FARMERS' KNOWLEDGE GAP ON USING AGROCHEMICALS IN POTATO CULTIVATION

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CERTIFICATE

This is to certify that the thesis entitled, **"FARMERS' KNOWLEDGE GAP ON USING AGROCHEMICALS IN POTATO CULTIVATION"**submitted to the Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka in partial fulfillment of the requirements for the degree of **Master of Science (MS) in Agricultural Extension**, embodies the result of a piece of bona-fide research work conducted by **MD ABDULLA AL MAMUN, Registration no. 12-04771** under my supervision and guidance. No part of this thesis has been submitted for any other degree or diploma.

I further certify that any help or source of information, received during the course of this study has been dully acknowledgement by him.

Dated: JUNE, 2018

Dhaka, Bangladesh

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Dedicated

To

My beloved

Parents

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One of the satisfied snapshots of composing this note of acknowledgement is to think back the whole voyage of my investigation and recollect every one of the general population, beginning from my supervisor, co-supervisor to course instructors, friends and family, or more all Almighty Allah.

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The Author

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Abbreviation and Acronyms

BBS	Bangladesh Bureau of Statistics
SAAO	Sub-Assistance Agriculture Officer
FAO	Food and Agriculture Organization
GDP	Gross Domestics Product
et al.	All others
MoP	Murate of Potash
SAU	Sher-e-Bangla Agricultural University
TSP	Tripple Super Phosphate
UAO	Upazila Agricultural Officer

“FARMERS’ KNOWLEDGE GAP ON USING AGROCHEMICALS IN POTATO CULTIVATION”

ABSTRACT

The main objectives of this study were to assess the extent of farmers’ knowledge gap on using agrochemicals in potato cultivation, to describe some selected characteristics of the farmers and to determine the influences of selected characteristics of the farmers to their knowledge gap on agrochemicals use. The study was conducted with randomly selected 113 farmers in Char Kewar union under Munshiganj sadar upazila of Munshiganj district. Knowledge gap on using agrochemicals in potato cultivation was the dependent variable and the dependent variable was measured by 14 different questions on knowledge on agrochemicals application in potato cultivation and the ten selected characteristics of the respondents contributed the independent variables of the study. Majority (43.4 percent) of the respondents had medium knowledge gap while 22.1 percent and 34.5 percent of them had low and high knowledge gap respectively on agrochemicals use in potato cultivation. Three characteristics of the respondents’ viz. education, experience in potato cultivation and extension media contact had significant positive contribution to their knowledge gap on using agrochemicals in potato cultivation. But age, farm size, potato cultivation area, annual family income, percentage of income from potato cultivation, time spent in potato farming and distance of farmer’s home to nearest market had no significant contribution to their knowledge gap on using agrochemicals in potato cultivation.

CHAPTER I
INTRODUCTION

1.1General Background

Agriculture is one of the most dominant economic activities in Bangladesh and regarded as the lifeline of the economy of Bangladesh. It's role is vital in enhancing productivity, profitability, income generation, employment and poverty alleviation in the rural areas for improving the livelihood of majority of the people. Agriculture sector contributes about 4.10 percent to the country's Gross Domestic Product (GDP) (Economic Review, 2018). This sector employs more than 45 percent of total labor force (BBS, 2014). Economy of this country is almost entirely dependent on agriculture that supplies raw materials for industrial production and food-stuff for human and animal consumption. People got the opportunity to choose rice as the staple food because of this land. At present, potato is the second largest food crops in Bangladesh next to rice.It is likely that less than 50 percent of potatoes grown worldwide are consumed fresh. The rest are processed into potato food products and food ingredients; fed to cattle, pigs, and chickens; processed into starch for industry; and re-used as seed tubers for growing the next season's potato crop.Potato ranks first among the vegetables in Bangladesh both in respect of area and production (BBS, 2006).In 2016-17, the area, production and average yield of potato in Bangladesh were 0.43 million hectare, 7.93 million tons and 18.24 tons per hectare, respectively (BBS, 2016).

Potato was introduced in this subcontinent in the sixteenth century. It was grown then in small plots as a vegetable. Potato has emerged as a major crop in Bangladesh. In the world, potato is cultivated 19,098,300.00 ha of lands and production is 381,682,000.00 tons (FAOSTAT, *et al*., 2017) and in Bangladesh, potato is cultivated is in 4,75,488 ha of lands and production is 94,74,098 metric

tons (BBS 2016-17). Potato is a staple food in developed countries. Potato is a popular and

Table 1.1 Areas irrigated under different crops in 2006

Crops		Area(ha)	Percent
Rice	Aus	1865000	12.5
	Aman	1162000	8.39
	Boro	9560000	69.07
Total rice area		10722000	77.46
Wheat		855000	6.18
Potato		587000	4.24
Vegetables		584000	4.22
Sugarcane		95000	0.69
Cotton		11000	0.08
Others		9888000	7.14
Grand total		**14842000**	**100**

(Sources: BBS, 2007)

important vegetable in Bangladesh. For the whole year it is used as a main vegetable. Annual consumption of potato has been growing rapidly, from around 34 kg per capita (FAO, 2014). Considering the increased demand for the food in the country potato is likely to play a very important role in the future.

To control pests farmers use high amount of agrochemicals on potato. Pradhan (1969) has reported that the use of pesticides to control pest and maximize the production of potato may be essential, but these toxic chemicals should be applied carefully and judiciously. The aim is to control the variety of pests for a longer period with the minimum use of pesticides. Other potent and recommended methods of cultural, mechanical, physical and biological control should be given equal importance in controlling pests and developing an effective and

economicinstructionmanagementprogramme (IPMP) against potato pests. There are many other negative consequences of using higher doses of agrochemicals. Most devastating ecological imbalance is caused due to indiscriminate use of agrochemicals. Pesticides affect fishes, living in the river tank, pond, etc. It is proven that dangerous pesticides are presented at an unacceptable level in the fishes of the Bay of Bengal which is too much harmful for human health. Fishes alone contributed to an unacceptable level of insecticides among Bangladeshi people which is five times more than their American counterpart (Sarker,1993). Excessive use of agrochemicals also reduce water conservation capacity of soil (Khaleque, 1993 and Rezauddin, 1994). Pesticide population and fertilizer wastes also caused microbial degradation in soil (Garg et al, 1994).

Since the farmers are the ultimate users of agrochemicals, it is necessary to know their knowledge gapon using agrochemicals. Over dose and frequent use of agrochemicals may be a threat for agro-ecology as well as human body. The farmers of Bangladesh do not use of agrochemicals judiciously, which may pose a serious threat of the environment. Therefore, there is a need to conduct a research to determine farmer's knowledge gap on using agrochemicals in potato cultivation.

1.2 Statement of the Problems

Bangladesh is a developing country. Its resources are also limited. On the other hand, the literacy rate is also not satisfactory (61.5%) compared to other countries (UNESCO, 2015). There is a huge gap of technical knowledge of the farmers with regards to agricultural practices. They cultivate crops year after year mostly through the traditional way. The modern cultural practices are not practiced by most of the farmers. Potato cultivation needs proper fertilizer management for the proper growth. A number of pests and insecticides attack the potato field. Farmer's knowledge on application of agrochemicals can help the farmers getting the maximum potato production. This study was conducted to minimize this research

gap. In this regard, this study attempted to find out the answers of the following research questions:

i) What are the characteristics of the farmers who cultivated potato?

ii) To what extent potato farmers having knowledge gap with regard to using agrochemicals?

iii) What are the factors affect potato farmer's knowledge gap on using agrochemicals?

1.3 Specific Objectives of the Study

The following specific objectives were framed out in order to give proper direction to the research work:

1. To describe the selected characteristics of the farmers engaged in potato cultivation; the characteristics are as follows:
   i. Age
   ii. Level of education
   iii. Farm size
   iv. Potato cultivation area
   v. Annual family income
   vi. Percentage of income from potato cultivation
   vii. Experience in potato cultivation
   viii. Extension media contact
   ix. Time spent in potato farming
   x. Distance of farmer's home to nearest market
2. To assess the knowledge gap of the farmers on using agrochemicals in potato cultivation; and
3. To identify the factors that significantly contributed potato farmer's knowledge gap on using agrochemicals.

1.4 Justification of the Study

Most of the people of Bangladesh live in the villages and they are directly or indirectly involved in agriculture. They are closely related with modern agricultural technologies. In one side, use of agrochemicals controls the pest and thus increases the yield but in other side it affects adversely the whole environment.

In Bangladesh many government and non-government organizations are working in the fields of agriculture and rural development. Sustainable agricultural growth and protection of environment are the issues of high priority to day. The findings of this research will be useful to those who are concerned with planning, implementation and evaluation of agricultural, rural development and environmental protection programs. The knowledge and skills gained by the researcher in conducting this research will help to conduct similar other studies in the future. Various agro-chemical companies and farms can also make use of the findings of this research in determining policies and practices for the marketing of their products.

1.5 Scope of the study

The present study was designed to have an understanding on farmer's knowledge gap on use of agrochemicals in potato cultivation. The findings of the study will fit to the areas of Bangladesh where physical, socio-economic, cultural and geographic condition do not differ much from those of the study area. Thus, the findings are expected to be useful to students, researchers, extension workers, and particularly for planners in formulating and designing the procedures for maintaining production with environment friendly ways. The findings may also be helpful to the field workers of different nation building departments to improve strategies of action to conform environment friendly sustainable potato production to the rural farmer. Lastly, the researcher believes that the findings and recommendations of this study will definitely lead to produce safe potato.

1.6 Assumptions of the Study

An assumption is the supposition that an apparent fact or principle is true in the light of the available evidence (Carter, 1945). The researcher cherished the following assumptions keeping in mind while undertaking this study:

i) The respondents included in the sample were capable of furnishing proper responses to the questions of the interview schedule.

ii) Views and opinions furnished by the respondents were the representative views and opinions of the whole population of the study.

iii) The responses furnished by the respondents were reliable and they truly expressed their opinions on use of agrochemicals in potato cultivation.

iv) The data collected by the researcher were free from bias.

v) The researcher who acted as the interviewer was well adjusted to the social and cultural environment of the study area. Hence, the respondents furnished their correct opinions without any hesitation.

vi) The respondents had almost similar background and seemed to be homogenous to a great extent.

vii) The information sought by the researcher revealed the real situation to satisfy the objectives of the study.

viii) The findings were useful in choosing the clients as well as for planning execution and evaluation the extension programme.

1.7 Limitations of the Study

Due to various reasons, such as fund, time and other necessary resources availability to the researcher and from the practical point of view, to make the study meaningful and manageable, this study has following limitations:

i. The study was confined in one union of Sadar Upazila in Munshiganj

district.

ii. The study was restricted within the farmers who had some cultivable land under their own cultivation.

iii. The population for the study was kept confined to the heads of the family who regularly cultivated their land.

iv. There were many characteristics of the farmers but in the study only 10 of them were selected for investigation.

v. For information about the study, the researcher depended on the data furnished by the selected respondents during their interview with him.

vi. Major information, facts and figures supplied by the respondents were applicable to the situation prevailing in the locality during the year 2019.

1.8 Definition of Important Terms

A researcher needs to know the meaning and contents of every term that he uses. It should clarify the issue as well as explain the fact to the investigator and readers. However, for clarity of understanding, a number of key concepts/terms frequently used throughout the study defined are interpreted as follows:

Knowledge

Knowledge is operationally defined for the purpose of this investigation asthose behaviors and test situations, which emphasized the remembering either by recognition or recall of ideas, material or phenomenon. It refers to the amount of understood information possessed by the farmers on various technological aspects of potato production.

Knowledge Gap

Knowledge gap was the difference between the desired level ofknowledge and the existing or actual level of knowledge of the farmers on the basis of use of

agrochemicals in potato cultivation at the time of interview.

Agrochemicals

It refers to the chemical i .e. chemical fertilizers and pesticides of different kinds, which are frequently used in agriculture. Agrochemicals are considered as important agricultural inputs for increasing productivity.

