ADOPTION OF BRRI DHAN49 BY THE FARMERS OF BOGRA SADAR UPAZILA

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ADOPTION OF BRRI DHAN49 BY THE FARMERS OF BOGRA SADAR UPAZILA

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CERTIFICATE

This is to certify that the thesis entitled, **"ADOPTION OF BRRI DHAN49 BY THE FARMERS OF BOGRA SADAR UPAZILA"** submitted to the faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **Master of Science (MS) in Agricultural Extension,** embodies the result of a piece of bona fide research work carried out by **Md. Atiqur Rahman**, Registration No. 10-04039, under my supervision and guidance. No part of this thesis has been submitted for any other degree or diploma.

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

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DEDICATION

DEDICATED
TO MY
BELOVED PARENTS

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LIST OF ABBREVIATIONS AND GLOSSARY

Abbreviation	Full word
APS	Adoption Period Score
AQ	Adoption Quotient
Ag. Ext. Ed.	Agricultural Extension Education
Ag. Ext. and Info. Sys.	Agricultural Extension and Information System
B	Multiple regression
BBS	Bangladesh Bureau of Statistics
BEC	Bangladesh Economic Census
BRRI	Bangladesh Rice Research Institute
DAE	Department of Agricultural Extension
et. al	All Others
GDP	Gross Domestic Product
MoYS	Ministry of Youth and Sports
OLS	Ordinary Least Squares
SAAO	Sub Assistant Agriculture Officer
SPSS	Statistical Package for Social Science
σ	Standard Deviation
$\bar{x}$	Mean

ADOPTION OF BRRI DHAN49 BY THE FARMERS OF BOGRA SADAR UPAZILA

ABSTRACT

The research examined the status of adoption of BRRI dhan49 and to explore the contribution of the selected characteristics of the cultivators with their adoption of BRRI dhan49. The methodology of this study is an integration of quantitative methods based on data collection in Ashokola, Polikukrul, Teldhap, Shashibadoni, Darial and Ontahar villages under Noongola union of Bogra sadar upazila. Data were collected from 116 BRRI dhan49 cultivators from January 21 to February 20, 2017. Descriptive statistics, multiple regressions were used for analysis. Most of the farmers (78.4 percent) belong to medium adoption followed by high adoption (11.2 percent) by the rice cultivators in adoption of BRRI dhan49 production technologies. Among the influential variables; level of education, annual family income, extension media contact, rice cultivation knowledge and attitude towards BRRI dhan49 were significant contributor and provided 53.8 percent contribution on adoption of BRRI dhan49. It was also found that 3.4%, 16.3%, 38.8%, 33.7% and 7.8% farmers were innovators, early adopters, early majority, late majority and laggards respectively regarding to BRRI dhan49 adoption. It is concluded that the adoption of BRRI dhan49 production technologies is moderate and needs further advancement. Based on the findings, it is recommended that respective authorities (DAE) should implement and popularize farmers based projects on a massive scale for adoption of BRRI dhan49.

Key words: BRRI dhan49, rice cultivation, adopters, adoption, farmers;

CHAPTER I

INTRODUCTION

1.1 General Background

Bangladesh is a farming depended nation. About 76 percent of the people live in rural areas, and 47.5% of the total manpower is involved in agriculture. In Bangladesh, agriculture contributes 18.82% of the gross domestic product (GDP) of the country in the year of 2014-2015 (BEC, 2016). Bangladesh has a long history of rice cultivation. Rice is grown throughout the country except in the southeastern hilly territories. The agro climatic states of the country are suitable for growing rice year-round. However, the national average rice yield is much lower (2.94 t/ha) than that of other rice-growing countries (BBS, 2012). Rice is the staple food for about 156 million people of the country. Rice (*Oryza sativa* L.) is the most important food for over two billion people in Asia and for hundreds million in Africa, America. To feed the ever-increasing population of these regions the world's annual rice production must be increased from the present 560 to 750 million tons by 2020 (Saranraj *et al.*, 2013).

During the year 2015-2016, rice ranked first position by production among all the cereals in Bangladesh. At present the total area and production of rice in Bangladesh is about 11.65 million hectares and 34.00 million metric tons, respectively (BBS, 2013). The population growth rate is 2 million year, and if the population increases along this same line, the total population will be 238 million by 2050. An expansion in total rice production is required to feed this over-expanding population. In the meantime, the total cultivable land is diminishing more than 1% per year attributable to the construction of industries, factories, houses, and highways. On the other hand, due to urbanization, food habits tend to change, demanding the cultivation of new crops that must share land used for rice cultivation.

Therefore, the modern varieties of rice have given its contribution to increase the yield per unit area of rice. Among the modern varieties, BRRI dhan49, benefit to expand rice production in a sustainable manner for the food and nutritional security of this exceptionally populated country. The main features of BRRI dhan49 are-

Developed by	Bangladesh Rice Research Institute(BRRI), Gazipur, Bangladesh
Origin	BR 6592-4-6-4, Bangladesh
Year of release	2008
Main characteristics	Plant height 100 cm, medium slender
Planting season and time	Kharif II, T. Aman, Mid-June-Mid July
Harvesting time	Late October
Yield	5.5t/ha

The rice cropping pattern of Bangladesh has changed-areas once occupied by the rainfed Aus gradually shifted to Boro cultivation. As a result, the contribution from each season also changed-Aman rice previously contributed a major portion of total rice, but Boro is now the major contributor to total rice production in the country, despite Aman coverage area being greater. Aus, Aman, and Boro rice were recently reported to account for 7%, 38%, and 55%, respectively, of the total rice production in Bangladesh (Risingbd, 2014). Bangladesh has made notable progress in sustaining respectable growth in rice production, and this growth in production has originated mostly from the shift from low-yielding traditional to high-yielding modern varieties when irrigation facilities were developed (Hossain *et al.*, 2006). Another factor contributing to the increase in total rice production by modern rice varieties such as BRRI dhan49 is the key to change in the rural economy.

Although Bangladesh has an agrarian economy, about 89% of total farm-holdings are below 2.49 acres in size (Kashem, 2013). However,

socioeconomic factors, such as the predominance of small and marginal farmers and tenancy cultivation in agrarian structure, did not impede the adoption of modern rice varieties in Bangladesh (Asaduzzaman, 1979; Mandal, 1980; Alauddin and Tisdell, 1996). Major constraints to the adoption of modern rice varieties were in fact logistic factors (Hossain *et al.*, 2006).

Bogra locale is considered as surplus rice generation zone of the nation, where BRRI Dhan49 was a noteworthy endeavor. Bogra sadar upazila range, in this manner, considered a most reasonable area to concentrate the marvels of selection of BRRI Dhan49 innovations by the rice cultivators. Contemplates on individual, gathering and society uncovered that acknowledgment of modem innovations is restrictive upon many variables. Some of these are social, individual, practical and situational components. While directing any review on the reception of modem advancements, these elements should be considered. Subsequently, the present examine felt need to lead an exploration entitled "Adoption of BRRI dhan49 by the farmers of Bogra sadar upazila."

1.2 Statement of the Problem

The achievement of any innovation relies on upon its dissemination among the potential clients, which eventually is measured by the level of selection of that innovation. Whenever advancement is acquainted with the farmer, it might be promptly or somewhat or completely acknowledged and it might likewise happen that the reception of advancement is stopped or completely ceased.

These happenings are unquestionably because of various variables. Selection of BRRI dhan49 innovations are impacted by the farmer's statistic and financial position. A comprehension about a similar will be helpful to the specialists, organizers and augmentation specialists in doing exploration, arranging and execution of expansion projects for upgrading adoption of BRRI dhan49 in rice cultivation. The motivation behind this review along these lines was to investigate the connections between various qualities of the agriculturists and

their selection of BRRI dhan49 advances in rice development. This was finished by looking for answers to the accompanying queries:

i. What are the extents of BRRI dhan49 producers?
ii. What personal and socio-economic characteristics were influenced farmers to adopt BRRI dhan49 cultivation?
iii. To what spread the contribution of the selected characteristics of farmers with their adoption of BRRI dhan49?
iv. To what expansion the BRRI dhan49 were adopted by the farmers?

The above-mentioned questions obviously impel the researcher for conducting the present research entitled "Adoption of BRRI dhan49 by the farmers of Bogra sadar upazila."

1.3 Objectives of the Study

The focal point of the research work was to explore the trends of adoption of BRRI dhan49 by the farmers. This is why the following objectives were structured out in order to provide an appropriate track to the research work:

i. To assess the extent of adoption of BRRI dhan49 by the farmers;
ii. To describe the selected socio-economic characteristics of farmers:
    - Age
    - Level of education
    - Effective farm size
    - Annual family income
    - Organizational participation
    - Cosmopoliteness
    - Extension media contact
    - Rice cultivation knowledge
    - Attitude towards BRRI dhan49
iii. To estimate the level of contribution of the selected characteristics of farmers in adoption of BRRI dhan49;
iv. To categorize the adopters of BRRI dhan49;

1.4 Scope of the Study

The present study was designed to have an understanding of adoption of BRRI dhan49 by the farmers and to explore its relationship with their selected characteristics.

i. The findings of the study will, in particular, be applicable to the study area at Sadar upazila under Bogra district. The findings may also be applicable to other locale of Bangladesh where socio-cultural, psychological and economic circumstance do not differ much than those of the study area.

ii. The findings of the study may also be subsidiary to the field workers of extension service to enhance their action strategies for adoption.

iii. The findings of the study will be conducive to accelerate the improvement in agriculture, farmers' logistic supports, information needs and the way of dissemination especially tuned to key role players in the society as well as adoption of BRRI dhan49 by the farmers. The outcomes might also be helpful to the planners and policy makers, extension workers and beneficiaries of the agriculture.

iv. To the academicians, it may help in the further conceptualization of the systems model for analyzing the adoption of BRRI dhan49 by the farmers. In addition, the findings of this study may have other empirical evidence to all aspects of adoption of BRRI dhan49 by the farmers which may be used to build an adequate theory of adoption.

