farmers

The contribution of extension media contact on assessment of losses of potato as perceived by the farmers was measured by testing the following null hypothesis; “There is no level of contribution of extension media contact on assessment of losses of potato as perceived by the farmers”.

The adjusted R^2 value of extension media contact from stepwise multiple regressions was presented in Table 4.13. The adjusted R^2 value of the concerned variable was found 0.311. The following observations were made on the basis of the value of the concerned variable of the study under consideration.

- a. The contribution of the extension media contact was **31.1 percent**.*
- b. It was the first highest contribution on adoption of modern technologies of rice cultivation.*
- c. The null hypothesis could be rejected.*

Based on the above finding, it was concluded that a respondent had more extension contact increased the capabilities of adoption on assessment of losses of potato as perceived by the farmers. Extension media contact enhances the abilities of the respondents at a short time than others which transformed them to minimise the losses of potato as perceived by the farmers.

4.3.2. Contribution of level of education on assessment of losses of potato as perceived by the farmers

The contribution of level of education on assessment of losses of potato as perceived by the farmer was measured by testing the following null hypothesis; “There is no level of contribution of level of education on assessment of losses of potato as perceived by the farmers”.

The adjusted R^2 value of the level of education from stepwise multiple regressions was presented in Table 4.13. The adjusted R^2 value of the concerned variable was found 0.369. The following observations were made on the basis of the value of the concerned variable of the study under consideration.

- a. *The contribution of the education was **36.9 percent**.*
- b. *It was the second highest contribution on assessment of losses of potato as perceived by the farmers.*
- c. *The null hypothesis could be rejected.*

Based on the above finding, it was concluded that a respondent had more level of education increased the capabilities of minimization of the losses of potato. Education enhances the abilities of the respondents at a short time than others which transformed them to minimize the losses of potato.

4.3.2. Contribution of problem faced by the potato farmers on assessment of losses of potato as perceived by the farmers

The contribution of problems faced by the potato farmers on assessment of losses of potato as perceived by the farmer was measured by testing the following null hypothesis; “There is no level of contribution of problems faced by the potato farmers on assessment of losses of potato as perceived by the farmer”.

The adjusted R^2 value of the problems faced by the potato farmers from stepwise multiple regressions was presented in Table 4.13. The adjusted R^2 value of the concerned variable was found 0.393. The following observations were made on the basis of the value of the concerned variable of the study under consideration.

- a. *The contribution of the problems faced by the potato farmers was **39.3 percent**.*

- b. It was the third highest contribution on assessment of losses of potato as perceived by the farmer.*
- c. The null hypothesis could be rejected.*

Based on the above finding, it was concluded that a respondent had more problems increased the capabilities of losses on assessment of losses of potato as perceived by the farmer. Problems decrease the abilities of the respondents to minimize the possible losses. On the other hand less problems faced by the potato farmers leading them to highest level of potato production.

4.4 Problem Faced Index in Potato Cultivation

The observed problem faced index in potato cultivation ranged from 108 to 254 against the possible range of 0 to 545. The formula for determining PFI has been shown in chapter 3. The selected 15 problems faced by the respondent which were arranged in rank order according to their descending order of problem faced index (PFI) as shown in table 4.15.

Table 4.15: Rank order of 15 selected problems faced by the farmer in potato cultivation

Problems	Extent of Problem faced				PFI	Rank Order
	High Problem (3)	Medium Problem (2)	Little Problem (1)	No Problem (0)		
Lower market price	62	32	4	2	254	1
Disease problem	56	28	16	0	240	2
Insect attack	48	32	18	2	226	3
Insufficient cold storage facilities	44	13	35	8	193	4
Problem faced due to political hazard	42	22	18	18	188	5
High labor cost at harvesting period	35	23	32	10	183	6
Cracking or damaging while marketing	30	28	32	10	178	7
High input cost	36	18	30	16	174	8
Crisis of input during cultivation	28	36	16	20	172	9
Unavailability of quality pesticide and fungicide	32	26	22	20	170	10
Quick rot after harvest	22	35	33	10	167	11
Lack of quality seed of potato	22	28	42	8	164	12
Lack of irrigation facilities during cultivation	24	31	29	16	163	13
Lack of uninterrupted supply of electricity for cold storage	16	22	42	20	134	14
Lack of sorting shade for curing, sorting and grading of potato	14	20	26	40	108	15