Chemical fertilizers

It may be defined as the materials of synthetic origin, which are added to soil to provide one or more plant nutrients. Urea, TSP, MP are the main chemical fertilizers which are frequently used in agriculture.

Pesticide

It refers to those substances which are used to save the crop plants from the damage of pests and diseases. Only insecticides and fungicides are considered as pesticides in this study. These are generally toxic materials, relatively non-specific for their targets. DDT, dieldrin, aldrin are some examples of pesticide.

Age

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

Level of Education

Education referred to the development of desirable knowledge, skill, attitudes, etc. of an individual through the experiences of reading, writing, observation and related matters.

Farm size

The farm size was defined as total amount of land owned by the respondents during the data collection period.

Potato cultivation area

Potato cultivation area was defined as the total amount of land which was brought under potato cultivation during the year of data collection.

Annual Family Income

Annual income referred to the total annual earnings of all the family members of a respondent from agriculture, livestock and fisheries and other accessible sources (business, service, daily working etc.).

Percentage of income from potato cultivation

Percentage of income from potato cultivation referred as the ratio of income from potato cultivation and total income. It was expressed as percentage.

Experience in Potato Cultivation

Experience in potato cultivation referred as the duration of direct involvement in potato farming.

Extension media contact:

It referred to an individual's (farmer) exposure to or contact with different communication media, source and personalities being used for dissemination of new technologies.

Time spent in potato farming

It referred as the total time spent of an individual's in potato farming in each day. It has been expressed as hours per week.

Distance of farmer's home to nearest market

It referred the distance to the nearest market from the farmer's home. It is expressed in kilometer.

CHAPTER II

REVIEW OE LITERATURE

The purpose of this chapter is to review of literature having relevance to the present study. The researcher made an elaborate search of available literature for the above purpose,which enriched his knowledge for clear understanding. This chapter here is presented in three different sections. The sections are,

First section: Farmer's knowledge onusing agrochemicals in potato cultivation

Second section: Relationship between selected characteristics and farmer's knowledge gap

Third section: The conceptual framework of the study

2.1Farmer's knowledge gap and use of agrochemicals incrop production

Dubey *et al.* (1981) defined technological knowledge gap as the difference between technology adopted and specific technology recommended.

Pillai and Subramonian (1986) measured technological knowledge gap by using quotients as proportion of gap between recommended practices for the area in hectare and adopted practices for the area in hectare, expressed in percentage.

De and Bangarva (1986) mentioned that technological knowledge gap is the difference between what is recommended and what has actually been adopted expressed in percentage.

Siddique and Rashid (1990) stated that fertilizer doses of 95.2,N,66.7,P2O5,145 kg K2O along with 10 tons of cow dung per ha was found to be higher yield compared to that of without cow dung.

Dangi and Intodia (1990) measured technological knowledge gap in terms of knowledge of the contact and follower farmers with respect to improved practices of major crops viz. wheat and cotton.

Ajore and Singh (1992) measured adoption gap as proportion of gap between, recommended package and adopted package.

Emergence of pest resistance to pesticides is one of the major negative aspects of pesticide use, compounded by a widespread claim that chemicals are harmful to human health and the environment (Pingali, 1995; Antle and Pingali, 1994; Rola and Pingali, 1993).

Jha and Shaini (1994) measured technological knowledge gap as the proportion of gap of summation of potentiality score for selected practices of scientific cattle rearing and summation of the extent of adoption of selected practices by the respondents.

It was found from the study conducted by Parveen (1995 that 58 percent of the farm women had moderate knowledge while 35 percent had high and 7 percent had poor knowledge on the use of fertilizer, pesticides and irrigation water.

Boudreau (1995) indicated “human faculty resulting from interpreted information; understanding that germinates from combination of data, information, experience, and individual interpretation. Variously defined as, Things that are held to be true in a given context and that drive us to action if there were no impediments."

According to Ray *et al.* (1996) technological knowledge gap has been defined as the proportion of gap in the adoption of practices to practices recommended, expressed in percentage.

Tantray and Dar (1996) measured technological knowledge gap between the recommended technologies and the adoption of these technologies in the field by

the farmers. They also considered knowledge of farmers about the recommended package of practices of season in measuring technological knowledge gap.

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.

Farmers use a wide range of pesticides to prevent crop loss from pest attack. Use of pesticides in crop production has spread rapidly worldwide since the 1950s with an estimated annual compound growth rate of 4.4% during the period 1993–1998 in the Asia/Oceania region (Yudelman et al., 1998).

Yadav *et al.* (2001) determined the level of technological knowledge gap regarding the use of nitrogenous fertilizers in major kharif crops (i.e. paddy and maize), and showed that majority of the paddy and maize growers had technological gap and used less than the recommended doses of nitrogenous fertilizers but the gap with respect to its time of application was of varying levels.

Thakral *et al.* (2001) studied the yield gaps between front line demonstrations and farmer's fields in mustard crop and reported that highest technological knowledge gap (2270 kg) was found in variety IAB- 8812.

Das et al. (2001) reported that the grain yield of both summer and kharif rice were higher in demonstration plots compared to farmers' practice resulting an average extension gap of 524 kg and 504 kg/ha respectively. Wide yield gaps were also recorded between the potential and demonstration yields (technology gap) of rice during both the season whereas, the technology gaps were higher in kharif rice (725 kg/ha) compared to that of summer rice (704-kg). Barman and Pandey (2001)

indicated that substantial technology adoption gaps in terms of irrigation, manuring and fertilization.

Saha (2001) made an attempt on farmers‟ knowledge on improved practices of pineapple cultivation and found that the majority (62 percent) of the farmers possessed good knowledge, 33 percent poor knowledge and only 5 percent possessed excellent knowledge.

Hossain (2001) found in his study on knowledge gained by the participation farmers under crop cultivation programme of care in a selected area of Mymensingh district that majority of the farmers (35 percent) had medium knowledge of crop cultivation, while 32 percent had low knowledge and the rest 33 percent possessed high knowledge of crop cultivation.

Das and Pal (2003) reported from his study that there was a large technological knowledge gap between the farmers practice and the research station practice in terms of transplanting date, harvesting date, and levels of N, P, and K application in adoption to recommended management practices for kharif rice in Cooch Behar, West Bengal, India.

Goswami *et al*. (2003) reported that high technological knowledge gap was observed in case of application of manure and fertilizers and use of pesticides in potato cultivation. However, majority of the farmers has medium technological knowledge gap.

Sharma *et al*. (2003) found a wide adoption gap, which was highest in use of micronutrients (99 percent). A wide gap was also observed between the potential and actual yield.

Verma *et al*. (2003) measured the extent of technological knowledge gap in groundnut production and the findings revealed that the overall technological gap was 39.44 percent.

Knowledge recalls or recognizes information, ideas and principles in the approximate form, which were learned previously (Huitt, W. 2004). Bhuiyan (2012) indicated that "knowledge may be defined as the scientific fact of an idea which is experimentally or empirically verified."

Fertilizers burn, delayed emergence, injury to plant tissues, and even death of plants may also occur with fertilizer application (Aziz, 2005).

2.2Relationship between selected characteristics and farmer's knowledge gap

2.2.1 Age and farmer's knowledge gap

Singh *et al*. (1991) conducted a study and concluded that age of the citrus growers had a negative trend but not significant relationship with knowledge gap of citrus growers.

Banarva *et al*. (1993) conducted a study and found that age of the farmers and their technological gap in recommended groundnut production technology was positive and insignificantly correlated.

Jha and Shaini (1994) reported in their studies that age of the tribal farmers was correlated with technological knowledge gap in cattle rearing practice but non-significant with the non-tribal farmers.

Ajore and Singh (1996) found significant positive relationship between age of the farmers and their adoption gap in reclamation of soils in progressive district but no relationship in less progressive district.

Baruah *et al*. (1998) conducted a study and found significant positive relationship between age and technological knowledge gap.

Singh and Kherde (1998) found negative and insignificant relationship between age and technological knowledge gap of the farmers with regard to cattle rearing practice.

Amin (2001) observed in his study that age of PETRRA and non-PETRRA beneficiaries had negative significant relationship with their knowledge on organic cocoon and skills on production, processing, storing of seeds. Huda *et al.* (1992) found that older farmers were more careful in keeping moisture content low of their seed. Hanif (2000) observed in his study that age of FFs farmers had significant relationship with IPM knowledge on environmental awareness. Rahman *et al.* (1988), Chandargi (1980) also found positive significant relationship between age and knowledge in their research.

Rahman (2015) observed in his study about Farmers' Knowledge and Attitude Regarding Cultivation of Salt Tolerant Variety (BRRI dhan 47) of Rice" that age of rice farmers had a positive significant relationship with knowledge on BRRI dhan 47 cultivation.

2.2.2 Education and farmer's knowledge gap

Singh *et al*. (1998) found significant and negative relationship between education and technological knowledge gap of the farmers. Bangrava *et al.* (1993), Singh et al. (1991), Jha and Shaini (1994) reported similar relationship for groundnut production technologies, knowledge gap of citrus, and cattle rearing practices.

Das *et al*. (1999) revealed that education of the farmers had a significant and negative association with adoption gap.

Chand (1999) found that education of the farmers had significant relationship with technological knowledge gap. Baruah *et al*. (1998) found a significant negative relationship between education of the farmers and their technology knowledge gap in rice cultivation.

Barman *et al*. (2000) reported in his study that education of the farmers had a significant and negative correlation with technological knowledge gap.

Huda (2001) reported that of education level of the farmers have motivated them to dry the seed and keep in sealed container to keep the moisture low.

Amin (2001) found that education of PETRRA and non-PETRRA beneficiaries had positive significant relationship with their knowledge on organic cocoon and skills on production and storing of rice seeds.

Uddin (2001) reported that education of the BSs had significant relationship with their opinion on environmental hazards and associated problems due to continuous and intensive rice farming.

Gourav (2001) conducted a study and found that education of the farmers had negative and significant relationship with technological knowledge gap in tomato cultivation.

Nurzaman *et al*. (2001) found that education had a positive significant relationship with IPM knowledge, attitude towards IPM and practice IPM.

Sutradhar (2002) revealed that academic qualification of the respondents had a significant positive relationship with their awareness on environmental degradation.

Farhad (2003) found in his study that the education of the respondents had significant and positive relationship with their knowledge in using IPM in vegetable cultivation.

Roy (2005) in his study found that education level of the farmers had significant and positive relationship with their knowledge on boro rice cultivation.

Haque (2005) revealed that education of the farmers had a significant and positive relationship with their adoption of modem rice varieties.

Haider (2005) found that there had significant relationship between education of respondents with their knowledge.

Rahman (2006) observed in his study that education level of the farmers had significant and positive relationship with their knowledge on prawn culture.

2.2.3 Farm size and farmer's knowledge gap

Islam (1993) in his study found that farm size had a significant positive relationship with adoption of improved practices.

Muttalab (1995) in his study observed that farm size of the farmers had a positive relationship with the adoption of improved potato farmers and showed positive and significant effect.

Parveen (1995) revealed that the homestead of the farm women had a positive significant relationship with their knowledge on use fertilizers, pesticides and irrigation water.

Hamid (1995) found that area under cultivation of farmers had had no relationship with the awareness on environmental pollution.

Alam (1997) studied the use of improved farm practices in rice cultivation by the farmers. The findings of the study showed that the farm size had a significant relationship with their use of improved farm practices in rice cultivation. Hossain (1981) and Mustafi et al. (1987) also reported the similar findings.

Hamid (1997) found that area under cultivation of farmers had no relationship with the awareness on environmental pollution.

Chowdhury (1997) conducted a research study on adoption of selected BINA technologies by the farmers. He indicated that farm size had strongly positive significant relationship with the adoption of selected BINA technologies. Rahman (1986), Hoque (1993) and Sarkar (1997) observed similar findings.

Hanif (2000) found that there was a negative insignificant relationship between farm size of the respondents and their awareness on environmental pollution.

Sutradhar (2002) found that farm size of the respondents had a significant positive relationship with their awareness on environmental degradation.

Hossain (2003) reported that the farm size of the respondents had positive and significant relationship with their knowledge on modern Boro rice at 0.05 level of probability.

