ASSESSMENT OF INNOVATION ADOPTION COMPETENCY OF THE FARMERS UNDER GOVERNMENT AGRICULTURAL EXTENSION SERVICES

A Thesis
By

SUMAYA TASKIN

MASTER OF SCIENCE
IN
AGRICULTURAL EXTENSION

Department of Agricultural Extension
Hajee Mohammad Danesh Science and Technology University
Dinajpur

December 2019

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Student No. 1805310
Semester: Jul-Dec 2019

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Approved as to style and content by

_____	_____
Professor Dr. Md. Abu Sayed Mondol	**Professor Dr. Md. Faruq Hasan**
Supervisor	Co-Supervisor

_____
Professor Dr. Md. Faruq Hasan
Chairman
Examination Committee
and
Chairman, Department of Agricultural Extension
Hajee Mohammad Danesh Science and Technology University
Dinajpur

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ABSTRACT

The purposes of the study were to determine the extent of competency of the farmers on innovation adoption, to determine the relationships between the extent of competency of the farmers and their selected characteristics and to explore the problems confrontation of the farmers in adopting innovation. Data were collected from four villages (Shuvra, Sadipur, Mostofabad and Mujahidpur) of Chehelgazi union of Sadar upazila under Dinajpur district during 12st August to 10th September 2019. The sample size of the study was 105 farmers and it was drawn from a population of 997 using simple random sampling method. Structured interview schedule were used for data collection. To measure the competency of the farmers on innovation adoption, 18 statements under three aspects of competency were measured along with a four-point rating scale. The majority of the farmers (61.90 percent) had medium competency, 20.00 percent had low competency and 18.10 percent had high competency on innovation adoption. Among the ten selected characteristics of the farmers six characteristics namely; educational qualification, annual family income, training received, extension media contact, attitude towards technology and scientific orientation had positive significant relationships, while age had negative significant relationship and household size, farm size and organizational participation had non-significant relationships with their competency on innovation adoption. Out of 18 statements of competency on innovation adoption 'controlling insect pest problem by sex pheromone trap' has ranked first (232) while 'accelerating planting and harvesting process by combine harvester (74) has last ranked as mentioned by the farmers. 'High cost of modern agricultural machineries' was the top ranked problem mentioned by the farmers followed by 'not getting fair price of agricultural produces' and 'lack of government incentives'.

CHAPTER 1

INTRODUCTION

1.1 General Background

Agriculture provides a livelihood to half of the world population even today as the basic source of subsistence for man over thousands of years. Bangladesh is mainly an agro-based country with area of 1, 47,570 sq. kilometers. The development of Bangladesh depends largely on the development of agricultural sector. More than 168 million people live in this country with a density of 1,115.62 people per sq. km. in 2019. Literacy rate goes up in Bangladesh. According to BBS (2018) the literacy rate of Bangladesh is 73.9%. Bangladesh has moved three spots up in the Global Human Development Index (HDI) 2018 to rank 136th out of 189 countries, according to the latest Human Development Report. In the first quarter of 2019, Bangladesh's was the world's seventh fastest growing economy with a rate of 7.3% real GDP annual growth (IMF, 2019). However, the country has a very small economy in terms of GDP and per capita income. Agriculture is the backbone of the economy and it contributes 14.74% of the GDP in Fiscal Year 2017-2018 (BBS, 2018).

Most of the people in the country lives in rural areas and they depend on agriculture directly or indirectly for their livings. The farm families are the main contributor to the economy and also the major portion of the population. The socio-economic condition of the farmer is very poor. To develop their livelihood adoption of agricultural innovation is important. Mechanization and technological advancement is necessary to accelerate farm activities as well as agricultural productivity. The cropping intensity and production of food crops has recently been increased significantly due to adoption of mechanized tillage, irrigation, and spraying operations (Sarker, 2000). By the early 2010s, these figures increased to at least 0.55 million power tillers (Ahmmed, 2014), 1.61 million pumps (BBS, 2011; BADC, 2013), and 0.25 million threshers. Use of irrigation pumps has been a key ingredient in Bangladesh’s current level of rice self-sufficiency (Hossain, 2009; Mainuddin and Kirby, 2015).

From time, immemorial agricultural sector of Bangladesh was operated by manual labor. Though manual labor utilization is significantly contributing in employment generation for the skilled and unskilled labor forces but it is hard to get higher yield from the field, because manual labor work is highly time consuming. But now-a-days there are many

innovative farm machineries in agricultural field which require less manpower and saves time. Innovation is a major instrument in social and economic development; especially, eco-friendly innovation stimulates not only production but an efficient use of natural resources as well. Generally speaking, agricultural innovations are conceptualized as being embodied in a physical technology, a practice or technique, or a skill. Getting a new idea adopted can be very difficult. This is all the more frustrating when it seems to the proponents of the new idea that it has very obvious advantages. Rural sociologists have studied the adoption of such agricultural innovations as specially bred crops (e.g., hybrid corn and high-yield wheat and rice); many kinds of machines (e.g., tractors, harvesters, pumps); chemical and biological fertilizers, pesticides, and insecticides; cropping practices (e.g., soil and water conservation); and techniques related to animal husbandry (e.g., new feeds, disease control, breeding).

However, farmers are the main executor and beneficiaries of these innovations. A well-functioning extension system is an important mechanism for disseminating information and promoting adoption of new farming technology among the farmers who otherwise may lack the knowledge and avenues to new technologies on their own. Provision of quality extension services greatly promotes such adoption and brings changes in agricultural productivity and farm income (Azikiwe *et al.,* 2013). Extension helps to reduce the differential between potential and actual yields in farmers' fields by accelerating technology transfer (i.e., to reduce the technology gap) and helping farmers become better farm managers (i.e., to reduce the management gap). Extension thus has a dual function in bridging blocked channels between scientists and farmers; it facilitates both the adoption of technology and the adaptation of technology to local conditions. The first involves translating information from the store of knowledge and from new research to farmers, and the second by helping to articulate for research systems the problems and constraints faced by farmers (Farrington, 1995). The government of Bangladesh has taken steps for developing the rural farmer communities as many farmers rely on government for agricultural extension services. Therefore, it is important to improve the quality of these services. Public sector extension has been criticized in developing country contexts for using approaches that are not responsive to the needs of the clientele (Chowa *et al.*, 2013). So, innovation adoption is very essential for the farmers to develop their present condition.

1.2 Statement of the Problem

In the early history of agricultural sector farmers used manual equipment for farming or crop production. With the passage time, the population increased rapidly and the gap

between crop production and requirement of food for the millions of people widened. The present scenario is we have to increase our agricultural production. Agricultural production can be increased by using modern technology and adoption of innovative farm machinery in agricultural sector. When a new innovation released in the agricultural field sometime farmers accept it or sometime they reject it. These various happen are certainly caused by many known and unknown reasons. It may be lack of their knowledge about adoption of innovation; farmers are not capable in adoption of new innovative machineries. The skill of farmers is not so rich in adoption of agricultural innovation.

In the view of the above background, facts and the need for having an understanding the competency of the farmers on innovation adoption, the present study with entitled "Assessment of innovation adoption competency of the farmers under government agricultural extension services" was undertaken. The study aimed at providing information regarding the following questions:

1. What is the extent of competency of farmers on innovation adoption?
2. What are the selected characteristics of farmers?
3. What relationships exist between the extent of competency of the farmers and their selected characteristics?
4. What are the problems faced by the farmers in adopting innovation?

1.3 Objectives of the Study

In order to make the study in manageable and operational way the following specific objectives were drawn:

1. To determine the extent of competency of the farmers on innovation adoption.
2. To determine the relationship between the extent of competency of farmers and their selected characteristics. Selected characteristics are

i.	Age	vi.	Training received
ii.	Educational qualification	vii.	Organizational participation
iii.	Household size	viii.	Extension media contact
iv.	Farm size	ix.	Attitude towards technology
v.	Annual family income	x.	Scientific orientation

3. To explore the problems confrontation of the farmers in adopting innovation.

1.4 Justification of the Study

The sustainable growth of the agricultural sector critically depends on the adoption of improved, scale-appropriate and eco-friendly technologies, including new disease-resistant

and climate-adjusted seeds, modern management practices and conservation of resources using new agricultural machineries. The adoption of new technology in agriculture is, therefore, at the core of agricultural growth and thus, rural poverty can be alleviated. Unfortunately, the adoption of new agricultural technology, including agricultural machinery, is seldom rapid (Pierpaoli *et al.,* 2013) and as a large number of factors can affect the adoption process (Feder *et al.,* 1986). This is because; new agricultural technologies are often correlated with risks and uncertainties about proper application, scale appropriateness and suitability with the prevailing environment and importantly with farmers' perceptions and expectations (World Bank, 2008). So assessing farmers' competency on innovation adoption is critically important to ensure sustainable growth and development of the agriculture sector.

Innovation in agriculture plays a key role in feeding our country, improving the quality of our natural resources and enhancing the quality of life of our citizens. Both in terms of R&D and scope; the users i.e. farmers must clearly understand how the development and adoption of innovation will bear potential contributions in agriculture. To make more effective and enforce any program or projects in this line, we should know the farmers' competency on innovation adoption. However, very few researches have been reported in our country to assess farmers' competency in this regards. Considering all these important points, the innovation adoption competency of the farmers has been considered as the central theme of this study. This study might become a useful reference for policy makers, development planners, extension workers and all concerned related to innovation issue to assess farmers' competency and to know the possible ways to overcome those problems.

1.5 Assumptions of the Study

An assumption is the supposition that an apparent fact or principle is true in light of the variable evidence. An Assumption is taken as a factor believed to be true without proof. The research was carried out keeping the following assumptions in mind:

1. The respondents included in the sample for this study were capable to furnish proper responses to the question set up in the interview schedule.
2. Views and opinions furnished by the respondents included in the sample were the representative view and opinion of the whole population of the study area.
3. The responses furnished by the respondents were reliable.

4. The researcher who acted as interviewer was very well adjusted to the social and cultural environment of the study area. Hence, the respondents furnished their correct opinions without any kind of hesitation.
5. The data collected by the researcher were free from bias and they were normally distributed.
6. The respondents selected for the study were component to satisfy the quarries of the research.

1.6 Limitations of the Study

The study was undertaken with a view to have an understanding of the competency assessment of the farmers on innovation adoption. However, in order to make the study manageable and meaningful from the research point of view, it became necessary to impose certain limitations as noted below:

1. The study was confined only Sadar Upazila under Dinajpur district.
2. Various individual characteristics might have influenced on the competency of the respondents. However, only ten individual characteristics are selected for investigation in this study.
3. The researcher relied on data collected from the farmers were furnished by them from their memory during interview.
4. The competency of the farmers was measured on the basis of their responses to the 18 selected statements.
5. There were many farmers in the study area but a few farmers were randomly selected from the study area due to limitation of time and resources.
6. For some cases, the researcher faced unexpected interference from the over interested side talkers while collecting data from the target respondents.

1.7 Definition of Important Terms

For clarity of understanding, certain terms frequently used throughout the study are defined and interpreted as below:

Innovation: An innovation is an idea, practice or object which perceived as new by an individual or other unit of adoption.

Adoption: Adoption means the action or fact of choosing to take up, follow or use something.

Competency: A competency is a broad grouping of knowledge, skill and attitude that enable a person to be successful at a number of similar tasks.

Assessment: Assessment is the process of gathering, analyzing, interpreting and using information about students' progress and achievement to improve teaching and learning.

Competency assessment: Competency assessment is an ongoing process of continually building knowledge, skills and attitudes.

Knowledge: Knowledge literally means knowing or what one knows about a subject, fact, person etc. Knowledge, however, refers to the amount of facts or information about an idea, object or person that a person knows.

Skill: A skill is ability, usually learned and acquired through training, to perform actions, which achieve desired outcome.

Attitude: Attitude meant one's feelings, beliefs and tendencies towards an object and concept. It was a state of readiness that influences a person to act in given manner. Attitude is a relatively stable tendency to respond with and positive or negative effect to a specific referent.

Problem: Problem means something that causes difficulty or that is hard to deal with. The term problem is referred to difficulties faced by the farmers in case of innovation adoption.

CHAPTER 2

REVIEW OF LITERATURE

The purpose of this Chapter is to review of literature having relevance to the present study. The researcher made and elaborated search of available literature for this research. But no study was found in this area. Therefore, attempt has been made in this Chapter to review some interlinked literature on this aspect from home and aboard. However, very few of these studies were related to the study of farmers' competency on innovation adoption.