PFI = Problem Faced Index

On the basis of PFI, it was observed that ‘lower market price of potato’ ranked first followed by ‘disease problems’, ‘insect attack’, ‘insufficient cold storage’, ‘problem faced due to political hazards’, ‘high labor cost at harvesting period’, ‘cracking or damaging while marketing’, ‘high input cost’, ‘crisis of input during cultivation’, ‘unavailability of quality pesticide and fungicide’, quick rot after harvest’, lack of quality seed of potato’, ‘lack of irrigation facilities during cultivation’, ‘lack of uninterrupted supply of electricity for cold storage’, and ‘lack of sorting shade for curing, sorting and grading of potato’.

CHAPTER V

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of the Findings

The study was undertaken to determine and describe the selected characteristics of the farmers, to assess the losses of potato, to explore the relationship between selected characteristics of the farmers with losses of potato as perceived by the farmers. The study was carried out in two unions of Domar upazila of Nilphamari District. 100 farmers were selected as sample from an updated list of 150 farmers involved in potato cultivation. Data were collected by a pre-tested interview schedule during 25th November, 2015 to 25th December, 2015. A summary of the major findings is given in the subsequent sections.

5.1.1 Selected characteristics of the farmers

Age

The age of the farmers ranged from 13 to 68, the mean being 42.28 and the standard deviation is 11.238. Around half (44 percent) of the respondents were middle aged compared to 29 percent of the respondents belonged to the young aged categories and 25 percent were in the old aged category.

Level of education

The education score of the respondents ranged from 0 to 16 with the average of 4.63 and standard deviation 4.357. Highest proportion (45 percent) of the farmers had primary education, 22 percent were illiterate, 27 percent had secondary education and only 6 percent of the farmers had above secondary education level.

Farm Size

The farm size of the farmers in the study area varied from 0.012-0.93 hectares (ha.). The average farm size was 0.082 ha with the standard deviation 0.1067. the highest proportion (49 percent) of the respondents belonged to marginal size, compared to having 36 percent small, and 15 percent medium farm respectively. The majority of the farmers had marginal farms. Thus most (85 percent) of the farmers were in the categories of marginal and small farm.

Annual Income

Annual income score of the respondents ranged from 0.3 to 30.2 (in thousand) with an average of 7.032 and standard deviation 6.1222. The highest proportion (40.0 percent) of the respondent to had low annual income, while 28.0 percent medium income and 32.0 percent had high income. As a result, the most (68 percent) of the respondents in the study area were low to medium income earners.

Family Size

The family size of the respondents ranged from 2 to 9 with an average of 4.94 and standard deviation 1.420. The majority of the respondents fell into small (39.5 percent) family category, while 27 and 4 percent had medium and large family size respectively.

Experience in potato cultivation

The experience in potato cultivation by farmers ranged from 2 to 7 with a mean and standard deviation of 5.44 and 1.008, respectively. the farmers belonged to high experience in vegetable cultivation category constituted the highest proportion (53 %) followed by medium experience (36 %), and low experience (11 %).

Knowledge on Potato Cultivation

The knowledge on loss assessment of potato could range from 0 to 60 while the observed scores ranged from 14 to 49 with the average 27.72 and standard deviation of 10.126. The highest proportion (42.0 percent) of the farmers had low knowledge while 32 percent had high and 26 percent had medium knowledge.

Findings show that majority of the farmers possessed low level of knowledge on various phases of potato cultivation.

Innovativeness

The innovativeness scores of the respondents ranged from 8 to 28 against the possible range of 0 to 40. The average and standard deviation were 16.22 and 4.964 respectively. The overwhelming majority (35 percent) of the respondents had medium innovativeness as compared to 32 percent low and 33 percent high innovativeness. Data also revealed that majority (68 percent) of the respondents were under medium to low innovativeness.

Extension media contact

The score of extension media contact by farmers ranged from 12 to 32 against the possible range of 0-51 with a mean and standard deviation of 23.67 and 5.997, respectively. The farmers belonged to high contact category constituted the highest proportion (37 %), medium contact (29 %) and low contact (34 %). The results indicate that the farmers' extension media contact with minimum frequency although they have medium contact.