Sana (2003) reported that farm size of the shrimp cultivators had no relationship with their knowledge of shrimp culture.

Farhad (2003) found that farm size of rural women farmer had a positive significant relationship with their knowledge in using IPM in vegetable cultivation.

Haque (2005) conducted a study to determine the relationship of farmers' characteristics with their adoption of modern rice varieties in Sadar upazila of Mymensing district. He reported that farm size of the rice growers had significant and positive relationship with the adoption of modem rice varieties.

Khan (2005) determined that farm size of the respondent had no significant relationship with their knowledge on maize cultivation.

Islam (2005) in his study explored that farm size of the farmers‟ had significant positive relationship with their knowledge on IPM in crop production.

Rahman (2006) examined in his study that farm size of the farmers had a significant relationship with knowledge on prawn culture.

2.2.4 Potato cultivation area and farmer’s knowledge gap

Singh et al. (1998) conducted a study and found significant negative relationship between farm size of the farmers and technology knowledge gap. Singh et al. (1991) reported similar relationship.

Patel et al. (2001) mentioned that there was a significant difference in technological knowledge gap between farmers with small and large holdings.

Gourav (2001) found that land holding of the farmers had negative and significant relationship with technological knowledge gap in tomato cultivation.

Tanushree (2015) observed in her study that strawberry cultivation area of farmers had positive significant relationship with knowledge on strawberry cultivation. Rahman (2015) also observed in his that BRRI dhan 47 cultivation area of rice farmers had positive significant relationship with knowledge on BRRI dhan 47 cultivation. Vegetable cultivation area had a positive and substantial significant relationship with knowledge on vegetables production activities by women members in homestead area under world vision project. The result found by (Islam, 2004).

2.2.5 Annual income and farmer's knowledge gap

Jha and Shaini (1994) found significant and negative relationship between per capita income and technology knowledge gap of the farmers.

Ajore and Singh (1996) explored significant and negative relationship between net income and adoption gap of the farmers.

Barman et al. (2000) found that annual income of the farmers had a significant and negative correlation with technological knowledge gap.

Rahman (2006) in practice of prawn culture, Roy (2006) in practice of boro rice cultivation and Islam (2005*)* in IPM crop production found that there was significant and positive relationship with annual family income.

2.2.6 Percentage of income from potato cultivation and farmer's knowledge gap

Pal (1995) in his study found a positive significant relationship between income of the farmers and their adoption of recommended practices in sugarcane cultivation.

Alam (1997) observed a positive and significant relationship between annual income of the farmers and the use of improved farm practices in rice cultivation.

Chowdhury (1997) found significant positive relationship between annual income and adoption of selected BINA technologies. Rahn1an (1986), Okoro and Obiduaka (1992), Islam (1993), Khan (1993) and Sarkar (1997) observed that similar result.

Aurangozeb (2002) conducted a study on adoption of in targeted homestead farming technologies by the rural women in RDRS. He found that there was a positive significant relationship between annual income of the respondent and their adoption of integrated homestead farming technologies.

Islam (2003) in his study found that there was a positive and significant relationship between family income of the farmers and adoption of organic manures.

Hossain (2003) revealed that annual income of the farmers had a significant relationship with their adoption at modern Boro rice cultivation practices.

Hoque (2005) conducted a study to determine the relationship of farmers' characteristics with their adoption or modem rice varieties in Sadar upazila of Mymensing district. Annual income of the rice growers had significant and positive relation with the adoption of modern rice varieties.

2.2.7 Experience in potato cultivation and farmer’s knowledge gap

Cacers (1981) and Jaime (1971) found significant relation between farming experience and adoption in their studies. Long farming experience helps in building confidence among the farmers and as such, technological gap might be less with the experienced farmers.

Islam (2008) found that vegetable cultivation experience had a positive and substantial significant relationship with knowledge on vegetables production activities by woman members in homestead area under world vision project.

Azad (2014) in his study concluded that vegetable cultivation experience of the farmers had significant relationship with their knowledge on postharvest practices of vegetables.

Tanushree (2015) observed in her study that strawberry cultivation experience of farmers had positive significant relationship with knowledge on strawberry cultivation. In their different study, Rayaparaddy and Jayaranaiah (1989) and Setty (1973) found that experience of the farmers had no relationship with their knowledge.

Mandal (2016) in his study concluded that watermelon cultivation experience of the farmers had no significant relationship with their knowledge on watermelon cultivation.

2.2.8 Extension media contact and farmer's knowledge gap

Ahmed (1974) found that here was a significant positive relationship between extension contact of the farmers and their agricultural knowledge.

Venugopal (1977) found that there was a significant association between the overall knowledge of agricultural extension officers in respect of rice cultivation and type of training received by them.

Bezbora (1980) studied adoption of improved agricultural technology by the farmers of Assam. The study indicated a positive relationship between extension contact and adoption of improved agricultural technology.

The findings of the study of Manjunatha (1980) revealed that the trained farmers had higher knowledge level and adopting behaviour compared to untrained farmers.

Ali (1984) found that contact and non-contact farmers differed significantly in respect of their media exposure. He observed that media exposure of the contact and non-contact farmers had significant contribution towards their agricultural knowledge.

Vidyashankar (1987) in his study found that the contact with extension agencies had contribute favorably to the attitude of the farmers.

Kaur (1988) found that extension contact and mass media exposure had significant influence upon opinion and level of knowledge of selected programme of rural women.

Rahman's (1995) study on farmers‟ knowledge on improved practices of potato cultivation by the farmers of Kajipur upazilla of Sirajgonj district. The study indicated a significant relationship between extension contact of farmers and their knowledge on improved practices of potato cultivation.

Hossain (2000) concluded that media exposure of the farmers had a significant relationship with their knowledge of Binadhan-6.

Sana (2003), Sarker (2002) and Rahman (2001) found in their study that media exposure of farmers were highly positive significant relationships with their knowledge.

2.2.9 Time spent in potato farming and farmer's knowledge gap

Nasrin (2017) conducted a research on farmer's knowledge on pesticide use and found no significant contribution of farmer's time spent in vegetables farming on farmer's knowledge.

2.2.10 Distance of farmer's home to nearest market and farmer's knowledge gap

Rahman (1993) conducted a study in Munshigonj and Narayangonj to investigate the comparative cost and return as well as loss arising from storing potato under

traditional as well as in cold storage and marketing channel. A fact that emerged is gross return as well as net return was higher under nearer distance to the long distance. Although total cost of storing potato in cold storage plants was higher than the traditional method, the former is more profitable than the other method.

Faroque (1997) found that female rural youth in Bhaluka (Mymensingh) lacked cash for buying seeds, seedling and fisheries and deprived of necessary knowledge in improved vegetable cultivation. He further added that the majority of female rural youth faced very high (54 percent) problems related to marketing due to distance.

2.3 The Conceptual framework of the study

A well-developed research project rests upon a rationally developed conceptual framework that usually composed of synthesis of related empirical evidences, a set of assumptions, principles, interrelationships between the concerned variables - all to lead the researcher for valid findings and finally to help her explain the observed phenomenon. Based on the related review of literature, consultation with the thesis supervisor, a conceptual framework was developed before the field work was accomplished. This framework is shown in Figure 1.

According to Rosenberg and Hovland (1960) the conceptual framework is kept in mind while framing the structural arrangement for the dependent and independent variables. This study was concerned with farmers‟ knowledge on pesticide use as dependent variable and selected characteristics of the farmers as independent variables.

In view of prime findings of review of literature, the researcher constructed a self-explanatory conceptual model of the study which is presented in Figure 1.

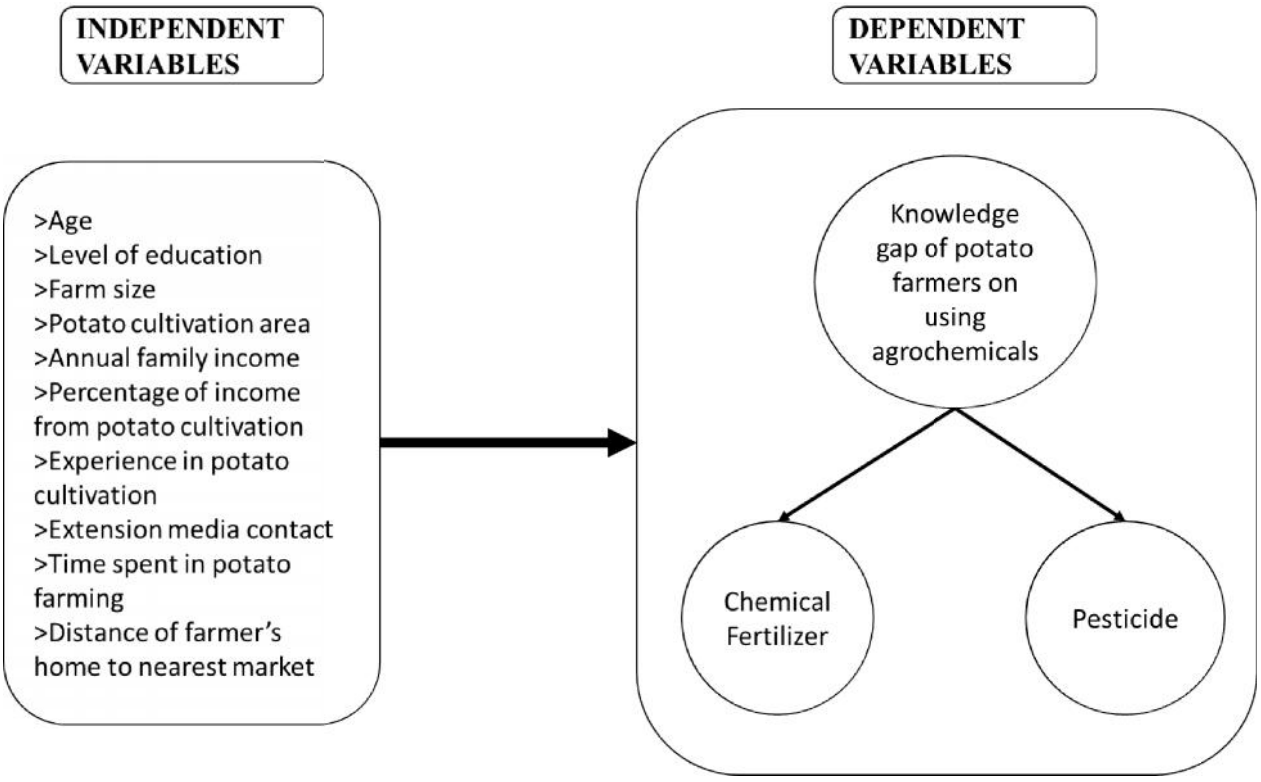

Figure 1: The conceptual framework of the study

CHAPTER III
METHODOLOGY

Methods and procedures used in conducting research need very careful consideration. Methodology should be such that enables the researcher to collect valid information and to analyze them properly to arrive at correct decisions. The methods and procedures followed in this research are described in this chapter.

3.1 Locale of theStudy

The study was conducted in the Sadar upazila under Munshigonj district. This upazilla is situated on districts headquarters. Among the 9 union of Sadar upazila, Char Kewar union was selected purposively as the locale of the study area. Then three (3) villages namely Torki, Fultola and Bagerhat from Char Kewar Union have also been selected purposively as study area.

Munshiganj Sadar area is 160.79 sq km. It is bounded by Narayanganj sadar, bandar (Narayanganj) and Sonargaon upazilas on the north, Bhedarganj and Naria upazilas on the south, Gazaria and Matlab uttar upazilas on the east, Tongibari and Nariaupazilas on the west. Tortal population of Munshiganj Sadar is 327015; male 170747, female 156268. Average literacy rate in Munshiganj Sadar is 56.6%. Main source of income of Munshiganj Sadar peoples is Agriculture. Main crops are potato, rice, maize, wheat, vegetables, jute, mustard, chilli etc.