1.5. Justification of the Study

Rice cultivation plays a vital role towards guaranteeing food security in Bangladesh. Presently impressive exertion is being made through research and extension delivery system to expand rice production. But the actual increase in production will depend on the activities of the rice cultivators and also the adoption of modern varieties in rice cultivation in our country. For that to enhance rice production efficiency, modern varieties play a great role.

The concept and benefits of the rice cultivation should be disseminated to the farmers in a convincing and attractive manner, so that farmers' response quickly to adopt modern varieties of rice cultivation. This is indisputably an educative process and it possible through Extension Education System, concerned mainly with increasing agricultural production and promoting living standards of the farmers.

The productive efficiency in agricultural production is an vital issue from the standpoint of agricultural improvement in developing countries since it provides pertinent information which is useful for drawing sound management decisions in resource allocations for creating agricultural policies and institutional improvements. Several adaptive exercises are regularly envisaged by the farmers in the local agriculture but the relative success to overcome these situation and primary variations gradually making them more vincibly. In this condition, the adaptive/adjustments capacities of the targeted people need to be gradually improved to comprehend the probabilistic vulnerabilities and its consequences over the agriculture and agriculturally based livelihoods (CEGIS, 2005). Bogra district was considered as a suitable area to study the process of adoption of BRRI dhan49 by the rice cultivators. Keeping the above facts in view, a study entitled 'Adoption of BRRI dhan49 by the farmers of Bogra sadar upazila'

1.6. Assumptions of the Study

An assumption is the supposition that an apparent fact or principle is true in the light of available evidence (Goode and Hatt, 1952). The researcher had considered the following assumptions while undertaking the study:

i. The respondents were efficient of furnishing proper answers to the questions contained in the interview schedule.

ii. The data collected by the researcher were free from favor and they were normally distributed.

iii. The responses answered by the respondents were valid and reliable.

iv. Information sought by the researcher revealed the real condition and was the representative of the whole population of the study area to gratify the objectives of the study.

v. The researcher was well adjusted to himself with the social surroundings of the study area. Hence, the collected data from the respondents were free from bias.

vi. The selected characteristics and the adoption of the farmers of the study were normally and independently allotted with respective means and standard deviation.

1.7. Limitations of the study

Considering the time, respondents, communication facilities and other necessary resources available to the researcher and to make the study manageable and meaningful, it became necessary to impose certain limitations as mentioned bellow-

i. The study was confined to one union namely Noongola of Bagra sadar upazila.

ii. It is difficult to get accurate information regarding adoption indicator from the farmers as many of them are illiterate.

iii. Characteristics of the farmers were many and varied, but only nine characteristics were selected for the research study.

iv. There were embarrassment situations at the time of data collection. So, the researcher had to manage proper rapport with the respondents to collect maximum accurate information.

CHAPTER II

REVIEW OF LITERTURE

Review of literature gives the clear and concise direction of the researcher for conducting the experiment. In this chapter, review of literature relevant to the objectives of this study was presented. This was mainly concerned with 'adoption of BRRI dhan49'. There was serious dearth of literature with respect to research studies on this aspect. So, the directly related literatures were not readily available for this study. Some researchers addressed various aspects of the adoption of BRRI dhan49 and its effect on client group and suggesting strategies for their emancipation from socio-economic deprivations. A few of these studies relevant to this research are briefly discussed in this chapter under the following three sections:

Section 1: Concept of Adoption, Adoption Process and Levels of Adoption of Agricultural Innovation

Section 2: Factors Related the Adoption

Section 3: Conceptual Framework of the Study

2.1 Concept of Adoption, Adoption Process and Levels of Adoption of Agricultural Innovation

2.1.1 The Concept of Adoption

According to Feder *et al.* (1985), adoption is "the degree of use of new innovation in long run equilibrium when a farmer has full information about the new technology and its potential". However, the equilibrium level of adoption will not be achieved if the technology is still being experimented by the farmers. Rogers (1995) defines innovation as an idea, practice, or object that is perceived as new by an individual or other unit of adoption. This wide definition captures any idea or process that is perceived to have utility. Lionberger (1968) and Van den Ban and Hawkins (1996) contended that, adoption is a process, which the decision to adopt usually takes time. People do not adopt new practice or idea as soon as they hear about it; they may wait

several years before trying it. Therefore, the adoption and diffusion of innovation process has been characterized as the acceptance overtime of some specific items by individuals (or adoption unit) linked to specific channels of communication. In this study the word innovation, technology and recommended practices will be used interchangeably.

2.1.2 Adoption process

Rogers (2003) described adoption as the decision by an individual to use the introduced technology or innovations as the best available alternative. Feder *et al.*, (1985) on the other hand defined adoption as the degree of use of a new technology in the long run equilibrium when farmers have the full information about the new technology. According to Spence (1994), adoption is not a one-off decision but a process in which the individual finally decides to use the introduced ideas or techniques, after a thorough assessment has been carried out. On the other hand, Guerin and Guerin (1994) defined technology adoption as the implementation of the already transferred knowledge about a technological innovation and is the end product of the technology transfer is the process. According to Rogers (2003), technology adoption involves a mental process that individual goes through when he or she becomes aware of information regarding the idea that is perceived to be new. The adoption process continues until decisions are made to use or reject the new idea (Rogers, 2003). The five steps in the adoption decision process are conceptualized as knowledge, persuasion, decision, implementation, and confirmation (Rogers, 2003). Spence (1994) the other hand on, indicated awareness, interest, evaluation, trial and adoption, as the stages involved in the adoption process. Although these authors term the adoption process differently, the steps described by them although have some minor differences, are very similar. These two models are compared in the following paragraphs.

The knowledge stage of the model is when an individual becomes aware of the existence of a technology as he/she receives information about it and understands how it works (Rogers, 2003). However, Spence (1994) described

this stage as the awareness stage. Spence further pointed out that the individual may obtain the information through mass media, or from written, spoken or visual material which the individual farmer can access.

The second stage of Rogers (2003) model is persuasion. At this stage, an individual may change his/her attitude towards the technology being introduced. Spence (1994) described this as the interest stage, whilst Pannell *et al.*, (2006) referred to it as the non-trial evaluation phase. During the interest stage, an individual will typically attempt to gain more factual data in order to enable an examination of the innovation at a closer level and to explore it in the context of personal circumstances, past experiences, and prevailing beliefs (Spence, 1994).

The third stage of Rogers (2003) model is decision. During this stage, the individual farmer engages in the activities that will consequently lead to the adoption (or rejection) of the new idea or technique. Spence (1994) considered this to be the evaluation of an innovation. Furthermore, during this process, an individual is attempting to assess whether the advantages will outweigh any perceived disadvantages. Pannell *et al.*, (2006) however, described this stage as the trial evaluation. They stressed that trials contribute substantially to both the decision-making and skill development aspects of the learning process. If small-scale trials are not possible (or not enlightening) for some reason, the opportunities for widespread adoption are greatly diminished. Farmers will be cautious about leaping into full-scale adoption due to the risk that the innovation may prove to be a full-scale failure. Practices which are not trial able may still be adopted, but generally the adoption occurs only after substantial information-seeking, discussion, analysis, and reflection (Pannell *et al.*, 2006).

The fourth stage of Rogers (2003) model is implementation. At this stage, the individual begins to completely apply or use the new idea (Rogers, 2003). Also, at this stage, farmers often look for more information to find out whether they have made the correct decision by adopting the technology (Van den Ban

and Hawkins, 1996). Spence (1994) considered this stage as a trial stage, since the implementation of the new idea is undertaken on a smaller scale. Duncan (1969) confirmed Spence's argument by stating that adoption is not an all-or-nothing decision. He suggested that there is a grey area between small-scale trialing and the eventual scale of adoption. Adoption is often a continuous process and it may occur within a gradual or stepwise manner, which sometimes results in only a partial adoption (Wilkinson, 2011). Farmers often change and modify their practices or technology, in order to adapt it to their own circumstances. However, Rogers (2003) argued that this is a full implementation stage, since the decision has already been made.