2.1 Concept and Meaning of Important Terms

2.1.1 Innovation

Innovation is a word that is derived from the Latin word *Innovare*, this means 'into new'. The simplest definition of innovations is doing something different. Innovation can also be explained as new idea, product, device or novelty. It is a mind-set, a way of thinking beyond the present and into the future. Innovation is the process of generating and combining ideas to make a relationship between present accomplishments and past experiences to solve a future problem.

Baregheh *et al*. (2009) brought a suggestion of a complete and multi stage process definitions of innovation: 'Innovation is the multi-stage process whereby organizations transform ideas into new/improved products, service or processes, in order to advance, compete and differentiate themselves successfully in their marketplaces'.

Rogers (2003) defined innovation as any idea, product, process or object that is perceived as new to an individual or group. Innovation can take many forms and can be incremental, in which small changes occur based on current experience, radical, where a breakthrough in science or technology provides a new change, or modular, where there is a change in concept within a component of a larger system (Blayse, 2004). For a product, process or idea to be considered an innovation, it does not need to be something new pertaining to the time when it was created, but rather the newness of the innovation can be measured if it is new to the individual or adopting unit. The newness of an innovation is often gauged on a person's knowledge, or decision to adopt (Rogers, 2003).

Innovations initiating new process or events, it also bring changes in behavior, personnel and approach and encompass much more than simply establish an effective tool (Reiman and Dotger, 2008). Innovation is an activity which companies solve problems by combining knowledge (Fri *et al*., 2013).

2.1.2 Adoption

Generally adoption means the action or fact of choosing to take up, follow, or use something. Adoption is a decision of "full use of an innovation as the best course of action available" and rejection is a decision "not to adopt an innovation" (Rogers, 2003), Adoption results from diffusion process. In the innovation change process, creativity leads to invention, and the first introduction or implementation of an invention is innovation, which could lead to adoption. Roger (1999) perceives the diffusion process as the spread of a new idea from its source of invention or creation to its ultimate users or adopters. The adoption process is thus the mental process through which an individual passes from first hearing about an innovation to final adoption.

2.1.3 Competency

A competency is a broad grouping of Knowledge, Skill and Attitude (KSA) that enable a person to be successful at a number of similar tasks. Competency could be divided into skills, knowledge and attitudes as per the Blooms Taxonomy (Bloom *et al*., 1964) and it elaborates that cognitive domain relates to mental skills (known as knowledge), psychomotor domain is concerned with manual or physical skills (known as skills), while the affective domain for growth in feelings or emotional areas (known as attitudes).

Knowledge: Information stored in someone's mind is called the knowledge. Knowledge is generally divided in to two types of capabilities as to understand and remember. The knowledge based outcomes lead to skilled behaviors are the recalling and explaining of underpinning knowledge which are factual and conceptual. Factual knowledge further divides in to knowing about objects, events or people and situations. Conceptual knowledge exists in two common forms as specific concepts and rules or principles which link concepts or facts. Therefore, we can define four types of knowledge and as per the Knowledge Model (Bloom, 1976) which could be described in terms of facts, procedures, concepts and principles.

Skills: A skill is the ability to carry out a task with determined results often within a given amount of time, energy, or both. When practical activities are performed by a person in a competent manner, we tend to call him/her as skilled person. According to Romiszowski (1990) skills are basically divided in to four categories which are given below:

1. Cognitive skill – Someone's thinking ability
2. Psychomotor skill – Someone's physical ability to perform tasks
3. Reacting skill – Someone's attitudinal reactions in terms of feelings or values towards things, situations or people
4. Interacting skill – Someone's skills on interacting to achieve specified goals such as communication, education, acceptance, persuasion etc.

Attitudes: The attitude of a person is determined by psychological factors like ideas, values, beliefs, perception, etc. It is also defined as 'a mental and neural state of readiness organized through experience, exerting a directive or dynamic influence upon the individual's response to all objectives and situations with which it is related'. In practice, the term 'attitude' is interchangeably used with terms such as values, judgments, beliefs, emotions, opinions, intentions or intentions (Bagozzi, 1994).

2.2 Reviews on Competency of the Farmer

Ubochioma *et al.* (2018) studied about seeks to outline competencies relevant to the needs of agriculture extension workers in carrying out their assigned duties to the satisfaction and joy of farmers. Results showed the current roles of extension and advisory services providers includes: dissemination of research results (100%), evaluating local extension programmes (100%), homes and field visit to famers (100%) among other roles. The following core competencies were needed- teaching skills (M=3.54), program planning (M=3.42), program implementation (M=3.77), education/information (M=3.88), program evaluation (M=3.34), knowledge management (M=3.34) among others. Again competent extension officers would accomplish the following dissemination of technologies (M=3.39) harnessing local knowledge (M=2.80), conveying extension messages (M=2.56) and maintaining relationship with farmers (M=3.32).

Umar *et al.* (2017) studied about competencies of agricultural extension workers in Malaysia. They found that 33 core competencies were used to evaluate these competencies

among agricultural extension workers. They noted that any capacity development program such as in-service training should pay more attention to which competencies with lower scores among agricultural extension workers to enhance these competencies among them.

Zarei *et al.* (2017) in their study indicated 28 competencies of farmers in agricultural e-commerce, which are classified into three sub categories, namely knowledge, attitude and skill competencies. The list of farmers' agricultural e-commerce competencies is like a pattern for agricultural educators to plan their teaching outlines towards enhances these competencies among farmers. In addition, it can be used as a benchmark to 1) define farmers' competency standards, 2) measure competency level of each farmer, 3) identify skills and knowledge where training is required based on competency gaps, and 4) determine the type and extent of training needed in agricultural e-commerce.

Farid *et al*. (2015) in their study examined the extent of adoption of improved farm practices by the farmers of northern Bangladesh and determined the influencing factors for adopting these practices. The farm practices adopted mainly by the farmers are modern varieties, line sowing, power tiller, optimum tillage, balanced fertilizer, STW/DTW, IPM, balanced irrigation, rice weeder, sprayer and thresher. Among all practices, 'power tiller' adoption is the highest and 'line showing' is the lowest. Finally, the researcher reported that socio-economic factors influencing adoption of improved farm practices may be taken into consideration while accelerating the face of technology adoption under farming system.

Kiplangat *et al.* (2015) studied about the effect of human competencies in adoption of e-commerce strategies among small and medium enterprises in Kenya. The results showed that ICT competencies among managers and employees influence the adoption of electronic commerce.

Mangkunegara and Waris (2015) explored the effect of competence on employee performance in company. The results of this study indicated that competencies of employee have a positive influence on the performance. They noted that competence is an important factor in order to achieve individual and company performance and if the employee has a good competence, then, he will work well in completing the work.

Mulder (2015) in his study reported that competence needs to be related to performance because the use of skills, knowledge and attitudes in professional action expresses the possession of competence and it is related to effective performance.

Anka (2014) developed a study to assess the factors affecting acceptance of agricultural innovations in Zurmi Local Government Area of Zamfara State of Nigeria. It was found that data regarding responses to new innovations have shown that (35%) of the respondents accepted new innovations while (65%) rejected the idea.

Martina *et al.* (2012) stated that identification and development of managerial competencies are important tools of human resources management. They identified twenty-seven competencies in knowledge-based organizations in the Czech Republic using content analysis method.

Islam *et al*. (2013) conducted a study on competency of the farmers on the application of One House One Farm approach and found that majority of the respondents (94%) had medium competency compared to 2% of them having high competency and only 4% respondents under low extent of competency.

Jabbar *et al.* (2011) found in their study that when technologies are scale neutral, poor and marginal farmers may not be aware about them and may not adopt them or adopt inadequately due to lack of knowledge and access to inputs and services.

Pearcy (2011) reported that economic justification, congruency with current practices, enjoyment, family acceptance, and availability of a local knowledgeable farmer were the most influential factors in adopting new practices.

Khosrowpour (2008) explored the necessary competencies for successful adoption and assimilation of business- to- business e-service in small and medium size corporations (SMES).

Taylor *et al.* (2004) noted that small and medium enterprises managers need to ensure that those undertaking electronic commerce development work have the necessary skills and knowledge to undertake such work in a competent and professional manner. They found that there is a wide variety of skills and knowledge required for electronic commerce projects in the small and medium enterprises sector and some of these most important competencies were determined.

2.3 Reviews on Relationships between the Selected Characteristics of the Farmers and their Competency on Innovation Adoption

2.3.1 Age and competency

Out of 12 studies reviewed by the researcher, 6 showed positive relationship, 2 negative and 4 no relationships between age of the respondents and competency (knowledge, skill/capacity and attitude). The summary of the reviews is given in Table 2.1.

Table 2.1 Summary of the reviews of relationships between age and competency

Researchers (Year)	Focus issue	Relationship		
		'+'ve	'-'ve	No
Knowledge				
Quayum (2018)	Farmers' knowledge on groundnut cultivation			√
Rahman (2015)	Farmers' knowledge and attitude regarding cultivation of salt tolerant variety	√		
Singh *et. al.* (2014)	Knowledge and attitude farmers towards improved wheat production technology	√		
Karim *et. al.* (2011)	Farmers' knowledge on quality seed production	√		
Skill/capacity				
Afrin (2017)	Farmers' innovation capacity in adoption of farm machineries			√
Tambo (2014)	Building farmers' capacity for innovation generation	√		
Amlaku (2012)	Innovation capacity in dairy production systems			√
Attitude				
Kaiser (2016)	Extension workers' attitude towards e-agriculture		√	
Parvin (2015)	Farmers' attitude towards four cropping pattern		√	
Ahmed (2014)	Farmers' attitude towards extension service	√		
Parvez (2007)	Farmers' knowledge, attitude and practices in using IPM			√
Kaiser (2016)	Extension workers' attitude towards e-agriculture		√	
Parvin (2015)	Farmers' attitude towards four cropping pattern		√	
Ahmed (2014)	Farmers' attitude towards extension service	√		
Parvez (2007)	Farmers' knowledge, attitude and practices in using IPM			√
Alam (2004)	Attitude of rural women towards homestead vegetable cultivation	√		

2.3.2 Educational qualification and competency

Out of 12 studies reviewed by the researcher, 7 showed positive relationships, 1 negative and 4 no relationships between the educational qualification of the respondents and competency (knowledge, skill/capacity and attitude). The summary of the reviews is given in Table 2.2.

Table 2.2 Summary of the reviews of relationship between educational qualification and competency

Researchers (Year)	Focus issue	Relationship		
		'+'ve	'-'ve	No
Knowledge				
Quayum (2018)	Farmers' knowledge on groundnut cultivation	√		
Rahman (2015)	Farmers' knowledge and attitude regarding cultivation of salt tolerant variety	√		
Abdullah (2013)	Farmers' knowledge on pond fish farming	√		
Karim (2011)	Knowledge on quality seed production	√		
Akhter (2003)	Farmers' knowledge on agricultural activities			√
Skill/capacity				
Afrin (2017)	Farmers' innovation capacity in adoption of farm machineries	√		
Tambo and Tobias (2014)	Building farmers' capacity for innovation generation			√
Amlaku (2012)	Innovation capacity in dairy production systems	√		
Attitude				
Kaiser (2016)	Extension workers' attitude towards e-agriculture			√
Parvin (2015)	Farmers' attitude towards four cropping pattern		√	
Ahmed (2014)	Farmers' attitude towards extension service			√
Parvez (2007)	Farmers' knowledge, attitude and practices in using IPM	√		

2.3.3 Household size and competency

Out of 11 studies reviewed by the researcher, 4 showed positive relationship, 2 negative relationships and 5 no relationships between the household size of the respondents and competency (knowledge, skill/capacity, and attitude). The summary of the reviews is given in Table 2.3.