3.2 Population and Sampling

The study location was three villages in Sadar upazila of Munshiganj district. A list of farmers of the study area were prepared by the researcher with the help of Sub-Assistant Agriculture Officer (SAAO) of Sadar Upazila Agriculture Office. The lists comprised of 452 which served as population of the study. Among 452 farmers, 113 (25% of total population) farmers were selected as following sample size of the study. The population and sample size are mentioned below in table 3.1

Table 3.1 Distribution of the farmers constituting the population and sample size in selected villages under Munshiganj Sadar upazila

Upazila	Union	Villages	Number of the farmers		
			Populations	Samples size (25%)	Reserve list
Munshiganj Sadar	Char kewar	Torki	177	44	4
		Fultola	119	30	3
		Bagerhat	156	39	4
Total			**452**	**113**	**11**

The number of farmers considered as reserve list was 11. The size was determined considering 10% of the sample size. In case of unavailability of the farmers from sample, the reserve list was utilized.

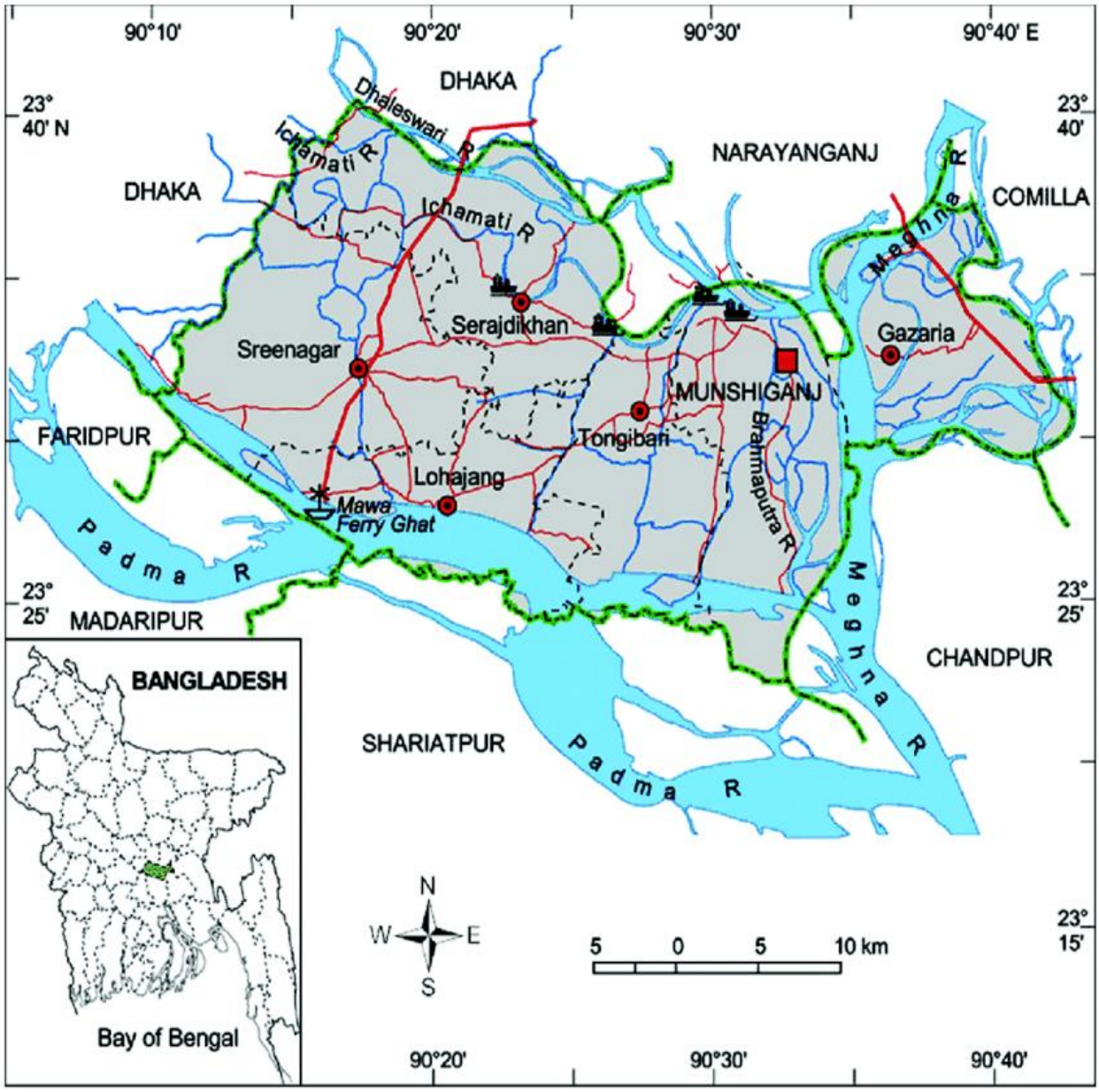

Figure 2: A map of Munshiganj district

Figure 3: A map of Munshiganj Sadar upazila showing Char kewar union.

3.3 Instrument of Data Collection

In a social research, preparation of an interview schedule for collection of information with very careful consideration is necessary. Keeping this fact in mind the researcher prepared an interview schedule carefully for collecting data from the respondents. Objectives of the study were kept in view while preparing the interview schedule.

Simple and direct questions and different scales were used to obtain information. Both open and closed form questions were designed to obtain information relating to qualitative variable which was finally be measured by ranking score.

The initially prepared interview schedule was pre-tested among 15 respondents of the study area. The pre-test was helpful to find out gaps and to locate faulty questions and statements. Alterations and adjustments were made in the schedule on the basis of experience of the pre-test. English version of the interview schedule is shown in appendix-A. Questions were asked systematically and explanations were made whenever it is necessary. The respondents were interviewed at their leisure time so that they can give accurate information in a cool mind.

3.4 Data Collecting Procedure

Data were collected through personal interviewing by the researcher himself. The researcher made all possible efforts to establish rapport with the respondent so that they could feel ease and comfort to response the questions in the schedule. Necessary steps were taken to explain the purpose of the study to the respondents and their answers were recorded sincerely. If any respondent felt difficulty in understanding any question, care was taken to help him getting understood. The researcher did not face any serious problem in data collection. The data collection took 31 days from 10th January to 13th February, 2019. The collected data were complied, tabulated and analysed. Qualitative data were converted into quantitative form by means of suitable scoring whenever needed.

3.5 Variables of the Study

A variable is any characteristics, which can assume varying or yield different values in successive individual cases (Ezekiel and Fox, 1959). An organized piece of research usually contains at least two important variables viz., dependent and independent variables.

3.5.1 Dependent variable

Dependent variable is the variable that is being measured in an experiment or the variables those are affect during research are called dependent variable. In this study the dependent variable is farmer's knowledge gap on using agrochemicals in potato cultivation.

3.5.2 Independent variables

Independent variables are the variables that the researcher changes to test their dependent variables. Or the variables that can take different values and can cause corresponding changes in other variables. In this research, the researcher selected ten characteristics of the respondent as the independent variables. The independent variables for this study were: age, level of education, farm size, potato cultivation area, annual family income, percentage of income from potato cultivation, extension media contact, time spent in potato farming and distance of farmer's home to nearest market.

3.5.3 Measurement of independent variables

In order to conduct study in accordance with the objectives, it was necessary to measure the selected variables. This selection contains procedure for measurement of both dependent and independent variables of the study. The procedures followed in measuring the variables are presented below.

3.5.3.1 Age

Age of the farmers was measured in terms of actual years from his birth to the time of interview, which was found on the basis of the verbal response of the rural people (Rashid, 2004). A score of one (1) was assigned for each year of one's age.

3.5.3.2 Level of education

Level of education was measured as the ability of an in individual respondent to read and write or the formal education received up to a certain standard. If a respondent did not attain formal education, his score was assigned as zero (0). A score of 0.5 was given to a respondent who only could sign his/her name. A score of one (1) was assigned for each year of schooling. If a respondent passed the S.S.C examination, his education score was given as 10, 12 for H.S.C., and so on.

3.5.3.3 Farm Size

Farm size of the respondents' farmer was measured using the following formula. The farm size was expressed in hectare.

Farm size = **A+B+1/2(C+D) +E**

Where,

A= Homestead area including pond

B= Own land under own cultivation

C= Land given to others as borga

D = Land taken from others as borga

E=Land taken from others as lease

3.5.3.4 Potato cultivation area

Potato cultivation area of a farmer was measured in terms of total area of land under potato cultivation of that farmer. It was expressed in decimal.

3.5.3.5 Annual family income

Total family income of a respondent was measured on the basis of total yearly earning from agriculture and other sources (service, business, daily labor etc.). For calculation of annual family income score, one (1) score was assigned for one thousand taka yearly income.

3.5.3.6 Percentage of income from potato cultivation

Percentage of Income from potato cultivation of the respondents was measured in percentage on the basis of income earned from potato cultivation on out of total annual family income.

3.5.3.7 Experience in potato cultivation

Experience in potato cultivation was measured on the basis of yearly farming practice on potato by the respondent himself. For calculation of farming experience score, one (1) score was assigned for one year potato farming experience.

3.5.3.8 Extension media contact

The agricultural extension media contact of a respondent was measured on the basis of the extent of his contact with selected 12 media in a scale ranging from-regularly, frequently, occasionally, rarely, not at all. The responses were scored as 4, 3, 2, 1 and 0 respectively. The use of agricultural extension media contact score of the respondents ranged from 0 to 48 where, 0 indicates no use and 48 indicates very high use. Based on their extension media contact, the respondents were classified into three categories as low contact, medium contact, and high contact. This variable appears in item number 8 in the interview schedule as presented in Appendix-A.

3.5.3.9 Time spent in potato farming

Time spent in potato farming by the farmers was measured by total hours spent due to potato farming by the farmers per week. A score of 1 was assigned for each hour. This variable appears in item number 9 in the interview schedule as presented in Appendix-A.

3.5.3.10 Distance of farmer's home to nearest market

Distance of farmer's home to nearest market place was marked by asking the question "what is the distance between your home and the nearest market". The respondents replied based on their idea. This variable was measured by the actual figure (kilometer). From their responses as the distance of the market place was categorized as short, medium and high distance. This variable appears in item number ten (10) in the interview schedule as presented in Appendix.

3.6 Measurement of dependent variable

Knowledge gap of potato farmers on using agrochemicals was the dependent variable of the study. It was measured based on knowledge of the growers on using agrochemicals in potato production. The knowledge of a farmer on potato production was determined by computing a knowledge score based question face in using agrochemicals in potato cultivation. The question was arranged on following Bloom's revised taxonomy, 1956. Each of the questions carried different marks. For each correct answer of a question a farmer received full weight and for wrong answer s/he received zero. However, for partial correct answer to a question s/he was given partial weight. Then, knowledge score of a farmer was obtained by adding together his/her weight for all the 14 questions. Thus, knowledge score of a farmer could range from 0 to 37, where 0 indicates very low knowledge and 37 indicates highest level of knowledge on potato production.

For determining knowledge gap of a farmer, a knowledge gap index was computed on the deviation of his/her obtained score from the maximum possible

knowledge score (37). This deviation was then expressed in percentage as the proportion to his/her maximum possible knowledge score as suggested by Singh et al., 1991. For better understanding, the formula for determining knowledge gap index is presented bellow:

$$KG = Kp - Ko$$

Where as,

KG = Knowledge Gap

Kp = Maximum possible score of a farmer (i.e. 37)

Ko= Obtained knowledge score by a farmer

3.7 Null Hypothesis

The following null hypothesis was undertaken for the present study. There is no significant relationship between the selected characteristics of farmers with farmer's knowledge gap on using agrochemicals in potato cultivation. The related characteristics are - age, level of education, farm size, potato cultivation area, annual family income, percentage of income from potato cultivation, experience in potato cultivation, extension media contact, time spent in potato farming and distance of farmer's home to nearest market.

3.8 Data Processing

3.8.1 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.

3.8.2 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.

3.8.3 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 four.

3.9 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. To find out the contribution of selected characteristics of the potato farmers to their knowledge gap on using agrochemicals, multiple regressions was used. Five percent (0.05) level of probability was used as the basis for rejection of a null hypothesis throughout the study.