Training exposure

Training exposure score of the respondent farmers ranged from 0 to 7 against possible range with a mean and standard deviation of 0.61 and 1.569, respectively. No training experience constitutes the highest proportion (73 %), low level training exposure (22 %) and medium training (5 %). Results revealed that the maximum percentage of respondents was in the category of no to low level training experience (95 %).

Organizational participation

The observed organizational participation score of the respondents ranged from 1 to 14. The mean score was 6.69 with the standard deviation 3.786. the highest 45 percent of the respondents had low organizational participation as compared to 32 percent medium participation and 23 percent having high participation. The study

reveals that most (77 percent) of the respondents in the study area were in low to medium organizational participation categories

Problem faced by the potato farmers

The problem faced by the potato farmers ranged from 10 to 36 against the possible range with a mean and standard deviation of 19.99 and 7.385, respectively. The highest proportion (38 %) of the farmers belongs to the group of high problem and followed by 28 % in medium problem and 34 % in low problem. Therefore, it was found that an overwhelming majority of the respondent farmers had medium to high problem.

5.1.2 Loss Assessment of potato as perceived by the farmers

The assesment of losses of potato scores of the farmers ranged from 8 to 29 against the possible range of 0 to 100. The average and standard deviation were 18.79 and 6.328 respectively. The highest proportion (41 percent) of the farmers had low losses, where 40 percent and 19 percent had high and medium losses of potato as perceived by the farmers.

5.1.3 Contribution of the Selected Characteristics of the farmers to assess the losses of potato as perceived by them

The R^2 values were found 0.411 and the corresponding F-ratio was 22.360 which were significant at 0.000 levels. For determining unique contribution of each of the three variables the increase in R^2 value was determined on assessment of losses of potato as perceived by the farmers. These three variables combined explained 39.3 percent of the total variation on assessment of losses of potato as perceived by the farmers. Extension media contact alone contribute 31.1 percent of the variation followed by level of education (5.8 percent) and problems faced by the potato farmers (2.4 percent), on assessment of losses of potato as perceived by the farmers.

5.2 Conclusion

Based on the findings and their logical interpretations in the light of relevant facts the researcher has drawn the following conclusions:

1. The findings revealed that highest proportion (41 percent) of the farmers had low losses, where 40 percent and 19 percent had high and medium losses of potato as perceived by the farmers respectively. These facts lead to conclude that maximum potato growers had to face losses in producing potato.
2. The findings also revealed that level of education, extension media contact and problems faced by the potato farmers showed significant relationship with assessment of losses of potato. Therefore, it may be concluded that more the level of education, extension media contact less the potato losses.
3. The findings exposed that that the majority (45.0 percent) of the farmers had primary level of education while 27 percent farmers had secondary level of education, 22 percent had no education and 6 percent higher level of education. Education develops mental and psychological ability of average person to understand, decide and adopt new practices and ideas. Hence, it is expected that education is one of the important factors in conquering the challenge to reduce loss of potato at various stage of production to marketing level.
4. It is found from the findings that the farmers belonged to high contact category constituted the highest proportion (37%), medium contact (29 %) and low contact (34 %). The results indicate that majority of the farmers had medium to high (71%) extension media contact. That is why, it can be guesses that maximum farmers experienced medium to low losses in producing potato.
5. The findings also revealed that the highest proportion (38 %) of the farmers belongs to the group of high problem and followed by 28 % in medium problem and 34 % in low problem. Therefore, it was found that the majority of the respondent farmers had medium to high problems.

5.3 Recommendations

5.3.1 Recommendations for policy applicators

The following recommendations were made on the basis of the findings and their logical interpretations:

1. The identified significant independent variables such as age, annual income from potato cultivation, family size, knowledge on potato cultivation and training exposure appears to be taken under consideration to minimize losses of potato. Lots of effort should be needed to encounter these variables with proper action plan.
2. In view of the absence of any contribution of level of education, it is recommended that the extension worker should work with the farmers to inspire for acquiring formal education. DAE should organize various training programs for educating them to build up skill in potato cultivation.
3. DAE should appoint more manpower and technical expertise at farming level to give technical and proper support to the farmers on this research area. Therefore, more number of farmers will be trained and disseminate their earned skill to other farmers.
4. Recommended that special attention should be given by the extension providers to the illiterate farmers and primary educated farmers, so that they become aware about the production technology of potato and possible losses period of it.
5. Recommended that agricultural extension agencies especially the DAE and relevant NGOs should critically review their training programs and make sound provisions so that the farmers understand the production technology of potato and it's storage and marketing strategy.
6. The five characteristics namely age, annual income from potato cultivation, family size, knowledge on potato cultivation and training exposure had negative significant contribution to the assessment of losses of potato as perceived by the farmers. Therefore, it is recommended that these characteristics need to be emphasized in planning and executing of

potato production.