Table 2.3 Summary of the reviews of relationships between household size and competency

Researchers (Year)	Focus issue	Relationship		
		'+'ve	'-'ve	No
Knowledge				
Singh *et. al.* (2014)	Knowledge and attitude farmers towards improved wheat production technology	√		
Azad (2013)	Knowledge on postharvest practices of vegetables	√		
Karim *et. al.* (2011)	Farmers' knowledge on quality seed production	√		
Roy (2006)	Farmers' knowledge on boro rice cultivation			√
Shaha (2003)	Farmers' knowledge about system of rice intensification (SRI) activities		√	
Skill/capacity				
Afrin (2017)	Farmers' innovation capacity in adoption of farm machineries			√
Amlaku (2012)	Innovation capacity in dairy production systems			√
Attitude				
Kaiser (2016)	Extension workers' attitude towards e-agriculture			√
Parvin (2015)	Farmers' attitude towards four cropping pattern		√	
Ahmed (2014)	Farmers' attitude towards extension service			√
Parvez (2007)	Farmers' knowledge, attitude and practices in using IPM	√		

2.3.4 Farm size and competency

Out of 14 studies reviewed by the researcher, 6 showed positive relationships, 2 negative relationship and 6 no relationships between the farm size of the respondents and competency. The summary of the reviews is given in Table 2.4.

Table 2.4 Summary of the reviews of relationships between farm size and competency

Researchers (Year)	Focus issue	Relationship		
		'+'ve	'-'ve	No
Knowledge				
Younus (2017)	Farmers' knowledge on climate change	√		
Azad (2013)	Knowledge on postharvest practices of vegetables	√		
Karim (2011)	Farmers' knowledge on quality seed production	√		
Zinia (2010)	Farmer's knowledge in red chittagong cattle rearing			√
Shaha (2003)	Farmers' knowledge about system of rice intensification (SRI) activities		√	
Skill/capacity				
Afrin (2017)	Farmers' innovation capacity in adoption of farm machineries	√		
Tambo (2014)	Building farmers' capacity for innovation generation			√
Amlaku (2012)	Innovation capacity in dairy production systems	√		
Attitude				
Parvin (2015)	Farmers' attitude towards four cropping pattern		√	
Rashid (2014)	Farmers' attitude towards the use of *dolochun* for crop production			√
Husna (2014)	Attitude towards pesticide risk reduction			√
Shahin (2012)	Dairy farmers' attitude towards the use of cattle health card			√
Khan (2012)	Farmers attitude towards modern jujube cultivation	√		

2.3.5 Annual family income and competency

Out of 13 studies reviewed by the researcher, 6 showed positive relationships, 1 negative relationship and 6 no relationships between the annual family income of the respondents and competency. The summary of the reviews is given in Table 2.5.

Table 2.5 Summary of the reviews of relationships between annual family income and competency

Researchers (Year)	Focus issue	Relationship		
		'+'ve	'-'ve	No
Knowledge				
Quayum (2018)	Farmers' knowledge on groundnut cultivation			√
Singh (2014)	Knowledge and attitude farmers towards improved wheat production technology	√		
Azad (2013)	Knowledge on postharvest practices of vegetables	√		
Karim (2011)	Farmers' knowledge on quality seed production	√		
Zinia (2010)	Farmer's knowledge in red chittagong cattle rearing			√
Roy (2006)	Farmers' knowledge on boro rice cultivation			√
Skill/capacity				
Sharmav *et. al.* (2014)	Role of farm women in agricultural operations and decision making pattern	√		
Kadu *et. al.* (2013)	Empowerment of women's SHG through food processing and dairy management practices	√		
Khalil *et. al.* (2013)	Adoption of BARI recommended potato varieties			√
Sarkar (2005)	Empowerment of women beneficiaries under concern Bangladesh			√
Attitude				
Kaiser (2016)	Extension workers' attitude towards e-agriculture	√		
Parvin (2015)	Farmers' attitude towards four cropping pattern		√	
Parvez (2007)	Farmers' knowledge, attitude and practices in using IPM			√

2.3.6 Training received and competency

Out of 12 studies reviewed by the researcher, 9 showed positive relationships and 3 showed no relationships between the training received of the respondents and competency. The summary of the reviews is given in Table 2.6.

Table 2.6 Summary of the reviews of relationships between training received and competency

Researchers (Year)	Focus issue	Relationship		
		'+'ve	'-'ve	No
Knowledge				
Shanto (2011)	Farmers' awareness on environmental pollution	√		
Zinia (2010)	Farmer's knowledge in red chittagong cattle rearing	√		
Islam (2002)	Proshika farmers' knowledge on ecological agricultural practices			√
Rahman (2001)	Farmers' knowledge on Alok 6201 hybrid rice	√		
Skill/capacity				
Afrin (2017)	Farmers' innovation capacity in adoption of farm machineries	√		
Sharma *et. al.* (2014)	Role of farm women in agricultural operations and decision making pattern	√		
Tambo and Tobias (2014)	Building farmers' capacity for innovation generation	√		
Khalil *et. al.* (2013)	Adoption of BARI recommended potato varieties	√		
Sarkar (2005)	Empowerment of women beneficiaries under concern Bangladesh	√		
Attitude				
Kaiser (2016)	Extension workers' attitude towards e-agriculture			√
Kafura (2015)	Farmers' attitude towards four cropping pattern	√		
Parvin (2015)	Use of ICT as extension tool by the farmers			√

2.3.7 Organizational participation and competency

Out of 12 studies reviewed by the researcher, 7 showed positive relationships and 5 no relationships between the organizational participation of the respondents and competency. The summary of the reviews is given in Table 2.7.

Table 2.7 Summary of the reviews of relationships between organizational participation and competency

Researchers (Year)	Focus issue	Relationship		
		'+'ve	'-'ve	No
Knowledge				
Ali (2012)	Knowledge of the vegetable growers on health and environmental perspectives of pesticide exposure			√
Shanto (2011)	Awareness of the farmers on environmental pollution	√		
Kausar *et. al.* (2009)	Fisheries knowledge of the pond owners	√		
Rahman (2006)	Knowledge of the farmers on prawn culture	√		
Islam (2005)	Socio-economic status of fish farming			√
Skill/capacity				
Afrin (2017)	Farmers' innovation capacity in adoption of farm machineries	√		
Sharma *et. al.* (2014)	Role of farm women in agricultural operations and decision making pattern	√		
Khalil (2013)	Adoption of BARI recommended potato varieties			√
Ahmed (2007)	Need assessment for capacity building of women			√
Attitude				
Samad (2010)	Farmers' attitude towards aerobic rice cultivation	√		
Sarker (2001)	Farmers' attitude towards organic homestead gardening program			√
Habib (2000)	Attitude of block supervisors towards the use of agrochemicals	√		

2.3.8 Extension media contact and competency

Out of 8 studies reviewed by the researcher, 5 showed positive relationships and 3 no relationships between the extension of media contact of the respondents and competency. The summary of the reviews is given in Table 2.8.

Table 2.8 Summary of the reviews of relationships between extension of media contact and competency

Researchers (Year)	Focus issue	Relationship		
		'+'ve	'-'ve	No
Knowledge				
Quayum (2018)	Farmers' knowledge on groundnut cultivation	√		
Rahman (2015)	Farmers' knowledge and attitude regarding cultivation of salt tolerant variety	√		
Singh *et. al.* (2014)	Knowledge and attitude farmers towards improved wheat production technology	√		
Mandavkar *et. al.* (2013)	Farmer's knowledge of oilseed production technology	√		
Roy (2006)	Farmers knowledge on boro rice cultivation	√		
Attitude				
Parvin (2015)	Farmers' attitude towards four cropping pattern	√		
Bari (2000)	Attitude of farmers towards hybrids rice Aalok 6201			√
Habib (2000)	Attitude of block supervisors towards the use of agrochemicals			√
Nurzaman (2000)	Knowledge, attitude and practice of FFS and non-FFS farmers in respect of IPM			√

2.3.9 Attitude towards technology and competency

Out of 4 studies reviewed by the researcher, 4 showed positive relationships between the attitude towards technology of the respondents and competency. The summary of the reviews is given in Table 2.9.

Table 2.9 Summary of the reviews of relationships between attitude towards technology and competency

Researchers (Year)	Focus issue	Relationship		
		'+'ve	'-'ve	No
Knowledge				
Shahin (2012)	Dairy farmers' attitude towards the use of cattle health card	√		
Rahman *et. al.* (2007)	A comparison between organic and inorganic farmers	√		
Chowdhury *et. al.* (2006)	Farmers' attitude towards sustainable agriculture	√		
Mannan (2001)	Attitude of proshika farmers towards ecological agricultural program	√		

2.3.10 Scientific orientation and competency

Out of 2 studies reviewed by the researcher, 1 showed positive relationships and 1 no relationships between scientific orientation of the respondents and competency (knowledge, skill/capacity and attitude). The summary of the reviews is given in Table 2.10.

Table 2.10 Summary of the reviews of relationships between scientific orientation and competency

Researchers (Year)	Focus issue	Relationship		
		'+'ve	'-'ve	No
Knowledge				
Quayum (2018)	Farmers' knowledge on groundnut cultivation			√
Pandya and Timbadia (2016)	Attitude of farmers about soil health care programme	√		

2.4 Conceptual Framework of the Study

Conceptual frameworks are a type of intermediate theory that attempt to connect to all aspects of inquiry (e.g. problem definition, purpose, literature review, methodology, data collection and analysis). Conceptual frameworks can act like maps that give coherence to empirical inquiry. Because conceptual frameworks are potentially so close to empirical inquiry, they take different forms depending upon the research question or problem (Wikipedia, 2012).

In this study the researcher attempted to highlight three concepts, namely farmers' selected characteristics, competency assessment of the farmers on innovation adoption and problems being confronted by the farmers in adopting innovation. An individual's competency may be influenced by his personal characteristics and through other interacting forces in his surroundings. As it is quite impossible to deal with all the forces and characteristics in a single study, it was, therefore, needed to be confined with some selected characteristics which were age, educational qualification, household size, farm size, annual family income, training received, extension media contact, organizational participation, attitude towards technology, scientific orientation. However, relating other situational factors with farmers' competency was not considered in this study. Again, problems confrontation in adopting innovation may hamper the formation of positive competency. On the basis of above discussion and review of literature, the conceptual model of this study has been structured as shown in Figure 2.1.

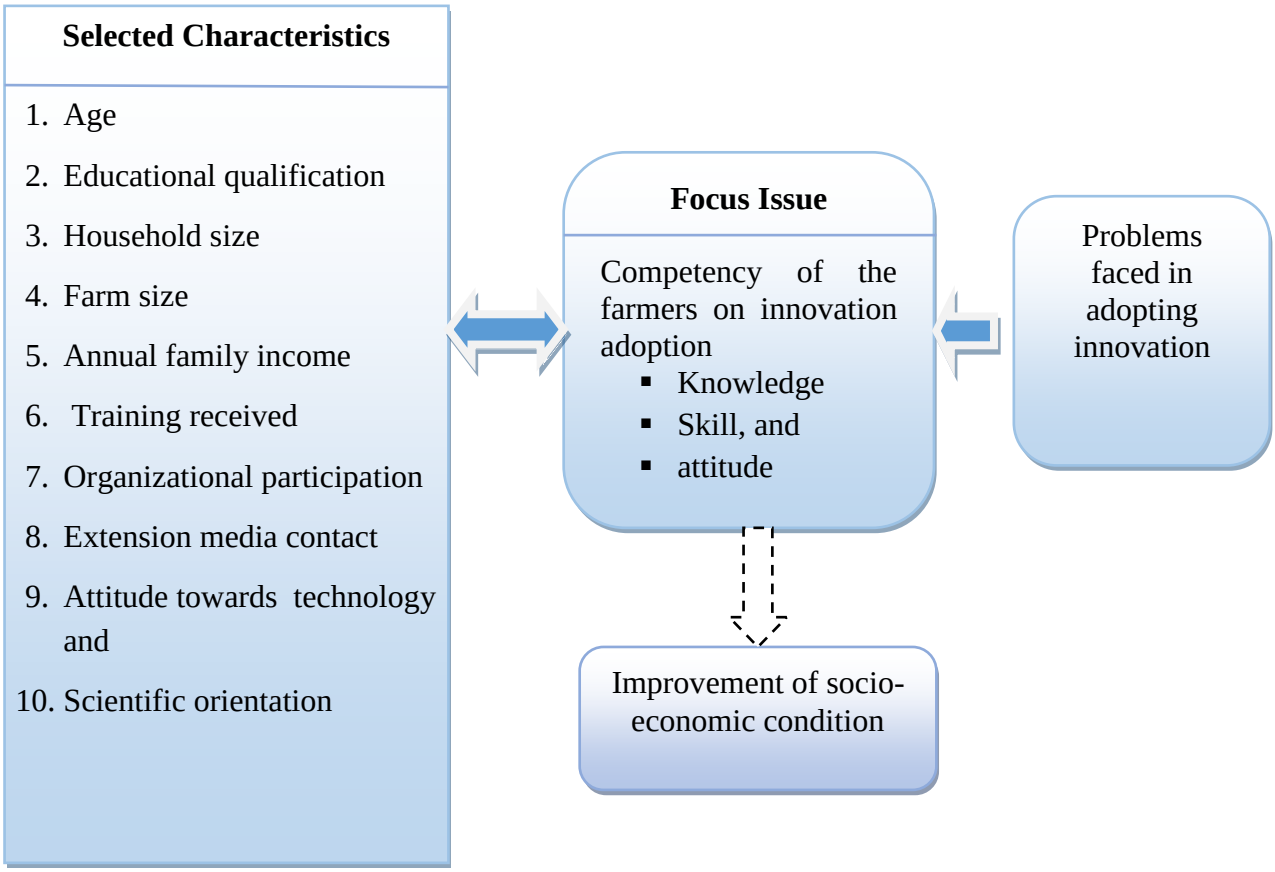

Figure 2.1 Conceptual framework of the study

CHAPTER 3

METHODOLOGY

The methodology used in conducting any research plays a critically important role and deserves careful consideration by the researcher while formulating methods and procedure. It enables the researcher to collect valid and reliable data in terms of hypothesis or research instrument and to analyze the data properly to arrive at correct and valid results. In fact, the research process rests upon on the foundation. However, the methods and operational procedures, operation of variable use in the statistical tests were presented in the subsequent sections of this Chapter.