CHAPTER IV
RESULTS AND DISCUSSION

Findings of the study and the interpretation of the result have been discussed in this chapter. Data that is found by interviewing respondent have been measured, analysed, tabulated and statistically treated according to the objectives. All these have been presented here under three sections. The first section deals with the farmer's selected characteristics. Second section deals with the knowledge gap of farmers on use of agrochemicals in potato cultivation. And the third section deals with the determinants of farmer's knowledge gap.

4.1 Selected Characteristics of the Farmers

This section deals with some characteristics which are assumed to be responsible for farmer's knowledge gap on use of agrochemicals. Different farmers have different type of characteristics based on their behavior. In this section ten characteristics of farmers have been selected. The selected characteristics of the farmers were age,level of education, farm size, potato cultivation area, annual family income, percentage of income from potato cultivation, experience in potato cultivation, extension media contact, time spent in potato farming and distance of farmer's home to nearest market. Some descriptive statistics of those characteristics of farmers are given below in Table 4.1. Here is a summary profile of characteristics of potato farmers.

Table 4.1 The salient features of the selected characteristics of the farmers

Categories	Measuring Unit	Range		Mean	SD
		possible	observed		
Age	Years	-	22-58	38.59	7.16
Education	Year of schooling	-	0.00-16	5.8	4.5
Farm size	Hectare	-	0.17-3.92	1.11	0.80
Potato cultivation area	Hectare	-	0.10-3.50	0.90	0.70
Annual family income	'000'taka	-	67.25-750	426.8	214.16
Percentage of income from potato cultivation	%	-	11.55-100	58.41	18.07
Experience in potato cultivation	Years	-	3-35	12	7.1
Extension media contact	Score	0-48	15-36	23.42	3.69
Time spent in potato farming	Hours/week	-	7-63	38.97	13.93
Distance of farmers home to nearest market	Km	-	0.1-2	1.12	0.44

4.1.1 Age

Age of the respondentsvaried from 22 to 58 years with an average being 38.59 years and a standard deviation of 7.16. Based on age, all the farmers were classified in three categories: "young" (up to 35), "middle aged" (36-50) and "old" (above 50). The distribution of the potato growers according to their age is shown in Table 4.2.

Table 4.2 Distribution of the farmers according to their age

Categories	Farmers		Mean	SD
	Number	Percent		
Young aged (up to 35)	42	37.2	38.59	7.16
Middle-aged(36-50)	64	56.6		
Old(above 50)	7	6.2		
Total	**113**	**100**		

Data represented in Table 4.2 indicate that majority (56.6 percent) of the respondents were middle aged as compared to 37.2 percent being young and 6.2 percent old. Findings again revealed that most (93.8 percent) of the respondents were young to middle aged. Therefore, it could be said that decision regarding the farming practices in the study area are expected to be considerably influenced by the middle aged farmers.

4.1.2 Education

Education scores of growers ranged from 0 to 16. The average score was 5.8with the standard deviation 4.5. Based on their score, the growers were classified into five categories as shown in Table 4.3.

Table 4.3 Distribution of the farmers according to their education

Categories	Number of farmers	Percent	Mean	SD
Cannot read and write(0)	9	8.0	5.8	4.5
Can only sign (0.5)	27	23.9		
Primary level (1-5)	13	11.5		
Secondary level (6-10)	52	46.0		
Above secondary	12	10.6		
Total	**113**	**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 favorable attitude, correct perception and knowledge about production technology of crops. Comparatively educated man is relatively more responsive to the technology and new innovation. The findings of this study, however, indicate that 31.9 percent of the farmers were illiterate or could sign their name only which is supposed to face a great difficulty in adjusting with the unfavorable condition regarding knowledge gap for potato production. Such consideration indicates the need for improving literacy level among the farmers for adjusting the knowledge gap about use of agrochemicals. It shows that 46 percent of the farmers had secondary level of education.

4.1.3 Farm size

The farm size of the respondents varied from 0.17 to 3.92 hectares. The average farm size was 1.11 hectare with a standard deviation of 0.80. Based on their farm size, the respondents were classified into five categories following the categorization of DAE. These categories were marginal landless (≤ 0.02), marginal farm holder (0.021-0.20 ha), small farm holder (0.21-1.00 ha), medium farm holder (1.01 ha to 3.0 ha) and high farm holder (above 3.0 ha).The distribution of the farmers according to their farm size is shown in Table 4.4.

Table 4.4 indicates that the small farm holder constitutes the highest proportion (48.67 percent) followed by medium farm holder (46.02 percent), whereas 1.77 percent was marginal farm holder. The findings of the study reveal that majority of the potato farmers were small to medium sized farm holder. The average farm size of the farmers of the study area (1.11 ha) was higher than that of national average (0.60 ha) of Bangladesh (BBS, 2014).

Table 4.4 Distribution of the farmers according to their farm size

Categories	Range (Hectare-ha)		Respondents'		Mean	SD
	Score (ha)	Observed	Number	Percent		
Landless	≤0.02	0.17-3.92	0	0	1.11	0.80
Marginal	0.021-0.20		2	1.77		
Small	0.21-1.00		55	48.67		
Medium	1.01-3.0		52	46.02		
Large	>3		4	3.54		
Total			**113**	**100**		

4.1.4Potato cultivation area

Area under potato production ofthe respondents varied from 0.10 to 3.50 hectare, the average being 0.90 ha with standard deviation of 0.70. The respondents were classified into three categories (Mean ± Standard Deviation) on the basis of their potato production area as shown in Table 4.5

Table 4.5 Distribution of the farmers according to potato cultivation area

Categories (Mean ± SD)	Numbers of farmers	Percent	Observed range	Mean	SD
Small farm (up to 0.2)	17	15	0.10-3.50	0.90	0.70
Medium farm (0.21-1.60)	81	71.68			
Large farm (above 1.60)	15	13.32			
Total	**113**	**100**			

Table 4.4 indicates that medium farm land under potato cultivation constitutes the highest proportion (71.68 percent) followed by small farm land under potato cultivation (15 percent), whereas 13.32 percent farmers had large farm land under

potato cultivation. The findings of the study reveal that majority of the potato farmers were small to medium sized farm land under potato cultivation.

4.1.5 Annual family income

Annual income score of the respondents ranged from 67.25 to 750 (in thousands) with an average of 426.8 and standard deviation 214.16. On the basis of the annual income, the respondents were classified into three categories (Mean ± Standard Deviation) as shown in Table 4.6

Table 4.6 Distribution of the farmers according to annual family income

Categories (Mean ± SD)	Number ofFarmers	Percent	ObservedRange	Mean	SD
Lower income (up to 212)	23	20.35	67.25-750	426.8	214.16
Medium income (213-640)	62	54.87			
High income (above 640)	28	24.78			
Total	**113**	**100**			

Data shown in Table 4.6 presented that the highest proportion (54.87 percent) of the respondents had medium annual family income while 20.35 and 24.78 percent of the respondents had small and high annual family income respectively.

The gross annual family income of a farmer is an important indicator of how much s/he can invest in her/his farming. Generally higher income encourages one's integrity to achieve better performance and to show his/her individual better status in the society. The higher income increases the risk taking capacity of the farmer's potato production. Farmers with low income generally invest less in their farms. It is therefore, likely that a considerable portion of farmers may face difficulty in potato production.

4.1.6 Percentage of income from potato cultivation

Percentage of income from potato cultivation wasranged from 11.55 to 100 (%). The average income from potato cultivation was 58.41 with the standard deviation 18.07. Based on their percentage of income, the farmers were classified into three categories (Mean ± Standard Deviation) as shown in Table 4.7

Table 4.7 Distribution of the farmers according to percentage of income from potato cultivation

Categories (Mean ± SD)	Number offarmers	Percent	ObservedRange	Mean	SD
Low (up to 40)	20	17.7	11.55-100	58.41	18.07
Medium (41-76)	82	72.57			
High (above 76)	11	9.73			
Total	**113**	**100**			

Data shown in above table clearly stated that majority portion of income of the farmers come from potato cultivation which is 72.57 percent while 17.7 and 9.73 percent are having low and high percentage respectively. This percentage clearly expressed that the major source of income of Munshiganj Sadar farmers are potato cultivation and they are highly dependent on only potato cultivation.

4.1.7 Experience in potato cultivation

The experience score of the respondents ranged from 3 to 35 years. The mean score was 12 yearswith the standard deviation 7.1. On the basis of experience, the respondents were classified into three categories (Mean ± Standard Deviation) namely, low experience, medium experience and high experience, as shown in Table 4.8

Table 4.8 Distribution of the farmers according toexperience in potato cultivation

Categories(Mean ± SD)	Farmers		Mean	SD
	Number	Percent		
Low (up to 5)	19	16.8	12	7.1
Medium (6-19)	73	64.6		
High (above 50)	21	18.6		
Total	**113**	**100**		

It was clearly revealed by table 4.8that the majority (64.6%) of the farmers had medium experience as compared to (16.8%) and (18.6%) having low and high experience respectively. The majority (83.2%) of the respondents had medium to high experience in potato cultivation. From the findings it can be said that farmers were engaged with potato cultivation since long.

4.1.8 Extension media contact

Extension media contact scores of the farmers ranged from 0 to 48 with an average of 23.42and standard deviation of 3.69. On the basis of their media contact, the respondents were classified into three categories (Mean ± Standard Deviation) namely, low contact, medium contact and high contact. The scale used for computing the media contact score of a respondent is given Table 4.9.

Table 4.9 Distribution of the farmers according to their media contact

Categories(Mean ± SD)	Farmers		Mean	SD
	Number	Percent		
Low contact (up to 20)	25	22.1	23.42	3.69
Medium contact (21-27)	76	67.3		
High contact (above 50)	12	10.6		
Total	**113**	**100**		

Data contained in the Table 4.9 indicated that the highest proportion (67.3%) of the respondents had medium extension media contact as compared to (22.1%) and (10.6%) having low and high extension media contact respectively. The majority (89.4%) of the respondents had low to medium extension contact in potato cultivation.

4.1.9 Time spent in potato farming

Time spent in potato farm by the farmers varied from 7 to 63 hours per week with an average of 38.97 and standard deviation of 13.93. Based on their time spent in potato farm, the farmers were classified into three categories (Mean ± Standard Deviation) namely less time spend, moderate time spend and high time spend. The distribution of the potato farmers according to their time spend in potato cultivation is presented in Table 4.10

Table 4.10 Classification of the respondents according to their time spent

Categories(Mean ± SD)	Farmers		Mean	SD
	Number	Percent		
Less time spend (up to 2)	23	20.35	38.97	13.93
Moderate time(26-53)	71	62.83		
High time spend(above 53)	19	16.82		
Total	**113**	**100**		

Data presented in Table 4.10 indicates that 62.83 percent of the respondents had spent moderate timewhereas small and high time spent 20.35 and 16.82 percent farmers respectively. Time spending in potato cultivation is helpful to increase knowledge, skill and change attitude of the farmers. It also builds confidence of the farmers for making appropriate decisions at the time of need. Generally, time spends in potato farming helps to cope with any problematic situation as well as improving skill.

4.1.10 Distance of farmer's home to nearest market

Distance of farmer's home to nearest market varied from 0.1 to 2 km with an average of 1.12 km and standard deviation 0.44. Based on the distance it was classified into three categories(Mean ± Standard Deviation) namely small distance, medium distance and large distance. The distance of farmer's home to nearest market is presented in table 4.11

Table 4.11 Classification of the respondents according to distance of farmer's home to nearest market

Categories(Mean ± SD)	Farmers		Mean	SD
	Number	Percent		
Low distance (up to 0.7)	25	22.1	1.12	0.44
Medium distance (0.8-1.5)	66	58.4		
High distance (above 1.5)	22	19.5		
Total	**113**	**100**		

Data presented in table 4.11 shows that majority 58.4 percent of the potato farmers has a medium distance to their local market whereas 22.1 percent of the farmers has low and 19.5 percent of farmers has large distance. Local market can be a good source of information and agricultural knowledge for the farmers and most importantly personnel are more available in local market. Farmers can meet local leader and input dealers in local market too.