5.3.2 Suggestion for further study

The present study highlights some aspects of particular dimensions (assessment of the losses of potato) of agricultural development, So it is suggested that concerned agencies should undertake further studies in order to have a deeper insight into the possible aspects of the losses of potato. The aspects for future study are presented below:

1. The present investigation explored the contributions of the twelve characteristics of the potato farmers to the assessment of losses of potato as perceived by the farmers. Further research may be conducted by taking other characteristics to observe contributions to the losses of potato as perceived by the farmers.
2. The present study was conducted in two unions of Domar upazila under Nilphamari district. So, similar studies may be undertaken in other parts of the country to verify the findings of the present study.
3. The present study was concerned only with the losses of potato as perceived by the farmers. It is therefore suggested that future studies should include innovations, adoption, practice, knowledge and attitude and so on regarding potato cultivation.
4. Age, annual income from potato cultivation, family size, knowledge on potato cultivation and training exposure showed significant negative contributions to the assessment of losses of potato as perceived by the farmers. Hence, further investigation is necessary to find out such contributions between the concern variables to authentic the present study.

Chapter VI

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Appendix-A
(English Version of the Interview Schedule)
Department of Agricultural Extension and Information Systems
Sher-e-Bangla Agricultural University, Dhaka - 1207
Interview schedule for collection of data in connection with the study
“ASSESSMENT OF POTATO LOSSES AS PERCEIVED
BY THE FARMERS”

Part - A

Serial No.:

Respondent Name:.....

Village: Upazilla.....

District: Mobile No.....

[Please provide the following information. Your information will be kept confidential and will be used for research purpose only.]

Part - B

1. Age

Please mention your age.....years.

2. Level of Education

Please mention your level of education.

1. I cannot read or write.
2. I can sign only.
3. I have studied up to class
(.....).

3. Farm Size

Please mention your farm size

SI No.	Type of land use	Area of land	
		Local unit	Hectare
1	Homestead		
2	Own land under own cultivation		
3	Land given to others on barga		
4	Land taken from others on bogra		
5	Land taken from others on lease		
6	Pond		
7	Orchard		
	Total		

4. Annual Income from Potato Cultivation

Please mention your annual income from potato cultivation
.....Tk.

5. Family Size

Please mention the number of your family member in the following groups:

- a) Male member person
- b) Female memberperson.
- c) Total memberperson.

6. Experience in Potato Cultivation

For how many years do you cultivate potato?
.....years.

7. Knowledge on Potato Cultivation

Please answer the following questions regarding potato.

SI. No.	Questions	Assigned Score	Obtained Score
1	Name three popular varieties of potato in your locality?	3	
2	How many types of seed are available in the market?	2	
3	How to recognize/identify quality seed potato?	2	
4	How to cut seed potato to sow in the field?	3	
5	Mention the seed rate of potato per acre according to grading of seeds?	2	
6	Mention the plant spacing for potato cultivation?	2	
7	What do you mean by field curing? How it is performed?	3	
8	Mention Urea, TSP and MOP doses per decimal in potato cultivation?	3	
9	Mention Boron and Zinc fertilizer doses in potato cultivation?	2	
10	Mention fertilizer dose of gypsum?	1	
11	Mention fertilizers application method in potato cultivation?	2	
12	Which stages of potato plant are critical for irrigation in potato cultivation?	2	
13	What is Earthing-up technique?	2	
14	What is solanization of potato? How can you protect solanization?	3	
15	What are the benefits of earthing-up in the potato field?	2	
16	Mention three harmful insects of potato plants?	3	
17	Mention the name of pesticide and it's application dose for controlling cut worm?	3	
18	Mention two viral diseases of potato with symptoms?	2	
19	How do you control Aphid infestation in the potato field?	3	
20	Which weather condition is vulnerable for the infestation of late blight of potato?	3	
21.	Mention the name of fungicide and in't application dose for controlling late blight of potato?	3	
22.	How many days it takes for the maturity of potato?	2	

23.	Why haulm pulling is necessary before harvesting potato?	2	
24.	What are the grades of potato?	2	
25.	How do you store potato in ambient condition?	3	
Total		60	

8. Innovativeness

If you use the following technologies, please mention the duration of its use from first hearing.