3.1 Locale of the Study

Sadar upazila of Dinajpur district was considered as the locale of the study purposively. Dinajpur Sadar upazila consists of 10 unions. Out of them only Chehelgazi union had been selected randomly for this study. A map of Dinajpur district showing the Sadar upazila is given in Figure 3.1 and another map of Sadar upazila showing the study area is given in Figure 3.2.

3.2 Populations and Sampling Design

Chehelgazi union consists of 28 villages. Among them, 4 villages were selected randomly for sampling of this study. An updated list of 997 farmers from the selected villages was collected from Upazila Agriculture Office of Sadar upazila under Dinajpur district. A sample of 105 farmers (10.5 percent) was selected by random sampling method. Simultaneously a reserve list of 10 farmers was made in order to use in case of non-availability of sampled farmers during interview. The detailed distribution of population and sample are shown in Table 3.1.

Table 3.1 Distribution of population and sample of the respondents

Upazila: Dinajpur Sadar				
Chehelgazi Union	Name of villages	Population	Sample	Reserve list
	Shuvra	360	38	4
	Sadipur	198	21	2
	Mostofabad	197	21	2
	Mujahidpur	242	25	3
	Total	997	105	10

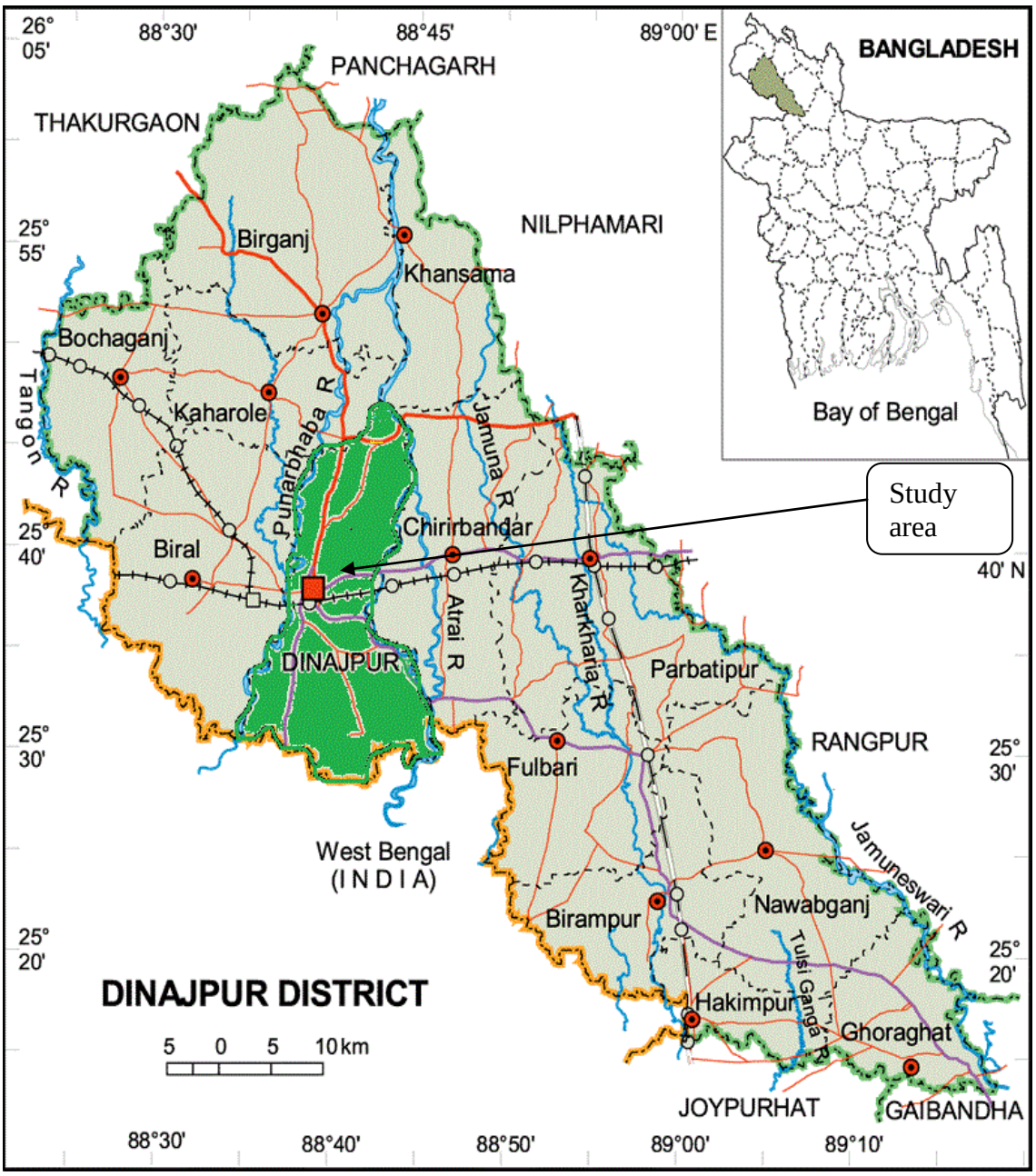

Figure 3.1 Map of Dinajpur district showing Sadar upazila (Bangladesh inset)

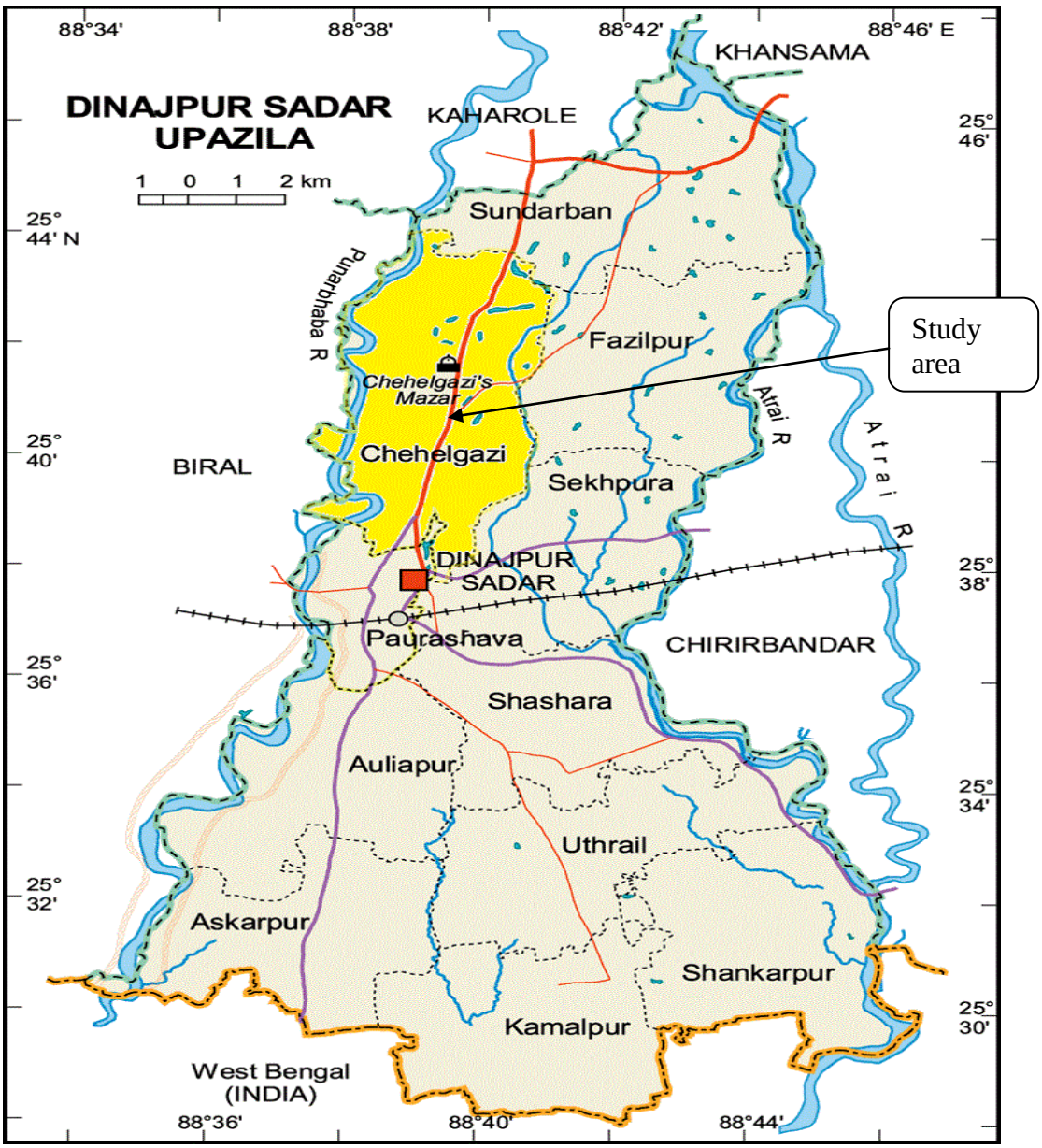

Figure 3.2 Map of Sadar upazila showing the study area

3.3 Research Instruments

A structured interview schedule was carefully prepared keeping the objectives in mind to collect relevant data. The questions and statements contained in the schedule were simple, direct and easily understandable to the respondents. Both open and closed forms of questions were included in the schedule. The draft interview schedule was prepared in advance and it was pretested with 10 respondents from the study area. This pretest facilitated the researcher to identify faulty questions in the draft schedule and hence necessary correction, addition and adjustment were made in the schedule accordingly. The modified and corrected interview schedule was finalized for the data collection. The survey instrument was initially developed in English and later it was translated into Bengali. An English version of interview schedule has been presented in *Appendix A.*

3.4 Methods and Procedure of Data Collection

In the survey, the researcher herself collected data from 105 farmers through structured questionnaire. The researcher first established rapport with the respondents and clearly explained the objectives of the study using local language as far as possible. As a result, the respondents furnished proper response to the questions without any hesitation. The questions were clarified whenever any respondent had difficulties in understanding. Excellent cooperation was received from the respondents and other people of the study area. No serious difficulty was faced by the researcher in collecting data.

3.5 Measurement of Variables

According to the relevant research area, the characteristics of farmers i.e. age, educational qualification, household size, farm size, annual family income, training received, organizational participation, extension media contact, attitude towards technology and scientific orientation were selected as the causal factor of this study. Assessment of competency of the farmers on innovation adoption was the focus issue of the study.

3.5.1 Measurement of selected characteristics

To keep the research within the manageable sphere, ten (10) characteristics of the farmers were selected for the study. The procedures of measurement of the selected characteristics were as follows:

3.5.1.1 Age

Age of a respondent was measured by counting the actual years from his/her birth to the time of interview on the basis of his statement. It was measured in terms of actual years. A

score of one (1) was assigned for each years of age. This variable appears in the question number 1 in the interview schedule (*Appendix A*).