4.2 Knowledge gap of farmers on use of agrochemicals in potato cultivation

Knowledge gap of the respondents ranged from 5-19 percent in accordance with scoring system against the possible range of 0-37 percent with the mean of 13.68 and standard deviation (SD) of 3.4. On the basis of knowledge gap, the farmers were classified into three categories (Mean ± Standard Deviation) as shown in Table 4.12

Table 4.12 Classification of the respondents according to knowledge gap of farmers on use of agrochemicals in potato cultivation

Categories(Mean ± SD)	Farmers		Mean	SD
	Number	Percent		
Low (up to 10)	23	20.35	13.68	3.4
Medium (11-17)	79	69.9		
High (above 17)	11	9.75		
Total	**113**	**100**		

Knowledge gap for crop production is very harmful. In want of proper knowledge, crop production may failure totally. Data shown in the Table 4.8 indicate that majority (69.9 percent) of the farmers of the total respondents had medium knowledge gap while 20.35 percent had Low and 9.75 percent had high knowledge gap for using agrochemicals in potato production. Findings again revealed that about 90 percent of the respondents had small to medium knowledge gap in using agrochemicals for potato production. In this study more than fifty percent of the respondents have medium knowledge gap in using agrochemicals for potato production. Using chemicals is very common for potato production but proper knowledge on using agrichemicals is not so common. Proper knowledge of agrochemicals can help in increasing the potato production and for producing more safe food. The lowest knowledge gap of farmers will ensure the maximum production of potato.

4.3 Contributing factors on the knowledge gap of potato farmers

In order to estimate the knowledge gap of potato farmers from the independent variables, multiple regression analysis were used which is shown in the Table 4.13

Table 4.13 Multiple regressions co-efficient showing contribution withselected characteristics of the farmer's knowledge gap on using agrochemicals

Dependent variable	Independent variable	B	P	R^2	Ad. R^2	F-value
Knowledge of farmers on using agrochemicals	Age	-.061	.665	.521	.474	11.11
	Level of education	-.306	.002**			
	Farm size	.387	.182			
	Potato cultivation area	-.349	.249			
	Annual family income	-.352	.003**			
	Percentage of income from potato	.021	.842			
	Experience in potato cultivation	-.362	.011*			
	Extension media contact	-.246	.003**			
	Time spent in potato farming	.017	.864			
	Distance of farmer's home to nearest market	-.077	.304			

NS-Not significant

*Significant at 0.05 level of probability

**Significant at 0.01 level of probability

Table 4.13 shows that level of education,annual family income, experience in potato cultivation and extension media contact of the respondents had significant negative contribution with knowledge gap on use of agrochemical in potato cultivation. Of these, level of education, annual family incomeand extension

media contact were the most important contributing factors (significant at the 1% level of significance) andexperience in potato cultivation was less important contributing factors (significant at 5% level of significance).Coefficients of other selected variables don't have any contribution on theirknowledge gap on use of agrochemicals.

The value of R^2 is an expression of how the variability in the dependent variable is accounted by the independent variables. So, the value of R^2 = 0.474 means that independent variables accounts for 52% of the variation with theirknowledge gap on use of agrochemicals in potato cultivation. The F ratio is 11.11 which is highly significant (p<0).

4.3.1 Contribution of education inknowledge gap on using agrochemicals in potato cultivation

The contribution of Education in knowledge gap on use of agrochemicals in potato cultivation by testing the following null hypothesis; "There is no contribution of education in knowledge gap on use of agrochemicals in potato cultivation".

The adjusted R^2 value of the concerned variables was found .002. 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 at 1% significance level (0 .002)

b. So, the null hypothesis could be rejected.

c. The direction between level of education and knowledge gap was negative.

The b-value of farmer's level of education was -0.306. So, it can be stated that as farmer's level of education increased by one unit, farmers' knowledge gap on use of agrochemicals in potato cultivation decreased by 0.306 units. Considering the effects of all other predictors are held constant.

Based on the above finding, it can be concluded that a potato farmer who had more education, increased the capabilities to reduce knowledge gap. Education enhances the knowledge of the potato farmers at short time than others which enabled them to reduce knowledge gap on use of agrochemicals in potato cultivation. And an educated person is more likely to be well aware about the update information about new technologies, new machineries and the latest market price of the crops. So, education has significantly contributed to the reduction of knowledge gap on use of agrochemicals in potato cultivation.

4.3.2 Contribution of annual family income in knowledge gap on using agrochemicals in potato cultivation

The contribution of annual family income in knowledge gap on use of agrochemicals in potato cultivation by testing the following null hypothesis; "There is no contribution of annual family income in knowledge gap on use of agrochemicals in potato cultivation".

The adjusted R^2 value of the concerned variables was found 0.003. 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 at 1% significance level (0.003)
b. So, the null hypothesis could be rejected.
c. The direction between annual family income and knowledge gap was negative.

The b-value of farmer's annual family income was (-0.352). So, it can be stated that as farmer's annual family income increased by one unit, farmers' knowledge gap on use of agrochemicals in potato cultivation decreased by 0.352 units. Considering the effects of all other predictors are held constant.

Based on the above finding, it can be concluded that a potato farmer who had more annual family income, increased the capabilities to reduce knowledge gap. Annual family income enhances the knowledge of the potato farmers at short time than others which enabled them to reduce knowledge gap on use of agrochemicals in potato cultivation. So, annual family income has significantly contributed to the reduction of knowledge gap on use of agrochemicals in potato cultivation.

4.3.3 Contribution of extension media contact in knowledge gap on using agrochemicals in potato cultivation

To identify the contribution of extension media contact on farmers' knowledge gap in using agrochemicals in potato cultivation was testing through multiple regression analysis which is shown in Table 4.13. The table shows that the contribution of extension media contact on farmers' knowledge gap in using agrochemicals in potato cultivation was negative and significant. The negative coefficient indicates that the higher the extension contact of the farmers the lower the knowledge gap in using agrochemicals in potato cultivation.

Based on the above finding, it can be concluded that a potato farmer who had more extension media contact, increased the capabilities to reduce knowledge gap. Extension media contact enhances the knowledge of the potato farmers at short time than others which enabled them to reduce knowledge gap on use of agrochemicals in potato cultivation. More media contact makes farmers updated and more informative. So, extension media contact has significantly contributed to the reduction of knowledge gap on use of agrochemicals in potato cultivation.

4.3.4 Contribution of experience in potato cultivation in knowledge gap on using agrochemicals in potato cultivation

The contribution of experience in potato cultivation in knowledge gap on use of agrochemicals in potato cultivation by testing the following null hypothesis; "There is no contribution of experience in potato cultivationin knowledge gap on use of agrochemicals in potato cultivation".

The adjusted R^2 value of the concerned variables was found 0.011. 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 at 5% significance level (0.011)

b. So, the null hypothesis could be rejected.

c. The direction between experience in potato cultivation and knowledge gap was negative.

The b-value of farmer's experience in potato cultivation was (-0.362). So, it can be stated that as farmer's experience in potato cultivation increased by one unit, farmers' knowledge gap on use of agrochemicals in potato cultivation decreased by 0.362 units. Considering the effects of all other predictors are held constant.

Based on the above finding, it can be concluded that a potato farmer who had more experience in potato cultivation, increased the capabilities to reduce knowledge gap. Experience in potato cultivationenhances the knowledge of the potato farmers at short time than others which enabled them to reduce knowledge gap on use of agrochemicals in potato cultivation. Experienced potato farmers are more likely to know the proper use of agrochemicals. They are supposed to be more expert in identifying insect and pest and applying proper chemicals. So, experience in potato cultivationhas significantly contributed to the reduction of knowledge gap on use of agrochemicals in potato cultivation.

CHAPTER V
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of findings

5.1.1 Knowledge gap on use of agrochemicals in potato cultivation

Knowledge gap of the respondents ranged from 5 to19 in accordance with scoring. Here, the average knowledge score was 13.68 with a standard deviation of 3.4. Data indicated that majority (69.9 percent) of the farmers of the total respondents had medium knowledge gap while 20.33 percent had low and 9.75 percent had high knowledge gap for using agrochemicals. Findings again revealed that about four fifth (79.65 percent) of the respondents had medium to high knowledge gap on use of agrochemicals in potato cultivation.

5.1.2 Selected characteristics of the farmers

Age

Age of the farmers ranged from 22 to 58 years with a mean and standard deviation of 38.59 and 7.16 respectively. The middle-aged potato farmers comprised the highest proportion (56.6 percent) followed by young old aged category (37.2 percent) and the lowest proportion were made by the old aged category (6.2 percent).

Education

The level of educational scores of the potato farmers ranged from 0 to 16 with a mean and standard deviation of 5.8 and 4.5 respectively. Respondents under secondary education category constitute the highest proportion which is 46 percent. On the other hand, the lowest 8 percent in can't read and write category. 23.9 percent respondents can sign only while primary level of education and above secondary level of education consist 11.5 and 10.6 percent respondents respectively.

Farm size

The farm size of the potato farmers ranged from 0.17 ha to 3.92 ha with a mean and standard deviation of 1.11 and 0.80 respectively. The researcher found that the small farm holder constitutes the highest proportion (48.67 percent) followed by medium farm holder (46.02 percent), whereas only 3.54 percent was large farm holder. The findings of the study reveal that majority of the potato farmers were small to medium sized farm holder.

Potato cultivation area

Land under potato cultivation of potato farmers ranged from 0.10 ha to 3.50 ha with the mean and standard deviation of 0.90 and 0.70 respectively. The researcher found that medium farm land under potato cultivation constitutes the highest proportion (71.68 percent) followed by small farm land under potato cultivation (15 percent), whereas 13.32 percent had large potato cultivation area.

Annual family income

Annual family income of the potato farmers ranged from 67.25 to 750 thousand taka with a mean and standard deviation of 426.8 and 214.16, respectively. The researcher found that potato farmers having medium annual income constitute the highest proportion (54.87 percent), while the lowest proportion in small income (20.35 percent) followed by high income (24.78 percent).

Percentage of income from potato cultivation

Percentage of income from potato cultivation of the potato farmers ranged from 11.55 to 100 percent with a mean and standard deviation of 58.41 and 18.07 respectively. The researcher found that potato farmers having medium annual income percentage from potato cultivation constitute the highest proportion (72.57 percent), while the lowest proportion in high annual income percentage from potato production (9.73 percent) followed by low income percentage (17.7 percent).

Experience in potato cultivation

The observed experience scores of the farmers ranged from 3 to 35 with the mean of 12 with a standard deviation of 7.1. The highest proportion (64.6 percent) of the farmers had medium experience; while 16.8 percent had low and 18.6 percent farmers had high experience in potato cultivation.

Extension media contact

Extension media contact of the potato farmers ranged from 15 to 36 with a mean and standard deviation of 23.42 and 3.69 respectively. The highest proportion (67.3 percent) of the respondents of the study area had the medium extension media contact, while 22.1 percent had low contact and 10.6 percent had high extension media contact.

Time spent in potato farming

Time spent in potato farming of the potato farmers ranged from 7 to 63 with a mean and standard deviation of 38.97 and 13.93 respectively. The highest proportion (62.83 percent) of the farmers had medium time spending in potato cultivation, while 20.35 percent had less time spending in potato cultivation and 16.82 percent had high time spending in potato cultivation.

Distance of farmer's home to nearest market

Distance to the nearest market of the potato farmers ranged from 0.1 to 2 kilometers with a mean and standard deviation of 1.12 and 0.44 respectively. The researcher found that potato farmers having medium distance to the market constitute the highest proportion (58.4 percent), while farmers having high and low distance to the market constitute 19.5 and 22.1 percent respectively.

5.1.3 Factors related in knowledge gap of potato farmers

There is a significant contribution of level of education, annual family income and extension media contact on knowledge gap potato farmers and all of these were the most important contributing factors (significant at the 1% level of

significance). Experience in potato cultivation were also the important contributing factors (significant at the 5% level of significance).