The fifth stage of Rogers (2003) model is confirmation. This stage is reached when the individual seeks more information towards supporting and reinforcing the decision he or she has made or when he or she discontinues the use of the new idea because of resultant difficulties (Rogers, 2003). Adopters, who are sometimes confronted with conflicting messages from change agents or peers, regarding the new practices, tend to discontinue using the new practice (Van den Ban and Hawkins, 1996). Some adopters may discontinue the use of a new idea or practice after adoption (Rogers, 2003). The discontinuation of a technology may be a result of the individual adopter being dissatisfied with the performance of the new idea or practice. It may also due to the fact that the individual has found a new practice that surpasses the existing one and as such they would like to replace it (Rogers, 2003). Spence (1994) on the other hand indicated that such a rejection could happen immediately after the acceptance of a technology, if there is a better alternative. The adoption of technology is influenced by a range of factors. In the following sections, the factors that influence the adoption decision of a new technology are examined.

2.1.3 Levels of adoption of agricultural innovation

Agriculture is a way of life to many subsistence farmers and other farmers are in constant search of ways in which to improve upon their lives. In agricultural context, adoption is decision made by an individual to start using new

agricultural innovations with the aim to increase productivity. This might be a new crop variety or management practices adopted by an individual, family or corporation. Adoption of agricultural technologies is considered as one of the ways that offer opportunities for improved agricultural production and hence improved life (Niyegela, 2007).

The technology must be widely adopted in order to self-sustain. Within the rate of adoption, there is a point at which agricultural technology reaches critical mass. The categories of adopters are: innovators, early adopters, early majority, late majority, and laggard. Innovators (2.5%) - had larger farms, were more educated, more prosperous and more risk-oriented, early adopters (13.5%) - younger, more educated, tended to be community leaders, less prosperous, early majority (34%) - more conservative but open to new ideas, active in community and influence to neighbors, late majority (34%) - older, less educated, fairly conservative and less socially active, laggards (16%) - very conservative, had small farms, oldest and least educated. Level of adoption of technology manifests itself in different ways in various cultures and fields and is highly subject to the type of adopters and innovation-decision process (Rogers, 1983).

2.2 Factors Related to the Adoption

There were a number of factors identified in the literature, which have influenced the adoption. Drawing on several studies on technology adoption such as Adesina and Zinnah (1992); Aguila-Obra and Melendez (2006); Chau and Tam (1997); Doorman (1991); Feder, Just and Zilberman (1985). It can be ascertained that the factors, which influence the farmers' decision to either adopt or not to adopt can be grouped under three major headings: 1) the characteristics of the technology; 2) internal factors; and 3) external factors. These factors are discussed in the following section.

2.2.1 Characteristic of technology as well as innovation

Rogers (1995) identified five characteristics of a technology or innovation that influenced adoption. These are: 1) relative advantage; 2) compatibility; 3) complexity; 4) trialability; and 5) observability. Feder *et al.,* (1985) identified three others and classified these technologies in relation to resource use. These characteristics included: 1) capital-saving or capital intensive; 2) land-saving or land-using; and 3) labor-saving or labor using. Feder and Umali (1993), Leathers and Smale (1991), and Pannell *et al.,* (2006) also identified associated risks with a new technology as an important factor that influenced adoption decisions of individuals. The following sections draw on the relevant literature to describe in detail each of these factors and their impacts on the adoption decisions of individuals.

a) Relative advantage

Relative advantage is the degree to which an innovation is perceived to be better than the idea it supersedes (Rogers, 1995). Relative advantage can also be described as the advantage of an innovation to achieve goals better (or at a lower cost) than previously (Van Den Ban and Hawkins, 1996). The degree of relative advantage is commonly expressed as economic profit, social prestige or other benefits (Rogers, 1995). It has been found that agricultural practices, which are believed to be profitable, have an increased likelihood of adoption, whilst those that are believed to provide less return are less likely to be adopted (Barr and Cary, 1992; Webb, 2004).

b) Compatibility

Compatibility refers to the degree to which an innovation is perceived as consistent with existing values, past experience, and the needs of the potential adopter (Roger, 1995, 2003). The more compatible an innovation is to a potential farmer's life experiences and situation, the more familiar they will be with the innovation and the less uncertain they will be about adopting the innovation (Deressa*et al*., 2009). Ogunlana (2004) also defined compatibility

as being the ease by which the farmers can integrate the new practices into their farming system and access other relevant inputs that would help in its adoption.

c) Complexity

The complexity factor is the degree to which a technology is perceived to be difficult to understand and use (Rogers, 2003). The greater the complexity of an innovation the more negatively a new farmer may view the technology. For example, the discontinuation of a system of rice intensification program, which was introduced in Madagascar for rice farmers, was largely due to the difficulties faced by farmers in understanding the application of the new practices and methods (Moser and Barrett, 2003). Gibson (1994) shared a similar view and reported that farmers in Papua New Guinea rejected growing rice because rice cultivation was seen as complex and difficult to manage.

d) Trialability

Trialability is the degree to which the technology can be tested on a small scale (Rogers, 2003). Ogunlana (2004) pointed out that farmers are always keen to adopt technologies which they have first trialed on a limited basis on their farm, compared to one they have to adopt on a larger scale - which might fail. Floyd *et al.*, (2003) and Rogers (2003) added that a technology, which can be gradually implemented without a large capital investment from outside, is important, since it will certainly enhance the farmers' decision to adopt the technology.

e) Observability

Observability is the degree to which the results of a technology can be visible to others (Rogers, 1995). *Cary* et al., (2002) argued that a profitable outcome is an important factor that influences the adoption decision. A lack of observable profit, as result of adopting a technology would inhibit the adoption of the technology by others. The more observable the outcomes of an innovation offers and is perceived as being suitable by the farmer, the rate of adoption will

become more positive (Rogers, 2003). For example, in a study on mangrove swamp rice varieties in Sierra Leone, Adesina and Zinnah (1992) found that farmers adopted a new variety of rice introduced to the area because they observed that the results were highly visible.

2.2.2 Internal factors

Several authors (Bantel and Jackson, 1989; Deressa *et al.*, 2009; Knowler and Bradshar, 2006; Pannell *et al.*, 2006; Staal*et al.*, 2002) suggested that there are four key internal factors that influence the adoption of technology. These factors include: 1) characteristics of the farmer; 2) on-farm factors; 3) cultural factors; and 4) leadership characteristics. The following sections draw on the relevant literature to describe in detail each internal factor that can influence a farmer's adoption decision.

2.2.2.1 Characteristics of the farmer

2.2.2.1.1 Age

The personal characteristics that may influence the adoption decision of a farmer include age, gender, education, and level of farming experience (Deressa *et al.*, 2009; Doss and Morris, 2000). These personal factors can affect the innovativeness of an individual and thus contribute to determining the rate at which farmers' will adopt new technology (Adesina and Zinnah, 1992; Deressa *et al.*, 2009; Spence, 1994). The age of the farmer is often considered to be one of the factors responsible for influencing his or her decision to adopt a technology (Souza *et al.*, 1993). Tiamiyu *et al.*, (2009) argued that younger farmers are more likely to adopt new technologies if they are not constrained by limited cash resources, whilst older farmers are less likely to adopt new technologies if they require extra physical labor. Older farmers may be less interested because they have less need for extra income. However, there is conflicting evidence on this relationship with some researchers finding no significant evidence between age and adoption (Curtis *et*

al., 2005; Guerin and Guerin, 1994; Shiferaw and Holden, 1998). For example, Adesina and Zinnah

(1992), in their study on the factors affecting the adoption of rice farming in Sierra Leone found that the age of farmers had no significant relationship to their adoption decision of rice farming. Moser and Barret (2003) in their study on factors affecting non-adoption of a system of rice intensification in Madagascar found that adopters and non-adopters who had more years of schooling adopted the rice intensification system at a higher rate than those with less education. They also found that farmers with more years of schooling were more likely to belong to a farmer association than farmers with low level of education. However, variables relating to experience are found in many studies, with mixed results. For example, Lin (1991) found that experience related positively to the adoption of hybrid rice in China. On the other hand, experience may be related to age, which has often been shown to be negatively related to adoption (Polson and Spencer, 1991; Zepeda, 1990). The other important aspect of experience, which is rarely investigated but is equally important, is the past experience of the farmer with the proponents of change (the government, their agents and policies advocated) (Agarwal, 1983; Stanley *et al.*, 2000). For example, Agarwal (1983) stated that the past experience of a farmer with the technology and its proponents can positively influence his/her decision to adopt the technology. However, in contrast, Stanley *et al.* (2000) found this relationship to be negative. They found that the previous experience of the potential adopters (with a previous government's failed program) was seen as a barrier to adoption. Finlay *et al.*, (2004), in a study examining land managers' attitude towards land management in Australia, supported this view. He found that the past experience of the land managers with government agents and their failed program only contributed to a general feeling of distrust and animosity towards government policies and their agents (such as the extension officers).

Byron *et al.* (2005) reports that, elderly farmers seem to be somewhat less inclined to adopt new practices than younger farmers. It is also well known that, in general, the older the farmers the less their willingness to try new innovations or take risks. Older farmers may have more experience, resources, or authority that can allow them more possibilities for trying recommended production practices (CIMMYT, 1993). Some studies indicate that the number of farming years has a positive and significant relationship with the use of recommended production practices at least in early years (Mattee, 2009). Furthermore, some of the studies found there are no relationship between age and the use of recommended production practices (Mattee, 2009). Still other studies show that younger farmers are more likely to adopt recommended production practices (Van den Ban and Hawkins, 1996). A study conducted at Dhamrai upazila under Dhaka district in Bangladesh that showed a non-significant relationship of age on adoption of BRRI dhan49 production technologies (Islam, 2007).