3.5.1.2 Educational qualification

Educational qualification was measured as the ability of the respondent to read and write or the formal education received up to a certain standard. A score of one (1) was assigned for each year of schooling in formal institution. For example, if a respondent passed the SSC examination, his/her education score was assigned as 10. Score 0.5 was given to the respondent who could sign name only and a zero (0) was given to the respondent who could not read and write. This variable appears in question number 2 in the interview schedule (*Appendix A*).

3.5.1.3 Household size

Household size was measured in terms of actual number of members in the family of the farmers. The family members included the respondent themselves, sons, daughters and other dependents. For example, if a respondent had five members in his/her family, his/her household size score will be 5. This variable appears in the question number 3 in the interview schedule (*Appendix A*).

3.5.1.4 Farm size

The farm size of a farmer is referred to the total area of land, on which his family carried out farming operations, in terms of full benefit to his family. The farm size was measured in hectares for each farmer using the following formula:

$$FS = A+B+\frac{1}{2}(C+D)+E+F$$

Where,

FS= Farm Size

A= Homestead

B= Own land under own cultivation

C= Land given to others on *borga*

D= Land taken from others on *borga*

E= Land taken from others on lease

F= Others (Pond, poultry yard etc.).

The data were first recorded in term of local unit i.e. bigha and then converted to hectare. This variable appears in the question number 4 in the interview schedule (*Appendix A*).

3.5.1.5 Annual family income

The annual income of a respondent's family was measured on the basis of yearly total earnings from farming such as agriculture (rice, maize, potato, vegetables, fruits, dairy, poultry, fish culture, land lease given); non-agriculture (service, business) and others (if any). A score of one (1) was assigned for each of "000" taka for measuring the annual family income of a respondent. This variable appears in the question number 5 in the interview schedule (*Appendix A*).

3.5.1.6 Training received

Training experience of a respondent was measured by the total member of day he/she attended in different training programs in his/her life. A score of one (1) was assigned for each day of training received. This variable appears in the question number 6 in the interview schedule (*Appendix A*).

3.5.1.7 Organizational participation

Organizational participation of a farmer was measured by computing an organizational participation score according to his nature and duration of participation in six (6) selected different organizations up to the time of interview. Each respondent was asked to indicate the frequency of his/her participation in different organization with four alternative responses as 'president/secretary', 'executive member', 'general member' and 'not involved' basis and weights were assigned as 3, 2, 1 and 0 respectively. The organizational participation score of a respondent was obtained by multiplying his/her participation score. This variable appears in the question number 7 in the interview schedule (*Appendix A*).

3.5.1.8 Extension media contact

It was measured as one's extent of exposure with different information sources. Questions on this variable was measured by computing an extension media contact score on the basis of a farmer's extent of contact with 15 selected media as obtained in response to question number 8 of the interview schedule (*Appendix A*). Each respondent was asked to indicate the frequency of his contact with each of the selected media with four alternative responses as 'frequently', 'occasionally', 'rarely' and 'not at all' basis and weights were assigned as 3, 2, 1 and 0 respectively. Scores obtained for use of 15 selected media by the respondents were summed together to compute his/her extension contact scores. The extension contact scores of a respondent could vary from 0 to 45 where, 0 indicating no extension contact and 45 indicating high extension contact.

3.5.1.9 Attitude towards technology

Five-point rating scale, a scale mentioned by Likert (1932) was used to find out the attitude towards technology of the farmers. Eight statements expressing feelings towards technology of the farmers were constructed. The respondents were asked to give their attitude regarding 8 statements related to the technology. In a statement a score of 5, 4, 3, 2 and 1, was assigned for responses reflected by the expressions; strongly agreed, agreed, undecided, disagreed and strongly disagreed respectively. The scoring order was reverse for the above expression in the negative statements. The attitude score of a respondent was computed by adding his scores for all the 8 statements. Attitude score, thus, obtained for a respondent could range from 8 to 40, where '8' indicated very unfavorable attitude and '40' indicated highest level of favorable attitude. The variable appears in response to question number 9 of the interview schedule (*Appendix A*).

3.5.1.10 Scientific orientation

Scientific orientation refers to the degree to which a respondent is oriented towards the use of scientific methods. Supe (1969) defined scientific orientation as the degree to which a farmer is oriented towards the use of scientific method of farming. The respondents were asked to give their scientific orientation regarding 6 statements. In a statement a score of 5, 4, 3, 2 and 1, was assigned for responses reflected by the expressions; strongly agreed, agreed, undecided, disagreed, and strongly disagreed respectively. The scoring order was reverse for the above expression in the negative statements. The scoring procedure developed by Supe (1969) and adopted by Parganiha (2016). The scores for the positive and negative statement were summed up to get the total score of an individual respondent. Maximum and minimum possible score of an individual could obtain were 30 and 6, respectively. The variable appears in response to question number 10 of the interview schedule (*Appendix A*).

3.5.2 Measurement of the focus issue

Farmers' competency assessment on innovation adoption was the focus issue of the study. A total 18 statements on various aspects of innovation adoption competency were asked to the farmers. The focus issue was measured through a 4-point rating scale. There were four options to response a statement, namely 'excellent', 'average', 'low', and 'not at all' with a corresponding score of 3, 2, 1 and 0 respectively for the positive statements. A respondent was asked to indicate his/her competency regarding a statement by selecting the appropriate option. The competency score of a respondent was measured by summing

up the scores for his/her responses to all the statements. Hence, scores of a respondent could range from 0 to 54; 0 indicating no competency and 54 excellent competencies on innovation adoption. Such methodology was used by Islam (2013) in his study. This variable appears in question number 11 in the interview schedule (*Appendix A).*

Farmers Competency Index (FCI) $= C_e \times 3 + C_a \times 2 + C_l \times 1 + C_n \times 0$

Where,

C_e = Number of farmers with "excellent"

C_a= Number of farmers with "average"

C_l = Number of farmers with "low"

C_n = Number of farmers with "not at all"

Thus, the FCI of individual statement could range from 0 to 315, where 0 indicating no competency and 315 indicating excellent competency of the individual statement on innovation adoption.

3.6 Problem Confrontation of the Farmers

It was measured by using a four point rating scale. A list of 10 probable problems that farmers could face in different aspects were listed and asked to indicate the extent of their problem confrontation. Each farmer was asked to indicate his option regarding each problem. For each problem score of 3, 2, 1 and 0 were assigned to problems as high, moderate, low and not at all respectively. The problem confrontation score was computed for each respondent by adding his scores for all 10 problems. The problem confrontation score could range from 0 to 30; 0 indicating no problem and 30 high problem. To ascertain the comparison among the problems a Problem Confrontation Index (PCI) was computed using the following formula:

Problem Confrontation Index (PCI) = $P_{hp} \times 3 + P_{mp} \times 2 + P_{lp} \times 1 + P_{np} \times 0$

Where,

P_{hp} = Number of farmers with high problems

P_{mp}= Number of farmers with moderate problem

P_{lp}= Number of farmers with low problems

P_{np}= Number of farmers with no problem

Thus, Problem Confrontation Index (PCI) of the farmers in adopting innovation ranged from 0 to 315, where 0 indicating no problem and 315 indicating high problem. This variable appears in question number 12 in the interview schedule (*Appendix A*).

3.7 Data Collection

The researcher herself through face-to-face interview collected data personally from selected respondents. Interviews were usually conducted with the respondents in their homes. While starting interview with any respondent the researcher took all possible care to establish rapport with them so that they did not hesitate to furnish proper responses to the question and statement in the schedule. If the respondents felt any difficulty in understanding any question, the researcher took utmost care to explain and clarify the same properly. The researcher in collecting data faced no serious difficulty. Excellent co-operation and co-ordination were extended by the respondents and other concerned persons during data collection. Data were collected from the study area during 12th August to 10th September 2019.

3.8 Compilation of Data

Based on the data available, a coding plan was prepared following the level of measurement. The collected data were coded, categorized, tabulated and analyzed scientifically. The qualitative data were converted into quantitative data by appropriate scoring techniques. The collected raw data were examined thoroughly to find out the errors and omissions. For this, the researcher made a careful scrutiny of the completed interview schedule to make sure that they were entered as complete as possible and well arranged to facilitate coding and tabulation.

3.9 Statement of Hypothesis

According to Kerlinger (1973), a hypothesis is a conjectural statement of the relation between two or more variables. It may prove to be correct or incorrect. In an event, however, it leads to an empirical test. Hypothesis may be broadly classified into two types, namely research hypothesis (H_a) and null hypothesis (H_0).

3.9.1 Research hypothesis

Research hypothesis (H_a) states anticipated relationships between concerned variables. Based on review of literature and development of conceptual framework, the research hypotheses was ‘there is relationships between age, educational qualification, household size, farm size, annual family income, training received, organizational participation, extension media contact, attitude towards technology and scientific orientation of the farmers and competency on innovation adoption’.

3.9.2 Null hypothesis

Null hypothesis (H_o) states that there is no relationships between age, educational qualification, household size, farm size, annual family income, training received, organizational participation, extension media contact, attitude towards technology adoption and scientific orientation of the farmers and competency on innovation adoption.

3.10 Statistical Analysis

The Statistical Package for Social Science (SPSS) computer package was used for data processing and analysis. The statistical measures such as range, mean, standard deviation, and percentage were used for describing both the selected characteristics and focus issue. In order to find out the relationships between the individual characteristics of farmers and the competency, Pearson's Product Moment Correlation Co-efficient (r) was computed. Tables were also used in presenting data for clarity of understanding.

CHAPTER 4

RESULTS AND DISCUSSION

In this Chapter the findings of the study and their interpretations have been conveniently presented. This Chapter deals with the finding of the research according to the objectives of the study. This Chapter has been divided into four sections in which focus issue and the selected characteristics have been presented in the first and second sections, respectively. The third and fourth section deals with the relationship between the selected characteristics of the farmers and competency on innovation adoption and the problems faced by the farmers in adopting innovation respectively.

4.1 Competency of the Farmers on Innovation Adoption

4.1.1 Statement wise competency of the farmers

Farmers' competency on innovation adoption was the focus issue of the study. A total 18 statements were considered and these were measured by 4-point rating scale. Based on the Farmers' Competency Index (FCI) score, the statements were also arranged in rank order as shown in the Table 4.1.

Table 4.1 Rank order and competency indices of farmers on innovation adoption (n=105)

Sl. No.	Statements	Extent of competency				FCI	Rank
		Excellent	Average	Low	Not at all		
A.	**Knowledge**						
1.	Increasing the food production system by good agricultural practice	13	43	40	9	152	7th
2.	Reducing the use of irrigation water through alternate wetting and drying	9	37	43	0	144	10th
3.	Controlling insect pest problem by sex pheromone trap	46	40	14	5	232	1st
4.	Accelerating planting and harvesting process by combine harvester	1	26	19	59	74	18th
5.	Protecting environmental degradation by using organic pesticide	22	37	7	10	147	12.5th
6.	Helps to recognize different types and varieties of agricultural product	17	43	37	9	174	3.5th
B.	**Skill**						
7.	Helps in getting the correct information about the market in appropriate time by improved technologies	29	46	18	12	197	2nd
8.	Improving farm management ability	16	28	30	31	134	16th

Contd.

Sl. No.	Statements	Extent of competency				FCI	Rank
		Excellent	Average	Low	Not at all		
	through using modern agricultural machineries						
9.	Helps in inspecting and evaluating the quality of products	13	35	31	26	140	14th
10.	Improving skills in preparing annual household cost/ family budget	16	38	26	25	150	8th
11.	Maintaining sustainability by the use of balanced fertilizer	21	41	29	14	174	3.5th
12.	Skills in working with computer and internet in receiving farm information	16	34	28	27	144	9th
C.	**Attitude**						
13.	Modern agricultural machinery reduce labor cost	9	43	28	25	141	12.5th
14.	Using modern agricultural machinery is more risky compared to traditional machinery	17	29	31	28	137	15th
15.	Modern technologies have more economic benefits than traditional practices	18	37	33	17	161	6th
16.	Quality vegetables can be produced by organic farming practices	22	36	29	18	167	5th
17.	Practicing fruit bagging helps to protect fruit from pest, disease etc.	7	42	37	19	142	11th
18.	ICTs help in getting updated farm information quickly	15	23	36	31	127	17th

FCI= Farmers' Competency Index

It was observed from Table 4.1 that 'controlling insect pest problem by sex pheromone trap' ranked 1st with FCI 232. Sex pheromone trap becomes popular among the farmers as it saves vegetables from pest attack in a large scale.