Characteristics of the farmers like age, farm size, potato cultivation area, percentage of income from potato, time spent in potato farming and Distance of farmer's home to nearest market had no significant contribution with their profitability of vegetable cultivation.

5.2 Conclusions

i) More than three fourth of the potato farmers had medium to high knowledge gap on using agrochemicals which indicates there still need to take initiative for improving the picture.

ii) A potato farmer with more education increased the capabilities to reduce knowledge gap on use of agrochemicals in potato cultivation. Education enhances the ability of the potato farmers to reduce knowledge gap at short time than others.

iii) The results indicate that annual family income had a negative and significant contribution with their knowledge gap. Therefore, it can be concluded that more the annual income possessed by the respondent, lesser would be knowledge gap of potato farmers.

iv) The results indicate that more than half (67.3 percent) of the respondents had medium media contact. The results might be a good scenario to reduce knowledge gap. However, still there is a need to take initiative to improve the extension media contact of the farmers.

v) The results indicate that almost three fourth (64.6 percent) of the respondents had medium experience of potato cultivation. The experience of farmers had a negative and significant contribution with their knowledge gap on use of agrochemicals.

5.3 Recommendations

5.3.1 Recommendations for policy implications

On the basis of findings and conclusions following recommendations were drawn:

i) Bangladesh government through Bureau of Non-formal Education (BNFE) and NGOs can take necessary steps to increase farmers' primary level of education through non-formal education (adult education) and regular farmers' training, workshop, rally needs to be organized to broaden their knowledge.

ii) Extension media contact had a very strong impact on knowledge gap. Steps should be taken by DAE to encourage farmers to have more media contact. More result demonstration, method demonstration, farm and home visit etc. program should be conducted to increase farmers' knowledge on using agrochemicals.

iii) Attention should be paid more to the farmers having less income and less experience in farming to increase knowledge on using agrochemicals. In this case to select farmers for training, rally and workshop, emphasize should be given to above mentioned farmers.

5.3.2 Recommendations for the future study

The following recommendations are made for the future study:

1. Findings of the study need to be varied by undertaking similar research in other potato growing zones of the country.
2. Only overall knowledge gap of farmers on use of agrochemicals was considered under the present study. Further research is needed to determine knowledge gap on specific practices.
3. The study was conducted in Sadar Upazila under Munshiganj District. Similar studies might be carried out in other area of Bangladesh.
4. This study investigated the relationship and contributions of 10

characteristics of the farmers to/on their knowledge on use of agrochemicals. Further research is needed to explore the effects of other characteristics of the farmers.

5. Similar research should be conducted at different crops of the country.

REFERENCES

Ahmed, A.K.R. (1974). Agricultural Knowledge of Fanners. M.Sc. (Ag. Ext. Ed.) Thesis, Department of Agricultural Extension and Teachers' Training, Bangladesh Agricultural University, Mymensingh.

Ajore, R. and A.P. Singh. (1992). Adoption Gap in Reclamation Technology of Sodic Soils among Marginal and Small Farmers in Progressive Districts of U.P. Agricultural situation in India. Special Number of Horizon in Agricultural Research II. XLVII: 531-533.

Ajore, R. and A. P. Singh. (1996). Correlates of Adoption Gap in Reclamation of Sodic Soils. Indian Journal of Extension Education. 32(1-4):52-57.

Alam, M.S. (1997). Use of Improved Farm Practices In Rice Cultivation By The Farmers. M.S. (Ag. Ext. Ed) Thesis, Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh.

Ali and Anwar (1987). A Study to Determine the Effect of Training and Visit Extension System at the Farmers level in Two Unions of Bogra District, M. S. (Ag. Ext. Ed.) Thesis, Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh

Ames, M., Spooner, D. (2008). DNA from herbarium specimens settles a controversy about origins of the European potato. American J. Bot. 95(2): 252–257.

Amin, M.S. (2001). Impact of Training on Transfer of Aquaculture Technologies In Some Selected Areas of Jamalpur District. M.S. (Ag.Ext. Ed.) Thesis, Department of Aquaculture, Bangladesh Agricultural University, Mymensingh

Aziz M A. (2005). Country Report, Bangladesh. Proceedings of the Asia regional workshop on the implementation, monitoring and observance of the international code of conduct on the distribution and use of pesticides, FAO of UN.

Azad, M. J., M. S. Ali and M. R. Islam. (2014). Farmers knowledge on postharvest practice of vegetables. International journal of experimental agriculture. 4(3):7-11.

BBS (Bangladesh Bureau of Statistics). (2006). Statistical Yearbook of Bangladesh, Bangladesh Bureau of Statistical Division, Ministry of Planning, Govt. of the People's Republic of Bangladesh, Dhaka.

BBS (Bangladesh Bureau of Statistics). (2014). Yearbook of Agricultural Statistics, Bangladesh Bureau of Statistical Division, Ministry of Planning, Govt. of the Peoples' Republic of Bangladesh, Dhaka.

BBS (Bangladesh Bureau of Statistics). (2002). Monthly Statistical Bulletin in Bangladesh. August, 2002. Bangladesh Bureau of Statistics, Ministry of Planning, Govt. of the Peoples' Republic of Bangladesh.

BBS (Bangladesh Bureau of Statistics) (2016). Monthly statistical year book.

Banarva, C. k, P. N. Kalla and K.C. Sharina.(1993). Relationship Between Independent Variables and Overall Technological Gap in the Recommended Ground Nut Production Technology. Indian Journal of Social Research. Vol. XXXIV No. 2: 140-142.

BARI (2016). The varieties of Potatoes in Bangladesh. Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur, Bangladesh. Retrieved from: http://www.bari.gov.bd/

Baruah, S.R. and C. Sarrilah, (1998). Transfer of Technology Gap in Scientific Tea Culture Among Small Tea Growers of Assam. Journal of Interacadenticia. 2(1-2): 90-97.

Barman, U., K. Pathak and M.K. Kalita. (2000). Analysis of Technological Gap in Ahu Rice Cultivation in Assam. Annuals Research. 5(2): 195-197.

Bezbora, S.N. (1980).Factors Affecting Adoption of Improved Agricultural Technology for Paddy Cultivation by the Farmers of Assam, Summery of Extension Research, Department of Extension Education, Panjab Agricultural University, Ludhiana, 6:24-27.

Bloom, B. S. (1956). Taxonomy of Education Objective: the Classification of Education Goals, by a Committee of College and University Examiners. Hand book I: cognitive domain. New York: Longmans.

Boudreau, A. (1995). The Knowledge Creating Company, New York: Oxford Universty Press.

Cacers, B. (1981). Adoption Behavior of Root Crops in Four Bicol Provinces. Ph.D. dissertation. Department of Extension Education. UPLB, Philippines, 63-65.

Campbell, G. M., Webb, C. and McKee, S. L. (1997). Cereals: Novel Uses and Processes.

CCWPU (2009). Columbus's contribution to world population and Urbanization (CCWPU): A Natural Experiment Examining the Introduction of Potatoes. Harvard University.

Chand, S. (1999). Technological Gap in Adoption of Improved Arhar Production Technology in Haryana. M.Sc. Thesis. CCS Haryana Agricultural University. "Thesis Abstract, XXV(4): 272.

Chowdhury, M. S. A. (1997). Adoption of Selected BINA Technologies by the Farmers of Boira Union in Mymensingh District. MS. (Agril. Ext. Edu.) Thesis, Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh.

CWHFP (1994). The Cambridge World History of Food- Potatoes (CWHFP).

DAM (2015). Marketing Status of Agricultural Goods: Potato. Department of Agricultural Marketing (DAM). Ministry of Agriculture, Government of the People's Republic of Bangladesh. Retrieved from: http://dam.portal.gov.bd/

Dangi, K.L. and S.L. Intodia. (1990). Technological Gap Among Wheat and Cotton Farmers in Canal Command Area. Indian Journal of Extension Education. XXVI(1&2): 44-47.

Das, R., N.S. Verma and S.P. Singh. (1999). Adoption Gap in Sorghum Production Technology in Haryana Agriculturul University Journal of Research. 29(1-2): 57-61.

Das, J.C., P.K. Neog, A.K. Choudhury, P.K. Barkakoty and N.N. Sarmah. (2001). Evaluation of Technological Impact on Rice-rice Sequence in Charaipani minor Irrigation Command, Assam. Annuls of Agricultural Research. 22(1):133-136.

De, D. and G.S. Bangarva, (1986). Wheat Production Technology, Cost-Intensive Dormant Technical Know-how. Journal of Extension System. 2(2):70-73.

Dubey, V.K., S.B. Sing, R. Saini and S.P.S. Saini. (1981). Gap and Constraints Analysis of Wheat Production. Indian Journal ofAgricultural Research. 15(1): 17-24

FAO. (2014). Food and Agricultural Organization of the United Nations. Rap.

Pub. 71 p.

FAOSTAT. (2012). Worldwide potatoes area harvest and production. FAO Statistical Yearbook 2012.

Faroque, M.G. (1997). Participation of Female Rural Youth in Selected Homestead Activities in Two selected villages of Bhaluka Upazila under Mymensingh District. M.S.(Ag. Ext. Ed.) Thesis, Department Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh.

Garg, N., K.L. Gagr and K. G. Kukeerji, (1994). Microbiological degradation of environmental pollutants. In: Recent advances in biodeterioration and biodegradation. Vol.2.pp. 327-362.

Gopal, J. and Khurana, S. M. P. (2006). Handbook of Potato Production, Improvement, and Postharvest. Haworth Press.

Goswami, K.K., A.K. Bandypadhyay and K. Shantanu. (2003). Technological Gap in Potato Cultivation in Some Selected Areas of Hooghly District. West Bengal. Journal of Interacademicia. 7(4): 461-465.

Gourav, V. (2001). Adoption and Technological Gap in Tomato Cultivation in Haryana. Thesis Abstract. Vol. XXVII No. l March 2002. Directorate of Extension Education. Chaudhary Charan Singh Haryana Agricultural University.

Haider, M.L. (2005). Farmer‟s Response to Integrated Pest Management for Increasing Vegetable Production. M.S. Thesis, Department of Agricultural Extension and Rural Development, Bangbandhu Sheik Mujibur Rahman Agricultural University, Gazipur

Hamid, M.A. (1997). Farmers' awareness on environmental pollution: A study inBangladesh. Asia Pacific Journal of Rural Development, VII (2): 107-117.

Hamid, M.A. (1995). Farmers' Awareness on Environmental Pollution Caused by the Use of Agro-chemicals in Two Selected Villages of Bangladesh Agricultural University Extension Centre. M.S. (Ag. Ext. Ed) Thesis. Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh.

Hanif, M.A. (2000). Comparative Analysis Between FFS and Non-FFS Farmers Regarding Environmental Awareness. M.S. (Ag. Ext. Ed.). Thesis, Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh.

Hossain, S.M. (2000). Farmers' Knowledge and Perception of Binadhan-6. M.S. (Ag.Ext.Ed.). Thesis, Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh.

Hossain, M.M. (2003). Farmers' Knowledge and Adoption ofBoro Rice Cultivation Practices. M.S. (Ag. Ext. Ed). Thesis, Department of Agricultural Extension Education, Bangladesh Agricultural Universtiy, Mymensingh.

Hoque, M. F. (2005). Adoption of Selected Modern Boro Rice Varieties by the Farmers in Three Selected Villages of Sadar Upazila of Mymensing District. MS. (Ag. Ext. Ed) Thesis. Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh.

Huitt, W.(2004). Bloom et al. Taxonomy of the cognitive domain. Education Psychology Interractive. Valdosta, GA: Valdosta State University. Retrived,from http://chiron.valdosta. edu/whuitt/col/cogsys/bloom.html.

Islam, K.M.M. (1993). Knowledge and Attitude of the Block Supervisors on Selected Modern Agricultural Technologies. M.Sc. (Ag. Ext. Ed.) Thesis, Department of Agricultural Extension and Teachers' Training, Bangladesh Agricultural University, Mymensingh.

Islam, M. A. (2005). Farmers' Knowledge and Practices in Using IPM Crop Production. M.S. Ag. Ext. Ed). Thesis, Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh.