2.2.2.1.2 Level of education

Education improves human capital, farm management capacity, the ability to understand and adopt recommended agricultural practices (Bezuayehu *et al.*, 2002). It is expected that better educated farmers are more likely to adopt recommended agricultural practices than less educated farmers (Cary *et al.*, 2002 and Nina, 1993). Mwaseba *at el.* (2006) reported that, education of household head has influence on adoption of recommended agricultural practices especially when the recommended agricultural practices require managerial skills. The education level of farmers also or could also affect their decision to adopt or reject a technology. Evidence from various sources has indicated that a positive relationship exists between the educational level of a farmer and the adoption of improved technologies (Doss and Morris, 2000; Moser and Barrett, 2003; Tiamiyu *et al.*, 2009). A study conducted at Dhamrai upazila under Dhaka district in Bangladesh that showed a significant relationship of education on adoption of BRRI dhan49 production technologies

(Islam, 2007). Amin (2015) conducted a study at Rajapur upazila under Jhalokathi district in Bangladesh that showed a significant contribution of education on adoption of modern technologies by the rice cultivators

2.2.2.1.3 Annual Family Income

Income may enhance labour and ability to purchase and therefore low level of income implies difficulties in buying farm inputs like improved seed, fertilizers and herbicides (Msuya, 2005). Many studies report positive contribution of income to household's adoption of recommended agricultural practices like use of improved seed varieties, fertilizers application, spacing, weeding, and pest management. For instance, different recommended agricultural practices adoption studies conducted by Kidane (2001) and Islam (2007) indicated positive relationship between income and adoption of recommended agricultural practices. Amin (2015) conducted a study at Rajapur upazila under Jhalokathi district in Bangladesh that showed a significant contribution of annual family income on adoption of modern technologies by the rice cultivators.

2.2.2.1.4 Organizational participation

Amin (2015) conducted a study at Rajapur upazila under Jhalokathi district in Bangladesh that showed a non-significant contribution of organizational participation on adoption of modern technologies by the rice cultivators. Hossain (2006) revealed that organizational participation of the farmers had no significant relationship with their adoption of HYV rice. Sardar (2002) conducted a study on adoption of IPM practices by the farmers under PETRRA project of RDRS. He observed that organizational participation of the farmers had no significant relationship with their adoption of IPM practices. Rahman (2001) conducted study on knowledge attitude and adoption of the farmers regarding Aalok 6201 hybrid rice in Sadar upazila of Mymensingh district. He found that organizational participation of the farmers is significant and positive relationship with their adoption regarding Aalok 6201 hybrid rice.

Kher(1992) carried out study on the adoption of improved wheat cultivation practices by the farmers in selected village Rajouri block, India. He observed that there was no significant relationship between the farmers' social participation and their adoption of improved wheat cultivation practices. Islam (2007) conducted a study at Dhamrai upazila under Dhaka district in Bangladesh that showed a significant relationship of organizational participation on adoption of BRRI dhan49 production technologies.

2.2.2.1.5 Extension media contact

Hossain (2006) concluded that the extension contact of the farmers had positive significant relationship with their adoption of selected HYV rice. Hossain (2003) concluded that communication exposure of the farmers had a significant and positive relationship with their adoption of modem Boro rice cultivation. Haque (2003) concluded that extension contact of the farmers had a significant positive relationship with their adoption of modem maize cultivation technologies. Sardar (2002) concluded that the extension contact had positively significant relationship with their adoption of IPM practices. Rahman (2001) conducted a study on knowledge, attitude and adoption of the fanners regarding Aalok 6201 hybrid rice in Sadar upazila of Mymensingh district. He found that extension contact of the farmers had a significant and positive relationship with their adoption of Aalok 6201 hybrid rice. Singh (1991) observed in his study that mass contact of the farmers had significant relationship with their level of adoption of plant protection measures. Alam (1997) studied the use of improved farm practices of rice cultivation by the farmers of Anwara Thana of Chittagong district. The study indicated no significant relationship of extension contact of the farmers with their use of improved farm practices in rice cultivation.

2.2.2.1.6 Rice Cultivation Knowledge

In this study knowledge refers to as an awareness of recommended practices or the optimum that is achievable in terms of efficiency. In this case refer to as

awareness of recommended rice production practices in the study area. A lack of understanding or knowledge about the recommended practices is often cited as a strong barrier to the adoption of recommended practices or innovations (Duvel, 1991). Amin (2015) showed a significant contribution of knowledge on modern technologies on adoption of modern technologies by the rice cultivators. Hossain (2009) showed that knowledge on IPM of the farmers had positive significant relationship with their use of IPM practices. Aurangozeb (2002) conducted a study on adoption of integrated homestead farming technologies by the rural women in RDRS. He found that there was a positive significant relationship between knowledge of the respondents and their adoption of integrated homestead farming technologies. Islam (2002) reported that agricultural knowledge of the farmers had significant relationship with their adoption of modern agricultural technologies in Sandwip. Chowdhury (1997) conducted adoption of selected BINA technologies by the farmers. He indicated that knowledge of the farmers had a strongly positive significant relationship with their adoption of selected BINA technologies. Sarkar (1997) found that potato production knowledge of potato growers had a positive and significant relationship with their adoption of potato cultivation practices.

2.2.2.1.7 Farmers' attitude towards BRRI dhan49

Attitude is the process by which a person receives information or stimuli from the environment and transforms it into psychological awareness (Van de Ban and Hawkin, 1988). According to Duvel (1991) perception is understood to be of more specific nature and is analyzed based on attribute of innovation. The attributes that can be directly associated with field forces are; prominence and relative advantages.

2.2.2.2 On-farm factors

On-farm factors include farm size, location, and land tenure (Daberkow and Mcbride, 2003; Knowler and Bradshar, 2007; Staal *et al.*, 2002). These factors exist within the farm environment in which farmers carry out their daily activities (Spence, 1994). The effect of farm size on adoption has been

frequently analysed in many adoption studies (Erenstein and Farooq, 2009; Daku, 2002; Doss and Morris, 2001). Evidence from various sources has indicated that there is a positive relationship between farm size and adoption (Erenstein and Farooq, 2009; Deressa *et al.,* 2009; Kasenge, 1998). In a number of studies, it was found that those with larger farms have a greater probability of adopting an innovation than owners of smaller sized farms (Azilah, 2007; Deressa *et al.,* 2009). Farmers operating larger farms tend to have greater financial resources and their opportunities to obtain credit are higher compared to those with smaller farms. In Kenya for example, a study by Gabre-Madhin and Haggblade (2001) found that large commercial farmers adopted new high-yielding maize varieties more rapidly than small holders did. However, in contrast, Hossain (1988) pointed out that small holder farmers are more willing to adopt labor intensive technologies than larger farmers did because small holder farmers can use family labor, which is relatively cheap compared to larger commercial farms. The location of the farm is also an important factor, which influences the adoption of a technology. For example, Zeller *et al.,* (1998), in a study on market access in Malawi found that farmers who had their farms located close to major markets adopted maize faster than those whose farms were located far from the market. In a developed country's context, Khanna (2001) found in the American Midwest that the farmers who had their farms located in proximity to soil research centers adopted new soil testing technology faster than those whose farms were located far away from the research Centre. Similarly, a study on the adoption of conservation tillage in Australia by D'Emden *et al.,* (2006), found that the proximity of the farm to the adopter's home was positively related to adoption. They further stated that farms that are located closer to locations that provide the service are more likely to adopt a new technology than farms located further away. Land ownership is widely believed to encourage the adoption of technologies linked to land (Kassie *et al.*, 2009). For example, in the Philippines, Neil and Lee (2001) found that land ownership was positively associated with hedgerow adoption. Whilst empirical studies have supported this hypothesis, the results

are not unanimous and the subject has been widely debated (Feder *et al.*, 1985; Rodriguez *et al.*, 2009). For example, Smucker *et al.*, (2000) found no definitive relationship between land ownership and technology adoption by peasant farmers in Haiti. Similarly, Rodriguez *et al.*, (2009), in a study on barriers to the adoption of sustainable agricultural practices in the 13 Southern States of the USA found the relationship between land ownership and the adoption of sustainable agricultural practices to be negative. This is because the landlords who lease their land to farmers dictated what crops would be grown on this land and this led farmers to be reluctant to adopt the new technology (Rodriguez *et al.*, 2009). This suggests that farmers working on leased land are less likely to adopt long-term technology practices because they perceive that the benefits of the adoption will not be necessary accrue to them. According to CIMMYT, (1993) farm size is a common variable in determining the adoption of an innovation. It has been recognized that, small and large farm operators differ in the speed of adoption of innovations (Polson and Spencer, 1991). Rogers (1983) adverts that those farmers who own large farms enjoy a high socio economic status. They also have ample mass communication opportunities, and are more innovative in adopting new agricultural technologies. Amin (2015) conducted a study at Rajapur upazila under Jhalokathi district in Bangladesh that showed a non-significant contribution of farm size on adoption of modern technologies by the rice cultivators. Islam (2007) conducted a study at Dhamrai upazila under Dhaka district in Bangladesh that showed a significant relationship of farm size on adoption of BRRI dhan49 production technologies. In following section, the cultural factors that influenced adoption decision are reviewed.