The 2nd ranked statement is 'helps in getting the correct information about the market in appropriate time by improved technologies'. Now-a-days farmers are getting market information about their agricultural products in advance by using mobile phone.

After that 'helps to recognize different types and varieties of agricultural product' and 'maintaining sustainability by the use of balanced fertilizer' both statements are obtained jointly ranked 3.5th.

The 16th ranked statement is 'improving farm management ability through using modern agricultural machineries'. This means farmers need to be more skilled in using modern machineries.

The 17th ranked statement is 'ICTs help in getting updated farm information quickly'. Farmers had unfavorable attitude toward adopting ICTs due to lack of operational knowledge of computer, lack of training facilities on ICT, poor knowledge on the availability of ICT based facilities, lack of personal interest etc.

The 18th ranked statement is 'accelerating planting and harvesting process by combine harvester'. It was found that farmers are not purchase combine harvester personally but they use it through renting.

4.1.2 Dimension wise competency of farmers

Three dimensions of competency namely knowledge, skill and attitude were used to assess the farmers' competency on innovation adoption. On the basis of possible score the dimensions was classified into three categories namely low, medium, and high. The computed values of all the dimensions have been shown in Table 4.2.

Table 4.2 Dimension-wise competency of farmers in innovation adoption (n=105)

Dimensions	Categories	Respondents		Range	Mean	Standard deviation
		Number	Percent	Observed (Possible)		
Knowledge	Low ≤6	18	17.14	4-14 (0-18)	9.19	2.79
	Medium (7-12)	73	69.52			
	High >12	14	13.33			
Skill	Low ≤6	17	16.19	5-13 (0-18)	8.95	2.05
	Medium (7-12)	85	80.95			
	High >12	3	2.85			
Attitude	Low ≤6	20	19.04	3-14 (0-18)	8.37	2.29
	Medium (7- 12)	78	74.29			
	High >12	7	6.67			

Data presented in the Table 4.2 indicate that most of the farmers belong to medium category for all of the dimensions of competency. According to the mean value farmers had more knowledge (9.19) than skill (8.95) and attitude (8.37) on innovation adoption. The highest 69.52 percent of the respondent had medium knowledge, 80.95 percent of the respondent had medium skill and 74.29 percent of the respondents had medium attitude. It seems that none of the dimensions existed in satisfactory level.

4.1.3 Overall competency of the farmers

Farmers' competency on innovation adoption was the main thrust of this research. The overall competency score of the farmers were ranged from 15 to 36 against the possible score of the farmers ranged from 0 to 54 with an average score of 26.51 and standard deviation 4.94. Following mean plus-minus standard deviation the farmers were categorized into three classes based on their competency scores; they are low competency (15-22), medium competency (23-31), and high competency (>32). The distribution of the farmers according to the competency score has been shown in Table 4.3.

Table 4.3 Overall competency of the farmers on innovation adoption

Categories	Respondents		Range	Mean	Standard deviation
	Number	Percent	Observed (Possible)		
Low (15-22)	21	20.00	15-36 (0-54)	26.51	4.94
Medium (23-31)	65	61.90			
High (>31)	19	18.10			
Total	105	100.00			

Table 4.3 reveals that, 61.90 percent of the farmers had medium competency, 20.00 percent had low competency and 18.10 percent had high competency on innovation adoption. Thus, the overwhelming majority (81.90 percent) of the farmers had low to medium competency on innovation adoption. In our country the farmers are not enough aware of mechanization, so they are not enough competent to adopt the agricultural innovation. It will take more time to get high competency of the farmers.

Islam (2013) conducted a study on Competency Assessment of the Farmers on the Application of One House One Farm approach and observed that only 3 percent had high competency. Only 4 percent of the farmers had low competency compared to 94 percent of them having medium competency.

4.2 Selected Characteristics of the Farmers

In the study, there were ten selected characteristics of the farmer such as age, educational qualification, household size, farm size, annual family income, training received, organizational participation, extension media contact, attitude towards technology and scientific orientation were selected. The composite findings of these selected characteristics of farmers are presented in Table 4.4 and have been discussed in subsequent sections.

Table 4.4 Profile characteristics of the farmers (n=105)

Characteristics	Scoring method	Range	Categories	Respondents		Mean	SD
		Observed (Possible)		No.	%		
Age	No. of year	25-70 (Unknown)	Young (25-35)	15	14.29	50.45	12.13
			Middle aged (36-50)	35	33.33		
			Old (>50)	55	52.38		
Educational qualification	Year of Schooling	0-18 (Unknown)	Illiterate (0)	15	14.29	5.32	4.78
			Can sign only (0.5)	20	19.05		
			Primary (≤5)	21	20.00		
			Secondary (6-10)	37	35.24		
			Above secondary (>10)	12	11.43		
Household size	No. of members	2-10 (Unknown)	Small (up to 4)	40	38.10	5.53	2.19
			Medium (5-6)	29	27.62		
			Large (above 6)	36	34.29		
Farm size	Hectare	0.06-1.87 (Unknown)	Marginal ((0.02-0.20)	9	8.57	0.65	0.33
			Small (0.21-1.0)	81	77.14		
			Medium (1.01-3.0)	15	14.29		
Annual family income	Score	102-650 (Unknown)	Low (≤159)	14	13.33	281.66	122.93
			Medium (160-405)	74	70.48		
			High (>405)	17	16.19		
Training received	Day	0-4 (Unknown)	No (0)	76	72.38	0.72	1.31
			Short (1-2)	21	20		
			Long (above 2)	8	7.62		
Organizational participation	Score	0-6 (Unknown)	No (0)	20	19.05	1.79	1.41
			Low (up to 2)	61	58.10		
			Medium (3-4)	15	14.29		
			High (above 4)	9	8.57		
Extension media contact	Score	12-34 (0-45)	Low (≤15)	9	8.57	22.23	4.39
			Medium (16-30)	91	86.67		
			High (>30)	5	4.76		
Attitude towards technology adoption	Score	15-32 (8-40)	Less favorable (≤19)	31	29.52	21.56	3.36
			Favorable (20-30)	69	65.71		
			Highly favorable (>30)	5	4.76		
Scientific orientation	Score	10-26 (6-30)	Low (≤14)	13	12.38	18.44	3.45
			Medium (15-22)	78	74.29		
			High (>22)	14	13.33		

SD= Standard deviation

4.2.1 Age

Age of the farmers ranged from 25 to 70 years. The average being 50.45 years and the standard deviation was 12.13 years. On the basis of age, farmers were classified into three categories i.e. young (25-35), middle aged (36-50) and old (>50) as shown in Table 4.4.

Data presented in Table 4.4 indicate that the highest proportion (52.38 percent) of the farmers was in the old aged category compared to 33.33 percent middle aged and only 14.29 percent young aged category. It appears that overwhelming majority (85.65 percent) of the farmers in the study area was comprised of middle to old aged. Middle to old aged farmers are more experienced than young farmers.

4.2.2 Educational Qualification

The educational qualification score ranged from 0 to 18, the average being 5.32 and the standard deviation was 4.78. On the basis of educational qualification the farmers were classified into five categories i.e. illiterate (0), can sign only (0.5), primary (≤5), secondary (6-10), above secondary (>10) as presented in Table 4.4.

The results indicates that about one-thirds (35.24 percent) of the farmers had secondary level of educational qualification, followed by 20.00 percent primary level, 19.05 percent can sign only, 14.29 percent illiterate and only 11.43 percent above secondary educational qualification. Thus, the highest proportion (85.71 percent) of the farmers was literate. The findings thus, indicate that the literacy rate in the study area is higher than that of the national literacy rate of 73.9 percent (BBS, 2018). Thus, it can be said that the respondents of the study area have more knowledge and skill on agricultural innovations.

4.2.3 Household size

The household size of the farmers ranged from 2 to 10, with an average of 5.53 and standard deviation of 2.19. Following social standard of quantitative classification (Hasan *et al*., 2018) on the basis of their household size, the farmers were classified into three categories i.e. small (up to 4), medium (5-6) and large (above 6). Distribution of the respondents according to their household size has been shown in Table 4.4.

Data contained in Table 4.4 show that majority of the farmers 38.10 percent had small household size, 27.62 percent had medium and 34.29 percent had large household size. Two-thirds (65.62 percent) of the farmers had low to medium family. The results may be due to the reason that rural large size families are breaking down into medium or small size households. Afrin (2017) found similar result in her study.

4.2.4 Farm size

The farm size of the farmers ranged from 0.06 to 1.87 hectares with an average of 0.65 hectares and standard deviation of 0.33 hectares. According to the farm size the farmers were classified into three categories namely; marginal (0.02-0.2), small (0.21-1.0) and medium (1.1-3.0) as suggested by DAE (1999) shown in Table 4.4.

Data indicate that about three-fourths (77.14 percent) of the farmers had small farm while, 14.29 percent medium and 8.57 percent landless farmers. Thus, the overwhelming majority (91.43 percent) of the farmers had small to medium farm. Therefore, it can be said that respondents of the study area are capable to adopting innovations. Similar result is also found by Quayum (2018) and Afrin (2017) in their respective farm.

4.2.5 Annual family income

Annual family income score was expressed in thousand taka. Annual family income scores in the study were found to vary from 102 to 650 thousand taka. The average score was 281.66 thousand taka and standard deviation of 122.93. Following mean plus minus standard deviation of quantitative classification annual the farmers were classified into three categories such as low (≤159), medium (160-405) and high (>405) as shown in Table 4.4.

Data presented in Table 4.4 shows that the highest proportion (70.48 percent) of the farmers had medium annual family income while 16.19 percent high and 13.33 percent low annual family income. Great majority (70.48 percent) of the respondents had medium income which may be due partial involvement of the family members in income generating activities.

4.2.6 Training received

The computed training received scores of the farmers ranged from 1 to 4 days. The average and standard deviation were 0.72 days and 1.31 days respectively. The farmers were classified into four categories based on the duration of training received i.e. no (0), short (up to 1), medium (1-2) and long (above 2) as shown in Table 4.4.

Data contained in the Table 4.4 indicate that 72.38 percent of the farmers had no training, while 20 percent had short duration training and 7.62 percent had long duration training. About three-fourth (72.38 percent) of the farmers were belonged to no training categories. Training is important for increasing the competency of farmers to adopt innovations. Thus, it should be concluded that the DAE and concern NGOs should arrange training program for those farmers who had no training on agricultural activities.

4.2.7 Organizational participation

Organizational participation score of the farmers ranged from 1 to 6. The average and standard deviation were 1.79 and 1.41 respectively. Based on organizational participation scores, the farmers were classified into following four categories i.e. no (0), low (up to 2), medium (3-4) and high (above 4) as shown in Table 4.4.

Data presented in Table 4.4 indicate that about three-fifths (58.10 percent) of the farmers had low organizational participation while 14.29 percent had medium, 19.5 percent had no and only 8.57 percent had high organizational participation. When an individual comes in contact with organization he learns new ideas and new ways of doing things and also may share their thoughts and ideas with others, so the farmers should increase their organizational participation.

4.2.8 Extension media contact

The computed extension media contact scores of the farmers ranged from 12 to 34 against the possible range of 0 to 45. The mean and standard deviation were 22.23 and 4.39 respectively. According to possible score ways of quantitative classification (Hasan *et al*., 2018), the farmers were classified into three categories such as: low (≤15), medium (16 to 30) and high (>30) extension media contact. The distribution of the farmers according to their extension media contact is contact is shown in Table 4.4.

Data presented in Table 4.4 indicate that highest proportion (86.67 percent) of the respondents had medium extension media contact while 8.57 percent had low and 4.76 percent respondents had found with high extension media contact. However, overwhelming majority (91.43 percent) of the farmers had medium to high extension media contact. Thus it can be said that the extension services of the study area were moderately satisfactory.

4.2.9 Attitude towards technology

Attitude towards technology scores of the farmers ranged from 15 to 32 against the possible range of 8 to 40 with a mean of 21.56 and standard deviation of 3.36. Following possible attitude score, the farmers were classified into three categories i.e. less favorable (≤19), favorable (20-30) and highly favorable (>30) as shown in Table 4.4.

Data presented in Table 4.4 express that two-third (65.71 percent) of the farmers had favorable attitude while 29.52 percent had less favorable attitude and 4.76 percent had highly favorable attitude towards technology. As the majority of the farmers had favorable attitude towards technology, they participate in different farming activities using updated farm techniques.