Sl. No.	Name of the practice	Do not use	Used within one year	Used within two years	Used within three years	Used after four years
1	Cultivation of Diamond/Cardinal/Granular varieties of potato					
2	Use of Bio-fertilizer					
3	Adoption of Earthing up technique					
4	Use of Power tiller					
5	Adoption of Haulm pulling technique					
6	Use of Gypsum					
7	Use of Green manure					
8	Use of Vermicompost					
9	Use of Grader to grade potatoes into various categories					
10	Adoption of Mulching technique					
Total						

9. Extension Media Contact

How frequently on your contact with the following agricultural information media?

Name of the media	Frequently	Often	Occasionally	Rarely	Not at all
Contact with SAAO					
Contact with AEO/AO					
Conducted Result Demonstration					
Participation in agricultural training					
Attended method demonstration meeting					
Contact with NGO officer					
Listening to Krishi radio program					
Watching Mati O manush/Channel I/RTV Krishi barta					
Read Krishi Kotha, Krishi Magazine, leaflet, booklet, bulletin etc.					
Attend Agril. Group Meeting					
Total					

10. Training Exposure

Do you attend any training? Yes / No .

If yes, then please mention the training courses you have attended so far.

Subject	Place	Duration (day)	Organization

11. Organizational Participations

Please mention the nature of your association with the following organizations:

Name of Organizations	Not Involved	Ordinary member with duration	Executive member with duration	President and secretary with duration
Union Council				
Co-operative Society				
BRAC				
School Committee				
Madrasha Committee				
Bazar Committee				
Upazila Agricultural Office				
Grameen Bank				
Mosque/Temple/Church/Pagoda Committee				
RDRS				
Cultural Organizations				
Village Society				
Total				

12. Problem Faced by the Potato Farmers

Please mention the extent of problems related to potato cultivation and marketing.

Sl. No.	Problems	Nature of Problem Faced			
		High Problem	Medium Problem	Little Problem	No Problem
1	Crisis of inputs during cultivation				
2	Lack of quality seed of potato				
3	High cost of inputs				
4	Insect attack				
5	Disease attack				
6	Lack of irrigation facilities during potato cultivation				
7	Unavailability of quality pesticide and fungicide				
8	High labor cost at the harvesting period				
9	Quick rot after harvesting				
10	Lack of sorting shade for curing, sorting and grading of potato				
11	Cracking or damaging while marketing				
12	Insufficient cold storage facilities				
13	Lack of uninterrupted supply of electricity for cold storage				
14	Lower market price				
15	Problem faced due to political hazards.				
Total					

13. Lossess of Potato as Perceived by the Farmers

Please mention your perception on losses potato in percentage.

SL. No.	Phases	Items	Percent loss of Potato in terms of total production	
			First year	Second year
1	Production Phase	Losses due to wrong irrigation, poor fertilizer management and poor intercultural operation.		
		Losses Due to insect/pest attack.		
		Losses due to Diseases infestation.		
2	Harvesting Phase	Losses due to immature or over mature stage.		
		Losses due to unwanted cracking or damaging at the time of harvesting operation.		
		Losses due to harvest without haulm pulling.		
3	Post-harvest Phase: While stored in ambient condition	Losses due to ratage, shrinkage and weight loss.		
		Losses due to mechanical injury.		
4	Post-harvest Phase: While stored in cold storage	Losses due to insect or pest attacks.		
		Losses due to physiological disorder in the cold storage.		
5	Marketing phase	Losses at the time of transportation(cracking/damage).		
		Losses due to backterial wilt.		
Total				

Thank you very much for your kind co-operation .

Signature of Interviewer

.....

Date:

.....