2.2.2.3 Cultural factors

Cultural factors have also been identified as having influenced adoption decisions by farmers. These factors include: 1) norms and 2) the traditions of a society (Herbig and Miller, 1991; Pannell *et al.*, 2006; Roger, 1995; Sommers and Napier, 1993; Straub, 1994; Tiraieyar, 2009; Twati and Tripoli, 2008;

Wejnert, 2002). The cultural norms of a society are also an important factor that influences an adoption decision. Wejnert (2002) argued that technologies, which are not compatible with cultural norms, are adopted only by a relatively small percentage of potential, individual adopters. For example, Rogers (1995) found that the residents of Los Molino in Peru did not adopt the practice of boiling drinkable water because it conflicted with their norm of serving such water only to sick people. Similarly, in Costa Rica, the rate of adoption of fertility-control practices by married couples was low because they conflicted with their cultural values relating to optimum family size (Rosero-Bixby and Casterline, 1993; 1994). The traditions of a society are one of the factors that play an important role in affecting farmers' decision-making, which includes the likelihood of them adopting new practices (Stanley *et al.,* 2000). For example, Sommer and Napier (1993) found that the adoption of sustainable agriculture practices by farmers in Amish communities was influenced by their cultural traditions towards land and soil protection. However, in contrast, Wejnert (2002) stated that the cultural traditionalism associated with social inertia when adopting new practices and ideas can negatively affect the adoption of technology. Lawrence *et al.,* (2004) argued that society's resistance to discarding long-held traditions would lead to a strong resistance (within that society) to change the adoption of new technology. In the following section, the leadership characteristics that influenced adoption decision are discussed.

2.2.3 External factors

Apart from the internal factors, the adoption decision of farmers is also influenced by external factors. Several authors such as Akpabio and Inyang (2007); Anderson and Feder (2007); Caswell *et al.,* (2001); Cornejo *et al.,* (2001); D'Emden *et al.,* (2008); Doss (2006); Fliegel (1993); Grarner and Sharp (2004); Kurlalova*et al.,* (2006); Mansuri and Rao (2003); Saltiel *et al.,* (1994); Sunding and Zilberman (2001); and Zeller *et al.,* (1998) identified five main external factors to have influenced the adoption decision of farmers.

These were: 1) government policy; 2) infrastructure development; 3) agro-climatic condition; 4) extension support; and 5) market access.

2.3 Conceptual framework of the study

In scientific research, selection and measurement of variables constitute an important task. Studies on individual, group and society revealed that acceptance of modem technologies is conditional upon many factors. Some of these are social, personal, economical and situational factors and the behavior of rice cultivators are influenced by these characteristics. The hypothesis of a research while constructed properly consist at least two important elements i.e.: a dependent variable and an independent variable. A dependent variable is that factor which appears, disappears or varies as the researcher introduces, removes or varies the independent variables (Townsend, 1953)**.** An independent variable is that factor which is manipulated by the researcher in his attempt to ascertain its relationship to an observed phenomenon. Variables together are the causes and the phenomenon is effect and thus, there is cause effect relationship everywhere in the universe for a specific events or issues.

This study is concerned with the 'Adoption of BRRI dhan49 in the Selected Areas of Bogra Sadar upazila. Thus, the adoption of BRRI dhan49 by the rice cultivators in the selected area of Bogra district was the dependent variable and 9 selected characteristics of the rice cultivators were considered as the independent variables of the study. Adoption of BRRI dhan49 may be affected through interacting forces of many independent variables. It is not possible to deal with all of the independent variables in a single study. It was therefore, necessary to limit the independent variables, which include age, level of education, effective farm size, annual family income, organizational participation, cosmopoliteness, extension media contact, rice cultivation knowledge and attitude towards BRRI dhan49 for this study.

Considering the above-mentioned situation and discussion, a conceptual framework has been developed for this study, which is diagrammatically presented in the following Figure 2.1.

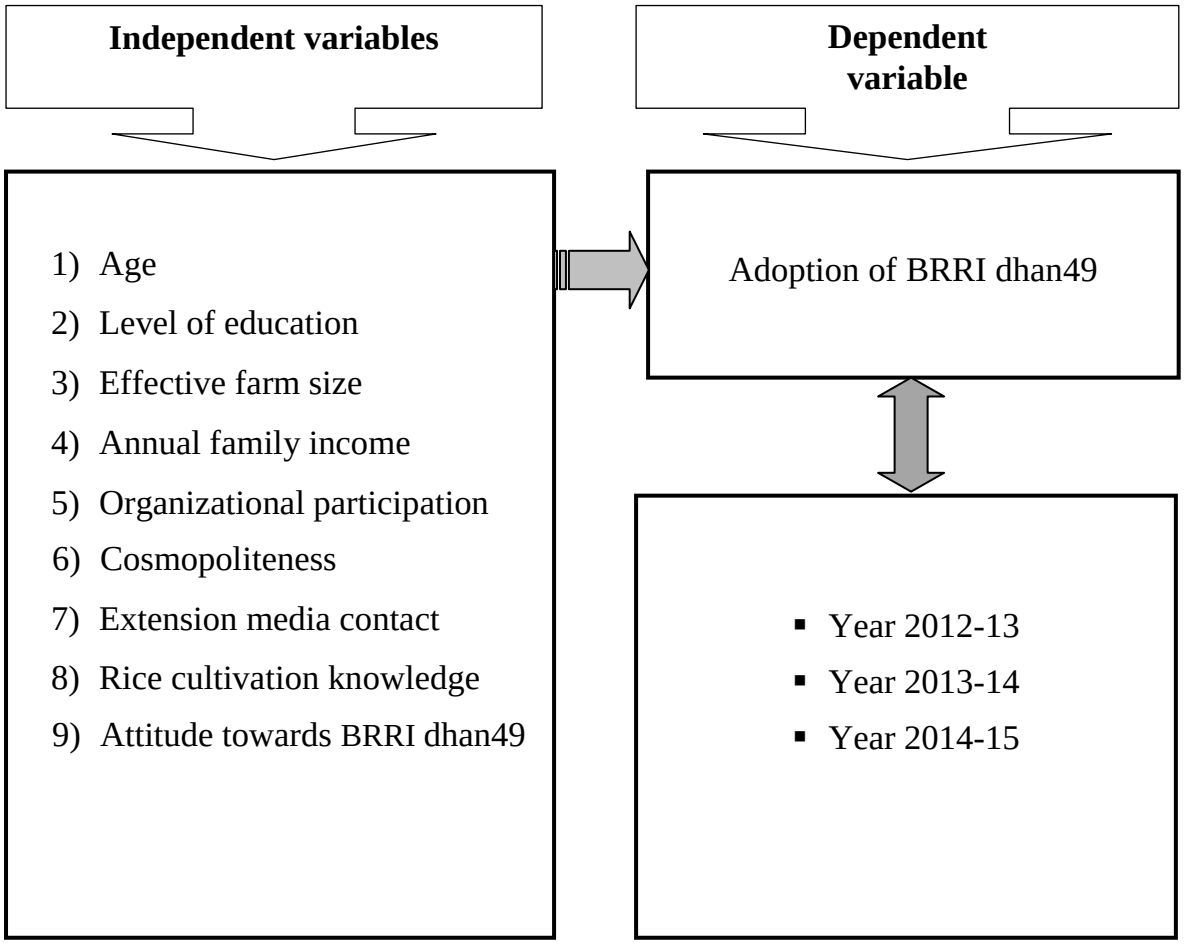

Figure 2.1 The conceptual framework of the study

CHAPTER III

MATERIALS AND METHODS

Methodology assumes an essential part in a logical research. To fulfill the objectives of the study, a researcher should be very careful while formulating methods and procedures in conducting the research. According to Mingers (2001), research methodology is a structured set of guidelines or activities to generate valid and reliable research results. This chapter of the thesis illustrates the research methodology and procedures used to collect and analyze the data for answering the research questions and attaining the purposes. The methods and operational procedures followed in conducting the study e.g. selection of the study area, sampling procedures, instrumentation, categorization of variables, collection of data, measurement of the variables and statistical measurements. A chronological description of the methodology followed in conducting this research work has been presented in this chapter.

3.1 Locale of the Study

The study was conducted in the sadar upazila under Bogra district. Bogra sadar upazila (Bogra district) area 197.75 sq km, located in between 24°41' and 24°59' north latitudes and in between 89°16' and 89°30' east longitudes. It is bounded by Shibganj (Bogra) upazila on the north, Shahjahanpur upazila on the south. The features of the farmers and agriculture at Sadar upazila are like- main sources of income agriculture 35.09%, main crops paddy, jute, potato, corn, mustard, vegetables etc. sadar upazila has 11 unions; out of these Noongola union was selected purposively as the study area. The villages of Noongola union namely Ashokola, Polikukrul, Teldhap, Shashibadoni, Darial and Ontahar villages were selected purposively for the study. The population of these villages had almost eager to cultivate the rice variety BRRI dhan49. The total farm population of the study area is 4910.