4.2.10 Scientific orientation

Scientific orientation score of the farmers could range from 6 to 30. However, the observed ranged was 10 to 26 with a mean of 18.44 and standard deviation of 3.45. Based on possible scientific orientation score, the farmers were classified into three categories namely; low (≤14), medium (15-22) and high (>22) as shown in Table 4.4.

The data contained in Table 4.4 show that 74.29 percent of the farmers belonged to the medium scientific orientation category, while, 12.38 percent and 13.33 percent of them were found to have low and high scientific orientation, respectively. However, the overwhelming (86.67 percent) of the farmers had low to medium scientific orientation. Therefore, the DAE can take initiatives for motivational tour for the farmers to research stations.

4.3 Relationships between the Selected Characteristics of the Farmers and their Competency on Innovation Adoption

This section deals with the findings exploring the relationships between the ten selected characteristics of the farmers and their competency on innovation adoption. The relationship was measured by using Pearson's Product Moment Correlation Co-efficient 'r'. If, the correlation is significant at five or one percent level of significance then the null hypothesis is rejected and if insignificant then the null hypothesis accepted. The results of the correlation analysis between each of the selected characteristics of the farmer with their competency on innovation adoption are shown in Table 4.5. On the other hand, the correlation matrixes of the concerned variables are presented in Appendix B for understanding the inter correlation among the characteristics.

4.3.1 Age and competency on innovation adoption

The computed value of correlation co-efficient between age of the farmers and their competency on innovation adoption is -0.215, which is negatively significant at 0.05 percent level of probability (Table 4.5). Hence, the concerned null hypothesis could be rejected. The findings indicated that age of the farmers have a negative significant relationship with their competency on innovation adoption at 0.05 level of probability.

Table 4.5 Relationships between respondent characteristics and focus issue

Focus issue	Selected characteristics	Computed values of 'r' with 103 d.f.	Tabulated value of 'r'	
			0.05 level	0.01 level
Competency of the farmers on innovation adoption	Age	-0.215*	±0.194	±0.254
	Educational qualification	0.683**		
	Household size	0.037		
	Farm size	0.187		
	Annual family income	0.207*		
	Training received	0.447**		
	Organizational participation	0.021		
	Extension media contact	0.552**		
	Attitude towards technology	0.421**		
	Scientific orientation	0.217*		

**Correlation is significant at 0.01 level of probability,* Correlation is significant at 0.05 level of probability, d.f.= degrees of freedom

4.3.2 Educational qualification and competency on innovation adoption

The computed value of correlation co-efficient between educational qualification of the farmers and their competency on innovation adoption is 0.683, which is positively significant at 0.05 percent level of probability (Table 4.5). Hence, the concerned null hypothesis is rejected. Thus, it could be said that education could play a significant role on the prospect of farmers' competency. Islam (2013), Biswas (2009), Roy (2008) and Alam (2008) found the similar findings in their respective studies.

4.3.3 Household size and competency on innovation adoption

The computed value of correlation co-efficient between household size of the farmers and their competency on innovation adoption is 0.037, which is less than the tabulated value at 0.05 percent level of probability (Table 4.5). Hence, the concerned null hypothesis could not be rejected. The finding indicates that the household size have no significant relationship with the competency of the farmers on innovation adoption. Islam (2013), Biswas (2009) and Roy (2008) found the similar findings in their respective studies.

4.3.4 Farm size and competency on innovation adoption

The computed value of correlation co-efficient between farm size of the farmers and their competency on innovation adoption is 0.187, which is less than at 0.05 percent level of

probability (Table 4.5). Hence, the concerned null hypothesis could not be rejected. The findings indicate that farm size of the farmers have no significant relationship with the competency of the farmers on innovation adoption.

4.3.5 Annual family income and competency on innovation adoption

The computed value of correlation co-efficient between annual family income of the farmers and their competency on innovation adoption is 0.207, which is positively significant at 0.05 percent level of probability (Table 4.5). Hence, the concerned null hypothesis is rejected. The finding indicated that annual family income of the farmers have a positive significant relationship with their competency on innovation adoption.

4.3.6 Training received and competency on innovation adoption

The computed value of correlation co-efficient between training received of the farmers and their competency on innovation adoption is 0.447, which is positively significant at 0.01 percent level of probability (Table 4.5). Hence, the concerned null hypothesis is rejected. The finding indicated that there is a positive significant relationship between training received and competency of the farmers on innovation adoption. Training helps an individual to be acquainted with advantages and limitations of different technologies and approaches. Enough competencies can be developed in an individual due to his participation in training. Tambo and Tobias (2014), Islam (2013), Roy (2008) also found the similar findings in their respective studies.

4.3.7 Organizational participation and competency on innovation adoption

The computed value of correlation co-efficient between organizational participation of the farmers and their competency on innovation adoption is 0.021, which is less than the tabulated value at 0.05 percent level of probability (Table 4.5). Hence, the concerned null hypothesis could not be rejected. The findings indicate that the organizational participation have no significant relationship with the competency of the farmers on innovation adoption. Islam (2013), Roy (2008) found the similar findings in their respective studies.

4.3.8 Extension media contact and competency on innovation adoption

The computed value of correlation co-efficient between extension media contact of the farmers and their competency on innovation adoption is 0.552, which is positively significant at 0.01 percent level of probability (Table 4.5). Hence, the concerned null hypothesis was rejected. Media contact enables an individual to come more in contact with different kinds of communication media namely individuals, group and mass. High media

contact means more farmers being enlightened and consequently having broader outlooks and progressive attitudes. This study reveals that, extension media contact have a positive significant relationship with competency of the farmers on innovation adoption. When the extension media contact is high, the famers were acquainted with more information which helped them to build up a favorable competency on innovation adoption. Islam (2013), Roy (2008) and Alam (2008) found the similar findings in their respective studies.

4.3.9 Attitude towards technology and competency on innovation adoption

The computed value of correlation co-efficient between attitude towards technology of the farmers and their competency on innovation adoption is 0.421, which is positively significant at 0.01 percent level of probability (Table 4.5). Hence, the concerned null hypothesis is rejected. The findings indicate that the attitude towards technology have a positive significant relationship with the competency of the farmers on innovation adoption. Biswas (2009) and Sharmin (2005) found similar findings in their respective studies.

4.3.10 Scientific orientation and competency on innovation adoption

The computed value of correlation co-efficient between scientific orientation of the farmers and their competency on innovation adoption is 0.217, which is positively significant at 0.05 percent level of probability (Table 4.5). Hence, the concerned null hypothesis is rejected. The findings indicated that scientific orientation has a positive significant relationship with the competency of the farmers on innovation adoption.

4.4 Problem Confrontation of the Farmers in Adopting Innovation

4.4.1 Overall problem confrontation of the farmers

The problem confrontation score of the farmers ranged from 14 to 25 against the possible range of 0 to 30 with as average of 20.09 and standard deviation of 2.30. Based on mean plus minus standard deviation, problem score of the farmers were classified into three categories i.e. low (14-18), medium (19-23), high (>23). The distribution of the farmers according to their problem score has been shown in Table 4.6.

The Table 4.6 revealed that majority of the farmers (70.48 percent) faced medium problems in adopting innovations. Only 26.67 percent faced low problems and 02.86 percent faced low problems.

Table 4.6 Distribution of farmers according to their problems in adopting innovation (n=105)

Categories	Respondents		Range	Mean	Standard deviation
	Number	Percent	Observed (Possible)		
Low (14-18)	28	26.67	14-25 (0-30)	20.09	2.30
Medium (19-22)	74	70.48			
High (>22)	03	02.86			
Total	105	100.00			

4.4.2 Problem wise distribution of the farmers

Distribution of the farmers according to their problems faced in adopting innovation has been showed in the Table 4.7 along with Problem Confrontation Index (PCI) and their rank order. Problem Confrontation Index (PCI) of the farmers ranged from 186 to 267 against the possible range of 0 to 315 (Table 4.7).

Table 4.7 Problem confrontation of the farmers in adopting innovation (n=105)

Sl. No.	Problems	Frequency of opinion					
		High	Medium	Low	No	PCI	Rank
1.	Lack of knowledge on new technologies	26	47	22	10	194	6th
2.	Inadequate management practices	21	52	26	06	193	7th
3.	High cost of modern agricultural machineries	59	44	02	0	267	1st
4.	Inadequate training facilities for the farmers	26	43	26	10	190	8th
5.	Insufficient extension support from DAE	24	52	23	06	199	5th
6.	Inadequate supply of innovation	28	54	14	09	206	4th
7.	Misuse of the credit supplied from the government	26	44	22	13	188	9th
8.	Not getting fair price of agricultural produces	47	45	8	05	239	2nd
9.	Unfavourable weather and climatic condition	25	45	21	04	186	10th
10.	Lack of government incentives	33	50	18	04	217	3rd

PCI= Problem Confrontation Index

Results of Table 4.7 show that the problem‘high cost of modern agricultural machineries’ got the first highest score and hence was considered as the 1st ranked problem. In our country, most of the farmers are poor and they are not able to purchase such kind of machineries due to their poverty. The problem ‘not getting fair price of agricultural produces’ got the second highest score and hence is considered as the 2nd ranked problem. This occurs due to the imbalance between production and market demand in our country. The problem ‘lack of government incentives’ got the third highest score and hence is considered as 3rd ranked position. And ‘unfavourable weather and climatic condition’ is considered as low problem by the farmers.

CHAPTER 5

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Summary of the Findings

The study was undertaken to find out the extent of farmers' of competency of the farmers on innovation adoption; to determine the relationship between the extent of competency of farmers and to explore the problems faced by the farmers in adopting innovation. The study was carried in Sadar upazila of Dinajpur district. Data were collected from 105 randomly selected farmers covering the selected study area from a population of 997 farmers. An interview schedule was used in data collection. The major findings of the study are summarized below.

5.1.1 Farmers' competency on innovation adoption

The overall competency score of the farmers ranged from 15 to 36 against the possible score of the farmers ranged from 0 to 54 with an average score of 26.51 and standard deviation of 4.94. About three-fifth (61.90 percent) of the farmers had medium competency, 20.00 percent had low competency and 18.10 percent had high competency on innovation adoption. On the basis of three dimensions of competency; the highest 69.52 percent of the respondent had medium knowledge, 62.86 percent of the respondent had medium skill and 71.43 percent of the respondents had medium attitude.

5.1.2 Characteristics of the farmers

The majority of the respondents (52.38 percent) were old aged while 33.33 percent were middle aged and 14.29 percent young aged. Level of education of the farmers ranged from 0 to 18 years of schooling. About one-third (35.24 percent) of the farmers had secondary education compared to 14.29 percent of illiterate, 19.05 percent could sign only, 20 percent had primary education and 11.43 percent had higher secondary education. The highest proportion (38.10 percent) of the farmers was found to be in small household compared to 27.62 percent medium and 34.25 percent large household size category.
Almost three-fourth (77.14 percent) of the farmers was in small farm, 8.57 percent marginal farm and 14.29 percent were in medium farm category. A great majority (70.48 percent) of the farmers had medium compared to 13.33 percent low and 16.19 percent high annual family income. The highest proportion (72.38 percent) of farmers had no training compared to 20 percent had short duration and 7.62 percent had long duration training received.

The highest proportion (58.10 percent) of the farmers had low organizational participation compared to 19.05 percent had no participation, 14.29 percent had medium and 8.57 percent had high organizational participation. The highest proportion (86.67 percent) of

the respondents had medium extension media contact while 8.57 percent had low extension media contact and 4.76 percent farmer was found under high extension media contact. Majority (65.71 percent) of the farmers had favorable attitude towards technology followed by 29.52 percent had low favorable attitude and only 4.76 percent had highly favorable attitude towards technology. Majority (65.71 percent) of the farmers had medium followed by 12.38 percent had low and only 13.33 percent had high scientific orientation.

5.1.3 Relationships between the selected characteristics of the farmers and their competency

Ten hypotheses were tested to explore the relationship of ten selected characteristics of the farmers with their competency on innovation adoption. The results can be summarized in the following way. Out of ten null hypotheses tested, 7 were rejected and 3 were not rejected. Test of hypothesis showed that educational qualification, annual family income, training received, extension media contact, attitude towards technology and scientific orientation had significant positive relationship with their competency on innovation adoption while farmers age had significant negative relationship and household size, farm size and organizational participation had no significant relationship with their competency on innovation adoption.