APPENDIX – B

FINDINGS

Table 4.1: Salient features of the farmers' selected characteristics and their contribution to the potato losses as perceived by them

Sl. No	Selected characteristics	Scoring system	Range		Categories	Farmers (n = 100)		Mean	Standard deviation (SD)
			Possible	Observed		No.	%		
1.	Age	Actual years	-	13-68	Young (up to 35) Middle (>35-50) Old (>50)	29 44 25	29.0 44.0 25.0	42.28	11.238
2.	Level of education	Years of schooling	-	0-16	No education (0) Primary (1-5) Secondary (6-10) Higher secondary (>10)	22 45 27 06	22.0 45.0 27.0 6.0	4.63	4.357
3.	Farm size	Hectares	-	0.13-1.23	Marginal (0.03-0.2) Small (0.21-1.0) Medium (1.01-3.0)	49 36 15	49.0 36.0 15.0	0.082	0.1067
4.	Annual income from potato cultivation	In ThousandTk.	-	0.3-30.2	Low (up to 60) Medium (61-110) High (>110)	40 28 32	40.0 28.0 32.0	0.41	0.23
5.	Family size	No. of members	-	2-9	Small (up to 5) Medium (6-7) Large (>7)	69 27 4	69.0 27.0 4.0	4.94	1.420
6.	Experience in potato cultivation	Scale score	-	2-7	Low experience (2-3) Medium experience (3-4) High experience (above 4)	11 36 53	11.0 36.0 53.0	5.44	1.008

Sl. No	Selected characteristics	Scoring system	Range		Categories	Farmers (n = 100)		Mean	Standard deviation (SD)
			Possible	Observed		No.	%		
7.	Knowledge on potato cultivation	Scale score	0-60	14-49	Low (3-6) Medium (7-10) High (>10)	42 26 32	42.0 26.0 32.0	27.72	10.126
8.	Innovativeness	Scale score	0-40	8-28	Low (upto 14) Medium (15-18) High (above 18)	33 35 32	33.0 35.0 32.0	16.22	4.964
9.	Extension media contact	Scale score	0-51	12-32	Low contact (12-21) Medium contact (22-26) High contact (above 26)	34 29 37	34.0 29.0 37.0	23.67	5.997
10.	Training exposure	Scale score	-	0-7	No training (0 days) Low training (1-2 days) Medium training (>2 days)	73 22 5	73.0 22.0 5.0	0.61	1.569
11.	Organizational participation	Scale score	-	1-14	Low participation (1-5) Medium participation (6-8) High participation (above 8)	45 32 23	45.0 32.0 23.0	6.69	3.786
12.	Problem faced by the potato farmers	Scale score	0-45	10-36	Low problem (10-16) Medium problem (17-23) High problem (above 23)	34 28 38	34.0 28.0 38.0	19.99	7.385
13.	Losses of potato as perceived by the farmers	Scale score	0-100	8-29	Low loss (8-16) Medium loss(17-21) High loss (above 22)	41 19 40	41.0 19.0 40.0	18.79	6.328

Appendix-C

Correlation matrix

N= 100

Character	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	X ₉	X ₁₀	X ₁₁	X ₁₂	Y
X ₁	1												
X ₂	.290**	1											
X ₃	.170	.200*	1										
X ₄	.025	-.004	.458**	1									
X ₅	.140	-.072	-.113	-.088	1								
X ₆	.117	.514**	.181	-.016	-.049	1							
X ₇	.084	-.008	-.144	-.152	.211*	.101	1						
X ₈	-.023	-.107	-.177	-.092	.046	-.112	.029	1					
X ₉	.164	.290**	.015	-.050	.049	.498**	.141	-.072	1				
X ₁₀	-.094	.170	-.051	.044	-.015	.035	-.093	-.019	-.113	1			
X ₁₁	.144	.486**	.176	.071	.004	.378**	.002	-.216*	.394**	.272**	1		
X ₁₂	.190	.016	-.038	-.016	.012	.206*	.293**	.071	.358**	-.047	.154	1	
Y	-.164	-.405**	.007	-.002	-.040	-.488**	-.145	-.045	-.564**	-.071	-.440**	-.338**	1

X₁: Age

X₂:Level of education

X₃: Farm size

X₄: Annual income from potato cultivation

X₅: Family size

X₆: Experience in potato cultivation

Y: Assesment of losses of potato as perceived by the farmers

X₇:Knowledge on potato cultivation

X₈:Innovativeness

X₉: Extension media contact

X₁₀: Training exposure

X₁₁: Organizational participation

X₁₂:Problem faced by the potato farmers