Islam, M.N. (2008). Knowledge on Vegetables Production Activities by Woman Members in Homestead Area Under World Vision Project. M.S. (AEIS). Thesis, Department of Agricultural Extension and Information System, Sher-e-Bangla Agricultural University, Dhaka.

Jha, B.K. and R.L. Shaini. (1994). A Study on Technological Gap Cattle Rearing Practices in a Tribal Sitting of Burdawn District (W.13.) Indian Journal of Dairy Science. 47(11): 921-925.

Kaur, M.R. (1988). An Evaluation Study of Women Development Programme Under Indo- German Dhauhadhar Project Palampur District Kumgra, H.P. Thesis Abstract. Harayana Agricultural University, Hissar, India. Thesis Abstract. 16(4): 258.

Khaleque, A. (1993). Bangladesh Research Develops New Fertilizers, The Bangladesh Observer, 26 September 93: 12. Rahman, M. M. 1986. Correlation of Adoption of Improved Practices in Transplanted Aman Rice. Bangladesh Journal of Extension Education,1(2):75.

Lansing, E. Michigan and V. G. Carter. (1945). Dictionary of Duration. New York and London: McGraw-Hill Book Company, Inc.

Manjunatha, L. (1980). A Comparative Study of The Knowledge Level and Adoption Behaviour of Trained and Untrained Farmers In Ghata Probha

Command Area, Karantaka State. The Thesis Abstract (1983).Haryana Agricultural University, Hisar, India. 9(1-4):18.

Miah and Rahman (1995) found that the level of education of the farmers had positive significant relationship with the awareness on farming environment.

Ministry of Finanace. (2015). Economic Review, 2015.

Mondal. T. (2014). Farmers' Knowledge, Attitude and practice regarding Strawberry Cultivation. M.S. Thesis. Dept. of Agricultural Extension& Information System, Sher-e-Bangla Agricultural University, Dhaka.

Nasrin, S. (2015). Farmers' knowledge on pesticide application in vegetable cultivation. M.S. Thesis. Dept. of Agricultural Extension & Information System, Sher-e-Bangla Agricultural University, Dhaka.

Nurzaman, M., Salehin, M.M. and Islam, M.N. (2001). Knowledge, Attitude and Practice on Integrated Pest Management Between Male and Female FFS Farmer. Bangladesh Journal of Training and Development. Vol.14.NO.1&2, 2001: 173-182.

OIA (1989). Office of International Affairs. Lost Crops of the Incas: Little Known Plants of the Andes with Promise for Worldwide Cultivation.nap.edu. p:92.

Parveen, S. (1995). Awareness of Farm Women on Environmental Degradation Due to The Use of Some Selected Modem Agricultural Technologies. M.S.(Ag. Ext. Ed.) Thesis, Department of Agricultural Extension and Teachers' Training, Bangladesh Agricultural University, Mymensingh.

Pingali, P.L., (1995). Impact of pesticides on farmer health and the rice environment: an overview of results from a multidisciplinary study in the Philippines. In: Pingali, P.L., Roger, P. (Eds.), Impact of Pesticides on

Farmer Health and the Rice Environment. Kluwer Academic Publishers, Boston.

POP (2009). Potatoes to Plastics. University of Maine.

Pradhan, G.A. (1969). Use of pesticides to control pest and maximize the production of potato. J. Econ. Entomol.63(1): 290-294.

Rahman, M. H. 1993 “Participation of Women in Rural Development: An Experience of Comprehensive Village Development Program”.The Bangladesh Rural Development Studies. 6(1): 47-57.

Rahman, M. Z. (2006). Knowledge of the Farmer’ on Prawn Culture in a Selected Area of Khulna District. M. S. (Ag. Ext. Ed). Thesis, Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh.

Rahman, M. A. (2015). Farmers’ Knowledge and Attitude Regarding Cultivation of Salt Tolerant Variety (BRRI dhan 47) of Rice. M.S. Thesis. Dept. of Agricultural Extension & Information System, Sher-e-Bangla Agricultural University, Dhaka.

Rashid, M. M. (1998). Vegetable Crop Agribusiness- A Consultancy Report. Prepared for the Project: strengthening of Bangladesh AVRDC Vegetable Research Development Programme. 253p.

Ray, G.L., P. Chatterjee and S.N. Banerjee. (1996). Technological Gap and Constraints in Agricultural Technology Transfer. Naya prakash, Kolkata, India pp. 94.

Rosenberg, M. and C. I. Hovland, (1960). Research on Communication and Attitude coated in Triandis, H.C. (1971). Attitude and Attitude Change. John Wiley Publisher, New York.

Roy, K.K. (2006). Farmers‟ Knowledge on Boro Rice Cultivation in some Selected Areas of Dinajpur District (unpublished M.S. thesis). Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh, Bangladesh.

Saha, M. (2001). Farmers‟ Knowledge on Improved Practices of Pineapple Cultivation. M.S. (Ag. Ext. Ed.) Thesis, Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh.

Sana, M.C. (2003). Farmers‟ Knowledge of Shrimp Cultivation in Ashasuni Upazila Under Satkhira District. M.S. (Ag. Ext. Ed.) Thesis, Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh.

Sarker, T.M. (1993). Fisheries Resources on the brink of Danger. The Bangladesh Observer, 24 May 93:8.

Siddique, M.A. and Rashid, (1990). Scope of increasing Indegenous variety of Bangladesh B.A.D.C. Dhaka, Bangladesh,pp: 166-167

Sharma, H.O., R.P. Singh and P. Mahesh. (2003). Production Constraints in Adoption of Improved Chickpea Technology in Madhya Pradesh. Indian Journal of Pulses Research. 16(2): 125-127.

Singh, T. and R. I. Kherde. (1998). Relationship Analysis between Selected Independent Variables and Technological Gap in Western Dry Region. Journal of Dairying Food and Home Sciences. 17 (3-7): 229-232.

Singh, S. P., R. S. Hudda and H. K. Verma. (1991). Knowledge gap of Citrus Growers.Indian Journal of Extension Education. XXVII (1&2): 117-120.

Spooner, D. M., Karen, M., Gavin, R., Robbie, W., Bryan, G. J. (2005). A single domestication for potato based on multilocus amplified fragment length polymorphism genotyping. PNAS, 102 (41): 14694-99.

Sutradhar, N.C. (2002). Farmers' Awareness on Environmental Degradation caused by the use of modern Agricultural Technologies. M.Sc. (Ag. Ext. Ed.) Thesis. Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh.

Tanushree, M. (2015). Farmers' Knowledge, Attitude and practice regarding Strawberry Cultivation. M.S. Thesis. Dept. of Agricultural Extension & Information System, Sher-e-Bangla Agricultural University, Dhaka.

Thakral, K., P. Bhatnagar and S.S. Punic. (2001). Assessment of Front Line Demonstrations on Mustard in North-western Region of 1-Iaryana. Annals of Agri-Bio Research. 6(1): 73-76

Tantray, A.M and K.M. Dar. (1996). Technological Gap in Cultivation of Sarson. Indian Journal of Extension Education. 32(1 to 4): 75-76

Uddin, M.B. (2001). Opinion of Block Supervisors on Environmental Hazarads and Associated Problems Due to Continuous and Intensive Rice Cultivation. M.Sc. (Ag. Ext. Ed.) Thesis, Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh.

Venugopal, M.K. (1977). Evaluation of Rice Training Program Conducted at Indo-Japancsc Agricultural Extension Training Centre, Mandhya, Karnaltaka Stale. *Thesis Abstract,* Haryana Agricultural University. 3(1-3): 14-15.

Verma, H.D., M.A. Munshiand and M.N. Popat. (2003). Status of Technological Gap in Groundnut Production. International Arachis News letter, 23: 30-32.

Vidyashanker, P.N. (1987). A Study of different Characteristics of Seed Growers of Bangladesh Districts. Thesis Abstract 11(4): 256. Directorate of Publication, Haryana Agricultural University, Hissar, India

Yadav, D.S., I.K. Singh and I.S. Sohi, (2001). Technological Gap in the Use of Nitrogenous Fertilizer in Kharif Crops. Annual Journal of Agricultural Research. 27(1-2): 103-110.

APPENDIX A

Department of Agricultural extension and information system

Sher-e-Bangla Agricultural University

Dhaka-1207

An Interview Schedule on

"FARMER'S KNOWLEDGE GAP ON USING AGROCHEMICALS IN POTATO CULTIVATION"

(This interview schedule is entitled for a research study)

Serial No:

Respondent Name:

Village:

Union:

Upazila:

District:

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

1.Age:

How old are you?

Ans:.....years.

2.Level of Education:

Please mention your level of education.

a) I cannot read or write.

b) I can sign only

c) I have studied up to class (…..)

3. Farm Size:

Please indicate the area of land under your possession:

Sl No.	Types of land use	Land area	
		Local unit	**Hectare**
1.	Homestead area		
2.	Own land under own cultivation		
3.	Given to others as borga		
4.	Taken borga from others		
5.	Taken lease from others		
6.	Others (Pond, Orchard etc.)		
	Total		

4. Potato cultivation area:

How much area you cultivated potato last year?

Ans: ……. decimal.

5. Annual Family Income:

Please indicate the income of your family from different sources in the last year.

Sl. No.	Sources of income	Amount of Production	Value (TK)
1.	Rice		
2.	Wheat		
3.	Vegetables		
4.	Potato		
5.	Maize		
6.	Livestock & Poultry		
7.	Fisheries		
5.	Service		

6.	Business		
7.	Others (please specify)		
Total			

6. Percentage of income from potato cultivation:

Please mention the percentage of income coming from potato cultivation.

% of income from potato cultivation =

$$\frac{\text{income from potato x 100}}{\text{total income}}$$

7. Experience in Potato Cultivation:

Please state the duration of your direct involvement in potato farming.

Ans:……years

8.Extension media contact:

Please indicate your extent of contact with following media:

SI. No	Communication media	Extent of communication				
		Regularly	Frequently	Occasionally	Rarely	Not at all
Individual contact						
1	Friend/ Neighbor					
2	Sub Assistant Agricultural officer(SAAO)					
3	Upazila Agriculture Officer/Additional Agriculture Officer/Agriculture Extension					

	Officer					
4	NGO Workers(s)					
5	Local leader					
6	Agricultural input dealer(s)					
Group contact						
I	Participation in group discussion					
2	Participation in demonstration meeting (Result & method demonstration)					
3	Participation in Field Day/Farmers Rally					
Mass contact						
1	Listening agricultural program in radio					
2	Watching agricultural related program in television					
3	Reading agricultural magazine (Krishi Katha/Leaflet/ Booklets etc.)					

9. Time spent in potato farming:

What extent you spend time for potato cultivation?

Ans: …… hrs/week.

10. Distance of farmer's home to nearest market:

What is the distance between your home and the nearest market?

Ans: ……km.

11. Knowledge gap of potato farmers on using agrochemicals:

Please answer the following questions

Sl No.	Questions	Full Marks	Marks Obtained	Knowledge Gap
Remembering				
1.	What are the fertilizers needed for potato cultivation?	2		
2.	What is the recommended dose of urea in potato cultivation?	3		
3.	Mention two pesticides and their use in potato cultivation.	2		
Understanding				
4.	Why do you use TSP during land preparation?	3		
5.	In what direction of wind pesticide should be sprayed?	2		
6.	How do you treat late blight disease in potato?	3		
Applying				
7.	What precautions you generally take before applying pesticides?	3		
8.	How much spray mix (pesticide + water) you need for the per tank to finish the spraying the field?	3		
Analyzing				
9.	How could you understand that your field is attacked by potato leaf roll disease?	3		
10.	How can you understand the deficiency symptoms of nitrogen fertilizer?	2		
Evaluating				
11.	If you find insect infestation in your field, what will you do first?	2		

12.	How will you determine the rate of fertilizer application in your field?	3		
Creating				
13.	If SAAO suggest you to control pest with less relying on chemical pesticides, then what you will do?	3		
14.	Less or high of recommended doses of fertilizer is harmful, do you agree? Explain.	3		
Total				

Date:……

……
Signature of interviewer