The map of the Bogra district has been presented in Figure 3.1. and the specific study locations of Noongola union under Sadar upazila of Bogra district have also been shown in Figure 3.2.

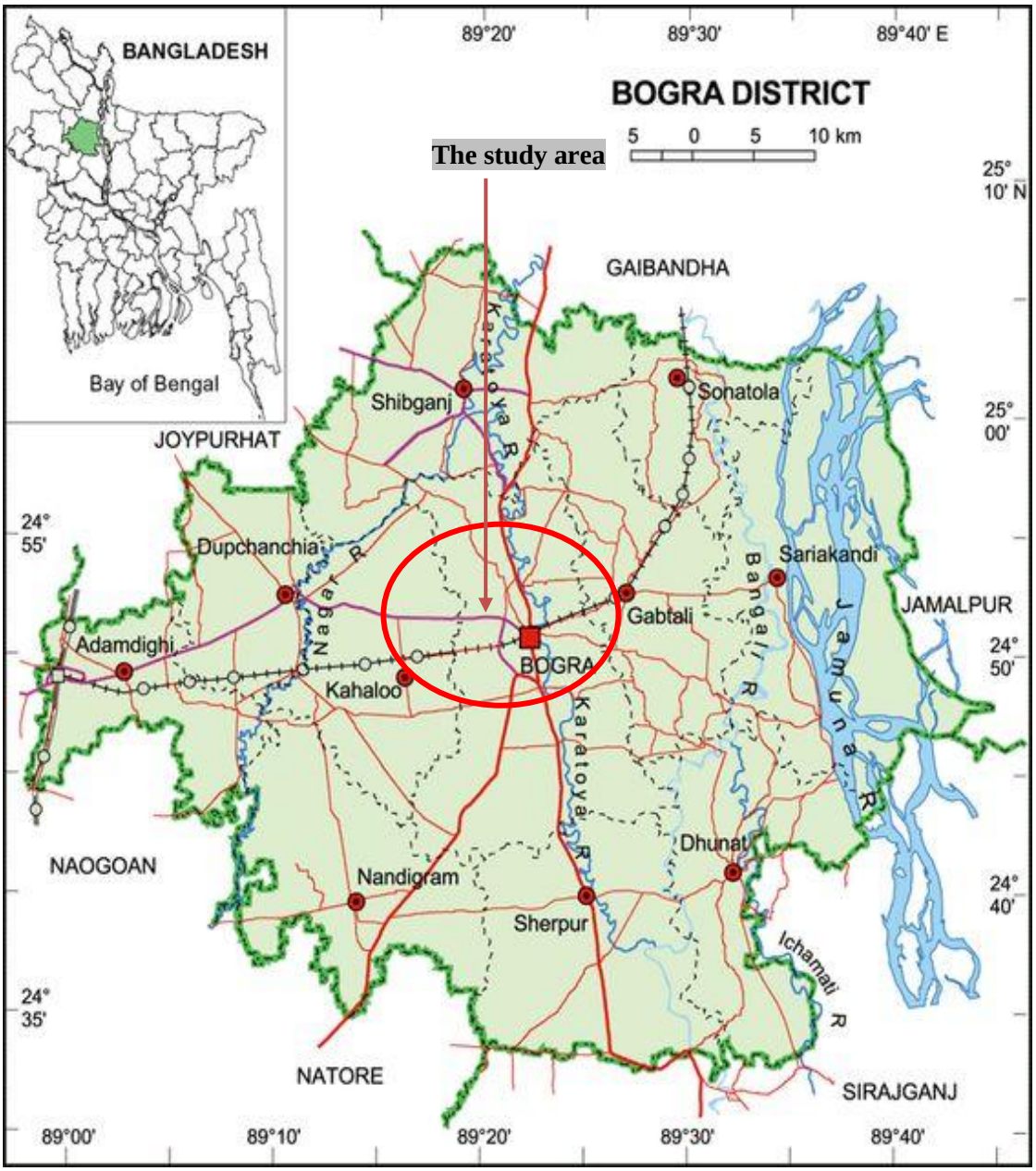

Figure 3.1 Map of Bogra district showing the study area of Bogra Sadar upazila. (Bangladesh inset)

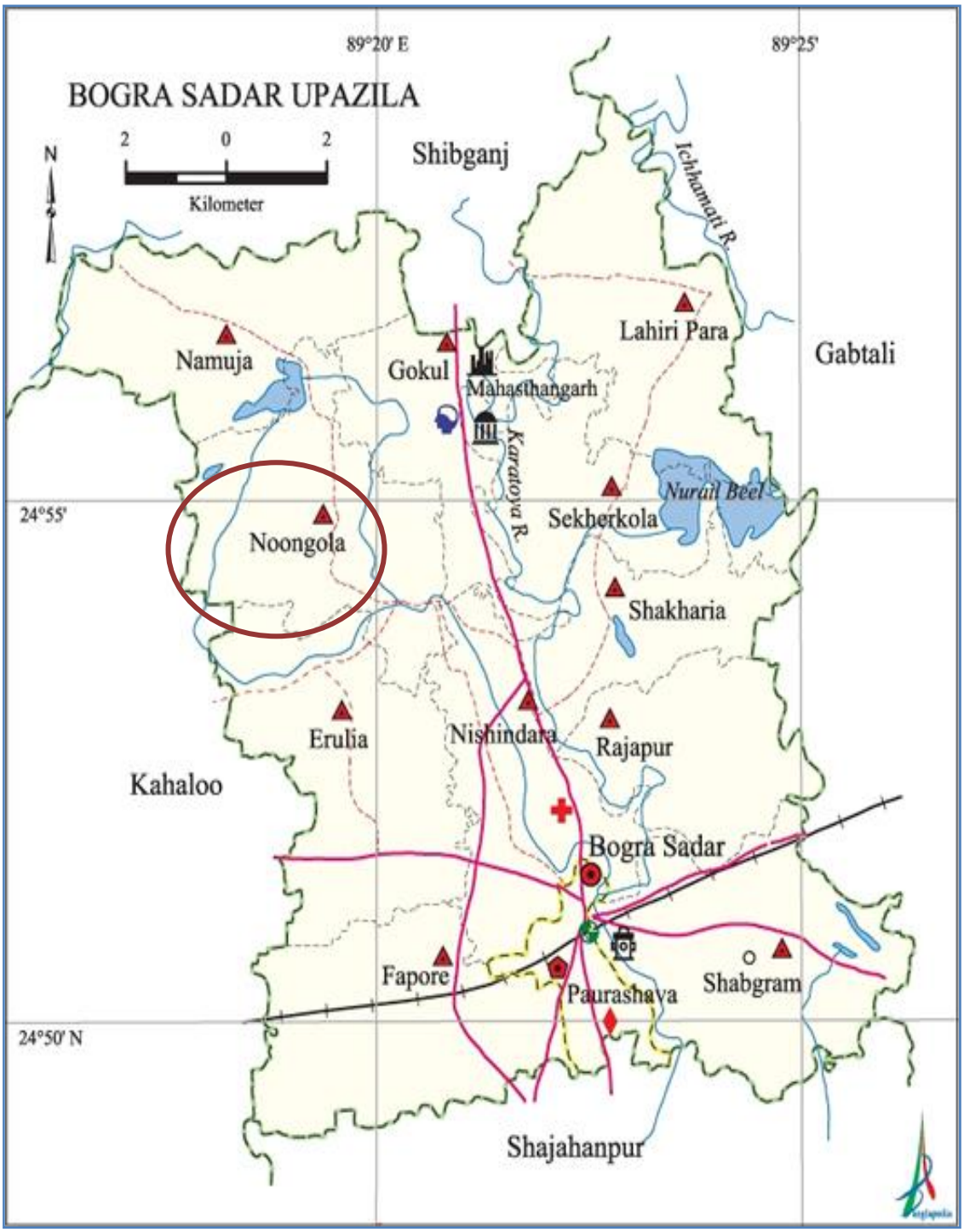

Figure 3.2 Map of Sadar upazila showing the study area of Noongola union.