5.1.4 Problem confrontation of the farmers

The problems faced by the farmers ranged from 14 to 25 with an average score 20.09 and the standard deviation of 2.30. The highest proportion (70.48 percent) of the farmers had medium problem compared to 26.67 percent had low problem and 2.86 percent having high problem. The top ranked three problems faced by the farmers in adopting innovation are: high cost of modern agricultural machineries (PCI 267), not getting fair price of agricultural produces (PCI 239) and lack of government incentives (PCI 217).

5.2 Conclusions

Findings of the study and the logical interpretation of their meaning in the light of other relevant facts enabled the researcher to draw the following conclusions:

1. The findings of the study revealed that the majority (61.90 percent) of the respondents had medium competency and 20 percent farmers had low and 18.10 percent farmers had high competency. Thus, it could be concluded that there is an ample scope to increase the competency of the farmers on innovation adoption.
2. Educational qualification of the farmers had significant positive relationship with the competency of the farmers on innovation adoption. It may be concluded that if

educational facilities are available to the farmers, the level of knowledge will be increased which in turn help in the adoption of innovations.

3. Annual family income, training received, extension media contact, attitude towards technology and scientific orientation of the farmers had positive relationship with the competency of the farmers on innovation adoption. Therefore, it may be concluded that these characteristics of the farmers should be considered in planning program related to improve competency of the farmers.
4. Household size, farm size and organizational participation had no significant relationship with their competency on innovation adoption. It was thus proved that farmers' competency is independent with their household size, farm size and organizational participation.
5. The major problems faced by the farmers in adopting innovation are high cost of modern agricultural machineries, not getting fair price of agricultural produces, lack of government incentives etc. It may be concluded that without minimizing of these constraints, increase in adoption of innovation may be difficult.

5.3 Recommendations

Based on the findings and conclusion of the study, the following recommendations are proposed. Recommendations have been divided into two groups; recommendations for policy implication and recommendation for further study are given below:

5.3.1 Recommendations for policy implication

On the basis of the findings and conclusion of the study, the following recommendations for policy implication are made:

1. It was observed that the highest proportion of the farmers had medium competency on innovation adoption. Department of Agricultural Extension (DAE) should take necessary steps to increase their competency on innovation adoption.
2. The results indicate that 85.69 percent of the farmers had can sign only to higher secondary level of education. Thus, it may be recommended that the government should give more emphasis to increase the educational qualification of the farmers and implement adult literacy program to develop their competency.
3. Massive and relevant training programs should be conducted for agricultural innovation to upgrade farmers' knowledge, skill and attitude. For the better adoption of agricultural innovation, the farmers need better skills and techniques to utilize their small resources. The DAE and concern NGOs should be involved in conduction of training program for the farmers.

4. Majority of the farmers thought 'high cost of modern agricultural machineries', 'not getting fair price of agricultural produces', and 'lack of government incentives' as the major problems among ten selected problems. So, effective steps should be taken by the respective authorities like DAE, NGOs etc. for strengthening extension services about updated agricultural technologies, hybrid variety of crop, as they can earn for money and decrease their financial problem, as well as they can share their problem with high authority.

5.3.2 Recommendations for further research

The researcher conducted a small piece of study, which could not make available all information for proper understanding on the competency of the farmers on innovation adoption .Therefore, following suggestions are put forwarded for further research:

1. The present study was conducted at Chehelgazi union in Sadar upazila under Dinajpur district. Similar studies may be conducted in other parts of the country to generalize the findings.
2. Relationships of ten characteristics of the farmers with their competency on innovation adoption were studied in this study. Further research should be conducted to explore relationships of other characteristics of the farmers with their competency on innovation adoption.
3. Farmers' age, educational qualification, annual family income, training received, extension media contact, attitude towards technology and scientific orientation of the farmers were significant related with their competency on innovation adoption. Hence, further study of investigation is necessary to find out such relationships between the concerned variables to authenticate the present findings.
4. Household size, farm size and organizational participation had no significant relationship with competency of the farmers. Further research is necessary in this aspect.

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Appendix A

Department of Agricultural Extension
Hajee Mohammad Danesh Science and Technology University, Dinajpur

An interview schedule on

Assessment of Innovation Adoption Competency of the Farmers under Government Agricultural Extension Services

Serial No…… Date……..

Name of the respondent…… Father's name ……

Village …… Mobile number……

(Please answer the following questions and put tick (√) whenever necessary)

1. Age: How old are you?

☐ Years

2. Educational qualification: Please indicate your educational level.

a) Can't read and write ☐
b) Can sign only ☐
c) . . . . . Pass

3. Household size: Please mention the number of members of your household

☐ Numbers

4. Farm size: Please indicate the area of land according to tenure status.

Sl. No.	**Types of land**	**Land area**	
		Local unit	Hectare
A.	Homestead		
B.	Own land under own cultivation		
C.	Land given to others on *borga*		
D.	Land taken from others on *borga*		
E.	Land taken from others on lease/mortgage		
F.	Others (pond, poultry yard etc.)		
	Total		

Farm size (FS) = $A+B+\frac{1}{2}(C+D)+E+F$

5. Annual family income: Indicate the income in taka from the last year (2018) from different sources.

Sl. No.	**Source of income**	Production (Local unit)	Market Price (Tk./Local unit)	Total (Tk.)
A.	**Agriculture**			
1.	Rice			
2.	Maize			
3.	Potato			
4.	Vegetables			
5.	Fruits			
6.	Dairy			
7.	Poultry			
8.	Fish culture			
9.	Land lease given			
B.	**Non-agriculture**			
1.	Service			
2.	Business			
C.	**Others (if any)**			
	Grand total			

6. Training received: Have you received any training on agricultural innovation**?**

Yes ☐ No ☐

If yes, how many days? Ans: ☐ Days

7. Organizational participation: Please indicate your nature of participation in different organizations.

Sl. No.	**Name of organizations**	**Nature of participation (years)**			
		Not involved	General member	Executive member	President/ Secretary
1.	School/ Madrasa committee				
2.	Mosque / Mondir committee				
3.	Bazar committee				
4.	Union parishad				
5.	NGO				
6.	Others (specify)				

8. Extension media contact: Mention of your extent of contact with the following communication sources in receiving innovation related information.

Sl. No.	Communication sources	Extent of contact			
		Frequently	Occasionally	Rarely	Not at all
A.	**Individual contact**				
1.	Local leaders (times/month)	≥5	3-4	1-2	0
2.	Model farmers (times/month)	≥5	3-4	1-2	0
3.	Input dealers (times/season)	≥6	4-5	1-3	0
4.	SAAOs (times/month)	≥5	3-4	1-2	0
5.	AEO (times/year)	≥5	3-4	1	0
6.	UAO (times/year)	≥4	2-3	1	0
C.	**Group contact**				
7.	Result demonstration meeting (times/year)	≥5	3-4	1-2	0
8.	Field day (times/year)	≥4	2-3	1	0
9.	Crop cutting day (times/year)	≥4	2-3	1	0
B.	**Mass media**				
10.	Internet (times/month)	≥3	2	1	0
11.	Poster (times/year)	≥4	2-3	1	0
12.	Farm magazine (times/year)	≥4	2-3	1	0
13.	Newspaper (times/month)	≥4	2-3	1	0
14.	F.M. Radio (times/week)	≥3	2	1	0
15.	TV (times/week)	≥5	3-4	1-2	0

9. Attitude towards technology: Please indicate your agreement to the following statements.

Sl. No.	Statements	Nature of opinion				
		SA	A	U	D	SD
1(+)	Agricultural innovations have been introduced to develop the socio-economic condition of the farmers					
2(-)	There is no contribution of new agricultural technologies for getting quality products					
3(+)	The application of modern technologies help the farmers to increase their income					
4(-)	Training is not helpful for the farmers to operate the innovations					
5(+)	Agricultural extension agents help the farmers to adopt innovations					
6(-)	Indigenous techniques are used to improve quality and quantity of agricultural products					
7(+)	Farmers can obtained knowledge about hybrid varieties by reading farm magazine					
8(-)	Innovation has no contribution to improve sustainable use of natural resources					

SA: Strongly Agreed; A: Agreed; U: Undecided; D: Disagreed; SD: Strongly Disagreed

10. Scientific orientation: Indicate of your opinion about the following statements.

Sl. No.	Statements	Level of agreement				
		SA	A	U	DA	SD
1(+)	Traditional methods of farming have to be changed in order to raise the level of living					
2(-)	Though it takes time for a farmer to learn new methods in farming it is worth the efforts					
3(+)	New method of farming give better results to a farmer than old methods					
4(-)	The way a farmer's forefather operate is still the best way of farming today					
5(+)	Even a farmer with lot of experience should use new methods of farming					
6(-)	A good farmer experiments with new idea in farming					

SA= Strongly agreed, A=Agreed, U=Undecided, D=Disagreed and SD= Strongly disagreed

11. Competency of the farmers: Please indicate your decision level to the following statements.

Sl. No.	Statements	Extent of competency			
		EX	A	L	N
A.	**Knowledge**				
1.	Increasing the food production system by good agricultural practice				
2.	Reducing the use of irrigation water through alternate wetting and drying				
3.	Controlling insect pest problem by sex pheromone trap				
4.	Accelerating planting and harvesting process by combine harvester				
5.	Protecting environmental degradation by using organic fertilizer				
6.	Helps to recognize different types and varieties of agricultural product				
B.	**Skill**				
1.	Helps in getting the correct information about the market in appropriate time by improved technologies				
2.	Improving farm management ability through using modern agricultural machineries				
3.	Helps in inspecting and evaluating the quality of products				
4.	Improving skills in preparing annual household cost/ family budget				
5.	Maintaining sustainability by the use of balanced fertilizer				
6.	Skills in working with computer and internet in receiving farm information				

Contd.

Sl. No.	Aspects	Extent of competency			
		EX	A	L	N
C.	**Attitude**				
1.	Modern agricultural machinery reduce labor cost				
2.	Using modern agricultural machinery is more risky compared to traditional machinery				
3.	Modern technologies have more economic benefits than traditional practices				
4.	Quality vegetables can be produced by organic farming practices				
5.	Practicing fruit bagging helps to protect fruit from pest, disease etc.				
6.	ICTs help in getting updated farm information quickly				

EX=Excellent; A= Average; L=Low; N=Not at all.

12. Problem confrontation: Please mention the extent of problem of the following problems in adopting innovations

Sl. No.	Problems	Extent of problem			
		High	Moderate	Low	No
1.	Lack of knowledge on new technologies				
2.	Inadequate management practices				
3.	High cost of modern agricultural machineries				
4.	Inadequate training facilities for the farmers				
5.	Insufficient extension support from DAE				
6.	Inadequate supply of innovation				
7.	Misuse of the credit supplied from the government				
8.	Not getting fair price of agricultural produces				
9.	Unfavourable weather and climatic condition				
10.	Lack of government incentives				

Thank you for your kind cooperation.

_____

Signature of the interviewer

Date:

APPENDIX B

Correlation matrix of the focus issue and the selected characteristics of the farmers

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	Y
X_1	1										
X_2	-0.375**	1									
X_3	0.372**	-0.229*	1								
X_4	0.154	0.130	0.276**	1							
X_5	0.132	0.173	0.238*	0.548**	1						
X_6	-0.013	0.559**	-0.133	0.170	0.103	1					
X_7	-0.056	0.202*	-0.026	0.038	0.132	0.114	1				
X_8	-0.242*	0.527**	-0.083	0.094	0.283**	0.361**	0.026	1			
X_9	-0.373**	0.583**	-0.188	0.016	0.011	0.284**	0.029	0.437**	1		
X_{10}	-0.235*	0.362**	-0.208*	-0.111	0.013	0.285**	0.120	0.253**	0.423**	1	
Y	-0.215*	0.683**	0.037	0.187	0.207*	0.447**	0.021	0.552**	0.421**	0.217*	1

*Correlation is significant at the 0.05 level, **Correlation is significant at the 0.01 level

Note:

X_1=Age

X_2= Educational qualification

X_3= Household size

X_4= Farm size

X_5= Annual family income

X_6= Training received

X_7= Organizational participation

X_8= Extension media contact

X_9= Attitude towards technology

X_{10}= Scientific orientation

Y= Competency of the farmers on innovation adoption