3.2 Population and Sample of the Study

People who permanently reside in the selected villages constituted the active population of this study. As all population of the study area could not possible to measure, head of the farm families of Ashokola, Polikukrul, Teldhap, Shashibadoni, Darial and Ontahar villages of Noongola union of Sadar upazila under Bogra district were the population of the study. However, representative sample from the population were taken for collection of data following random sampling technique. One farmer (who mainly operated the farming activities of the family) from each of the farm families was considered as the respondent. Updated lists of all farm families who cultivated rice var. BRRI dhan49 of the selected villages were prepared with the help of SAAO and local leader (Matobbor). The total number of rice cultivators in these villages was 4910; where 747 farm family heads from Ashokola village, 815 farm family heads from Polikukrul village, 780 farm family heads from Teldhap village, 876 farm family heads from Shashibadoni village, 758 farm family heads from Darial village and 934 from Ontahar village under the union of Noongola. Thus, 4910 rice cultivators constituted the population of the study which is shown in the following table 3.1

Table 3.1. Population of the study area

Name of the selected upazila	Name of the selected union	Name of the selected villages	Number of the respondents
Bogra Sadar	Noongola	Ashokola	747
		Polikukrul	815
		Teldhap	780
		Shashibadoni	876
		Darial	758
		Ontahar	934
		Total	4910

3.2.1. Determination of the sample size

There are several methods for determining the sample size; here, followers (Yamane, 1967) was used formula for study group:

$$n = \frac{z^2 P\,(1-P) N}{z^2 P\,(1-P) + N\,(e)^2}$$

Where,

n = Sample size;

N, Population size = 4910;

e, The level of precision = 9%;

z = the value of the standard normal variable given the chosen confidence level (e.g., z = 1.96 with a confidence level of 95 %) and

P, The proportion or degree of variability = 50%;

The sample size (n) is = 116

3.2.2 Distribution of the population, sample size and reserve list

According to the Yamane's formula, the respondents comprised of 116 rice cultivators. A reserve list of 12 rice cultivators (ten percent of the sample size) were also prepared so that the rice cultivators of this list could be used for interview if the rice cultivators included in the original sample were not available at the time of conduction of interview. The farmers of the Ashokola, Polikukrul, Teldhap, Shashibadoni, Darial and Ontahar villages of Noongola union were measured according to the proportionate of the total sample size (116) which was calculated using Yamane's (1967) formula. The distribution of the population sample and number of respondents along with the reserve list are given in the following Table 3.2.

Table 3.2. Distribution of the rice cultivators according to population and reserve list

Name of union	Name of villages	Population of rice cultivators	Sample size	Farmers number in the reserve list
Noongola	Ashokola	747	18	2
	Polikukrul	815	19	2
	Teldhap	780	18	2
	Shashibadoni	876	21	2
	Darial	758	18	2
	Ontahar	934	22	2
Total		4910	116	12

3.3 Data Collection Methods and Tools

3.3.1 Data collection methods

The survey method was used to collect quantitative data that allow to answer the research questions framed and to gain an understanding of the determinants of constraints faced by the farmers in vegetable production. Individual interviews were used in the survey and were conducted in a face-to-face (Bryman, 2001) situation by the researcher. This method is useful to get unanticipated answers and to allow respondents to describe the world as they really see it rather than as the researcher does (Bryman, 2001).

3.3.2 Data collection tools

Structured and different semi-structured interview schedules were prepared to reach the objectives of the study. A structured interview schedule was prepared containing open and closed questions. The open questions allowed for the respondents to give answers using their own language and categories (Casley and Kumar, 1998). The questions in this schedule were formulated in a simple and unambiguous way and arranged in a logical order to make it more attractive and comprehensive. The instruments were first developed in English and then translated into Bengali. The survey tools were initially constructed

based on an extensive literature reviews and pre-tested. The schedule was pre-tested with 15 randomly selected rural women in the study area. The pre-test was helpful in identifying faulty questions and statements in the draft schedule. Thus, necessary additions, deletions, modifications and adjustments were made in the schedule on the basis of experiences gained from pre-test. The questionnaires were also checked for validity by supervisor and educational experts at Sher-e-Bangla Agricultural University (SAU). Finally, based on background information, the interview schedule was finalized. Data was gathered by the researcher personally. During data collection, necessary cooperation was obtained from field staff of different GOs and NGOs and local leader. The Secondary data were collected from 10 January to 15 January, 2017. The final data collection was started from 21 January and completed in 20 February, 2017. Books, journals, reports and internet documents were used as secondary sources of data supporting or supplementing the empirical findings of the study.

3.4 Variables and their measurement techniques

The variable is a characteristic, which can assume varying, or different values in successive individual cases. A research work usually contains at least two important variables viz. dependent and independent variables. An independent variable is that factor which is manipulated by the researcher in his attempt to ascertain its relationship to an observed phenomenon. A dependent variable is that factor which appears, disappears or varies as the researcher introduces, removes or varies the independent variable (Townsend, 1953). In the scientific research, the selection and measurement of variable constitute a significant task. Following this conception, the researcher reviewed literature to widen this understanding about the natures and scopes of the variables relevant to this research. At last he selected 9 independent variables and one dependent variable. The independent variables were: age, level of education, effective farm size, annual family income, organizational participation, cosmopoliteness, extension media contact, rice cultivation knowledge and attitude towards BRRI

dhan49. The dependent variable of this study was the "adoption of BRRI dhan49". The methods and procedures in measuring the variables of this study are presented below:

3.4.1 Measurement of independent variables

The 9 characteristics of the rice cultivators mentioned above constitute the independent variables of this study. The following procedures were followed for measuring the independent variables.

3.4.1.1 Age

Age of the farmers was measured in terms of actual years from their birth to the time of the interview, which was found on the basis of the verbal response of the rural people (Rashid, 2014). A score of one (1) was assigned for each year of one's age. This variable appears in item number 1 in the interview schedule as presented in Appendix-I.

3.4.1.2 Level of Education

Education was measured by assigning score against successful years of schooling by a farmer. One score was given for passing each level in an educational institution (Rashid, 2014).

For example, if a farmer passed the final examination of class five or equivalent examination, his/her education score has given five (5). Each farmer of can't read & write has given a score of zero (0). A person not knowing reading or writing but being able to sign only has given a score of 0.5. If a farmer did not go to school but took non-formal education, his educational status was determined as the equivalent to a formal school student. This variable appears in item number 2 in the interview schedule as presented in Appendix-I.

3.4.1.3 Effective farm size

Effective farm size of a farmer referred to the total area of land on which his/her family carried out the farming operation, the area being in terms of full

benefit to the family. The term refers to the cultivated area either owned by the farmer or cultivated on sharecropping, lease or taking from other including homestead area and measured using the following formula (Rashid, 2014).

EFS = A + B + ½ (C + D) + E

Where, EFS = Effective Farm size,

A = Homestead area including garden and pond,

B = Own land under own cultivation,

C = Land taken from others as borga

D = Land given to other as borga,

E = Land taken from others on lease,

The data was first recorded in terms of local measurement unit i.e. kani or decimal and then converted into hectare. The total area, thus, obtained is considered as his farm size score (assigning a score of one for each hectare of land). This variable appears in item number three (3) in the interview schedule as presented in Appendix-I.

3.4.1.4 Annual family income

The term annual income refers to the annual gross income of rice cultivators and the members of his family from different sources. It was expressed in taka. In measuring this variable, total earning taka of an individual rice cultivator was converted into score. A score of one was given for every one thousand taka. The method of ascertaining income involved three phases. Firstly, the income from agricultural crops in the preceding year was noted and converted into taka. Secondly, income comes from animals and fish resources. Thirdly, other source income included earning form small business, service, other family members income, day laborer, fishing and others (if any). This variable appears in item number 4 (four) in the interview schedule as presented in Appendix-I. Based on the available information cited by the farmers, they were classified into three categories (Mean ± Standard Deviation) namely ‘low’, ‘medium’ and ‘high’ annual family income.

3.4.1.5 Organizational participation

Organizational participation of a respondent was computed on the basis of his/her participation in different organizations. This variable appears in item number 5 (five) in the interview schedule as presented in Appendix-I. Scoring of the organizational participation was done using the following formula and in the following way:

$$OP = P_{om} + P_{em} + P_{eo}$$

Where, OP = Organizational participation score,

P_{om}= Participation as ordinary member,

P_{em} = Participation as executive member and

P_{eo} = Participation as executive officer (president/secretary).

Nature of participation	Score assigned
No participation	0
Participation as ordinary member	1
Participation as executive member	2
Participation as executive officer	3

For example, if a respondent participated as an executive committee member of school committee, an ordinary member at NGO organized society and no participation in other organizations, that respondent would have a total score 3. Based on the available information cited by the farmers, they were classified into three categories (Mean ± Standard Deviation) namely 'low', 'medium' and 'high' organizational participation.

3.4.1.6 Cosmopoliteness

Cosmopoliteness of a respondent was measured in terms of his/her nature of visits to six different places external to his/her own social system. The scale used for computing the cosmopoliteness score was presented below:

Extent of visit	Score assigned
Regularly	4
Frequently	3
Occasionally	2
Rarely	1
Not at all	0

Logical frequencies of visits were considered in each of the alternative responses of each item as shown in question no. 6 (six) of the interview schedule. The cosmopoliteness score of a respondent was determined by adding together the scores obtained from visit to each of the six (6) types of places. The cosmopoliteness score of the respondents could range from 0 to 24, where, 0 indicating no cosmopoliteness and 24 indicating very high cosmopoliteness.

3.4.1.7 Extension media contact

It was defined as one's extent of exposure to different communication media related to farming activities. Agricultural extension media contact of farmers was measured by computing extension media contact score on the basis of their nature of contact with ten extension media. Each farmer was asked to indicate his nature of contact with five alternative responses, like regularly, frequently, occassionally, rarely and not at all basis to each of the ten media and score of four, three, two, one and zero were assigned for those alternative responses, respectively. These five options for each medium were defined specially to each medium considering the situation, rationality and result of pre-test. Logical frequencies were assigned for each of the five-alternative nature of contact. Extension media contact of the farmers was measured by adding the scores of ten selected source of information. Thus, extension media contact score of a farmer could range from 0 to 40, where "0" indicated no extension media contact and "40" indicated highest level of extension media contact. This variable appears in item number 7 (seven) in the interview schedule as presented in Appendix-I. Based on the available information cited by the

farmers, they were classified into three categories (Mean ± Standard Deviation) namely ‘low’, ‘medium’ and ‘high’ extension media contact.

3.4.1.8 Rice cultivation knowledge

Rice cultivation knowledge of a farmer was measured by asking him/her 15 questions related to different components of rice production. It was measured assigning weightage two (2) for each question. So, the total assigned scores for all the questions became 30. The score was given according to response at the time of interview. Answering a question correctly an individual could obtain full score. For wrong answer or no answer he obtained zero (0) score. Partial score was assigned for partially correct answer. Thus, the agricultural knowledge score of a farmer could range from zero (0) to thirty (30), where “0” indicates no knowledge and “30” indicate highest knowledge. This variable appears in item number 8 in the interview schedule as presented in Appendix-I. Based on the available information cited by the farmers, they were classified into three categories (Mean ± Standard Deviation) namely ‘low’, ‘medium’ and ‘high’ rice cultivation knowledge.

3.4.1.9 Attitude towards BRRI dhan49

Attitude towards BRRI dhan49 of a respondent implies to his/her beliefs, outlook, perception and action tendencies. To determine this criterion, a number of 8 statements (4 positive and 4 negative) were randomly presented before the interviewees. A five-point scale was used to measure the attitude of the beneficiaries. This scoring was done in the following manner:

Extent of agreement	Score
Strongly agreed	+2
Agreed	+1
No opinion	0
Disagreed	-1
Strongly disagreed	-2

All the scores for positive and negative statements were summed up and the final score was determined. This variable appears in item number nine (9) in the interview schedule as presented in Appendix-I. Based on the available information cited by the farmers, they were classified into three categories (Mean ± Standard Deviation) namely poorly favorable attitude, moderately favorable attitude and highly favorable attitude towards BRRI dhan49.

3.4.2 Measurement of dependent variable

Adoption of BRRI dhan49 was measured by computing Adoption Quotient (AQ). It was calculated by asking the farmers i) cultivated area of BRRI dhan49 ii) potential area for cultivation of BRRI dhan49 iii) years of BRRI dhan49 cultivation. Adoption of BRRI dhan49 was measured by Adoption Quotient as the following formula suggested by Bhuiyan (2005):

$$\text{Adoption Quotient (}\mathbf{AQ}\text{)} = \frac{c/p}{y} \times 100$$

Where, c = cultivated area

P = Potential area

y = Years of BRRI dhan49 cultivation

Using above formula, adoption of BRRI dhan49 production technologies score of a respondent could range from 0-100, while 0 indicating no adoption and 100 indicating highest adoption. This variable appears in item number 10.1 in the interview schedule as presented in Appendix-I. Based on the information cited by the farmers, they were classified into three categories namely ‘low’, ‘medium’ and ‘high’ adoption of BRRI dhan49.

3.5 Measurement of Adopter Categories

Before measuring the adopter categories, the researcher calculated the Adoption Period Score (APS) of BRRI dhan49 by asking the question to the farmers “how many times did you cultivate after hearing about the BRRI dhan49 qualities in your land?” The adopter categorization on the basis of

APS driving the bell-shaped curve into five areas by using its two parameters (mean and standard deviation). After assigning APS for all farmers according to the adoption Period of all farmers were calculated as follows (Roger, 1995):

Innovator = ($\bar{x}$ - 2σ)

Early adopter = ($\bar{x}$ -2σ) to ($\bar{x}$ -σ)

Early majority = (x - σ) to ($\bar{x}$)

Late majority = ($\bar{x}$) to ($\bar{x}$ + σ)

Laggards & non-adopters = ($\bar{x}$ + σ) to ($\bar{x}$ +2σ)

The measure of adoption used and the procedure followed to classify adopters where 1st group were innovator and then early adopter, early majority, late majority and last group considered as laggards.

3.6 Hypothesis of the study

According to Kerlinger (1973) "a hypothesis is a conjectural statement of the relation between two or more variables". Hypotheses are always in declarative sentence form and they are related, either generally or specifically from variables to variables. In broad sense hypotheses are divided into two categories: (a) research hypothesis and (b) null hypothesis.

3.6.1 Research hypothesis

"Each of the 9 selected characteristics (age, level of education, effective farm size, annual family income, organizational participation, cosmopoliteness, extension media contact, rice cultivation knowledge and attitude towards BRRI dhan49) of farmers has significant contribution on adoption of BRRI dhan49."

3.6.2 Null hypothesis

A null hypothesis states that there is no contribution between the concerned variables. The following null hypothesis was formulated to explore the contribution of the selected characteristics on adoption of BRRI dhan49. Hence, in order to conduct tests, the earlier research hypothesis was converted into null form as follows:

"There is no contribution of the selected characteristics (age, level of education, effective farm size, annual family income, organizational participation, cosmopoliteness, extension media contact, rice cultivation knowledge and attitude towards BRRI dhan49) of farmers on adoption of BRRI dhan49."

3.7 Data Processing and Analysis Methods

Bogdan and Biklen (2006) insist that data analysis is an on-going part of data collection. Initially, all collected data were carefully entered in Microsoft Excel. Exported data were checked randomly against original completed interview schedule. Errors were detected and necessary corrections were made accordingly after exporting. Further consultation with Supervisor and in some cases with Co-supervisor were required. Finally, data were exported from the program Microsoft Excel to SPSS/windows version 22.0, which offered statistical tools applied to social sciences. After processing, scaling and indexing of the necessary and relevant variables to perform subsequent statistical analysis for drawing inferences.

As outlined earlier, there are many different forms and methods that can be used to analyze both quantitative and qualitative data in accordance with the objectives of the study. Both descriptive and analytical methods were employed in order to analyze the data. Descriptive techniques have been used to illustrate current situations, describe different variables separately and construct tables and graphs presented in results. These included: frequency distribution, percentage, range, mean, median, standard deviation and coefficient of variance.

In most cases the opinions of respondents were grouped in broader categories. Analytical techniques have been utilized to investigate the contribution of the selected characteristics of the farmers to their adoption of BRRI dhan49. Statistical test like regression was used in this study. Each statistical technique

is used under specific conditions and depends on the measurement scale of different variables.

3.8 Statistical analysis

Regression analysis was used to identify the linear combination between independent variables used collectively to predict the dependent variables (Miles and Shevlin, 2001). Regression analysis helps us understand how the typical value of the dependent variable changes when any one of the independent variables is varied, while the other independent variables are held fixed. Ordinary Least Squares (OLS) is used most extensively for estimation of regression functions. In short, the method chooses a regression where the sum of residuals, ΣUi is as small as possible (Gujarati, 1995). The factors that contribute to the adoption of BRRI dhan49 are analyzed using a regression model. The overall quality of the model has been tested by ANOVA specifically F and R^2 test.

The data were analyzed in accordance with the objectives of the proposed research work. The factors that contribute to the adoption of BRRI dhan49 by the farmers are analyzed using a regression model, multiple regression analysis (B) was used. Throughout the study, five (0.05) percent and one (0.01) percent level of significance were used as the basis for rejecting any null hypothesis. If the computed value of (B) was equal to or greater than the designated level of significance (*p*), the null hypothesis was rejected and it was concluded that there was a significant contribution between the concerned variable. Whenever the computed value of (B) was found to be smaller at the designated level of significance (*p*), the null hypothesis could not be rejected. Hence, it was concluded that there was no contribution of the concerned variables.

The model used for this analysis can be explained as follows:

$$Y = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + b_8x_8 + b_9x_9 + e;$$

Where, Y= is the adoption of BRRI dhan49;

Of the independent variables, x_1 is the rice cultivators age, x_2 is level education, x_3 is effective farm size, x_4 is annual family income, x_5 is organizational participation, x_6 is cosmopoliteness, x_7 is extension media contact, x_8 is rice cultivation knowledge and x_9 is attitude towards BRRI dhan49. On the other hand, b_1, b_2, b_3, b_4, b_5, b_6, b_7, b_8 and b_9 are regression coefficients of the corresponding independent variables, and e is random error, which is normally and independently distributed with zero mean and constant variance.

CHAPTER IV

RESULTS AND DISCUSSION

The recorded observations in accordance with the objective of the study were presented and probable discussion was made of the findings with probable justifiable and relevant interpretation under this chapter. The findings of the study and their interpretation have been presented in this chapter. These are presented in four sections according to the objectives of the study. The first section deals with the selected characteristics of the farmers, while the second section deals with the adoption of BRRI dhan49. The third section deals with contribution of farmers' selected characteristics to their adoption of BRRI dhan49, while the fourth section deals with categorization of BRRI dhan49 adopter.

4.1 Characteristics of the Farmers

Behavior of an individual is determined to a large extent by one's personal characteristics. There were various characteristics of the farmers that might have consequence to adoption of BRRI dhan49. But in this study, nine characteristics of them were selected as independent variables, which included their age, level of education, effective farm size, annual family income, organizational participation, cosmopoliteness, extension media contact, rice cultivation knowledge and attitude towards BRRI dhan49 that might be greatly influenced farmers' adoption of BRRI dhan49 are presented below:

4.1.1 Age

The age scores of the farmers have been varied from 28 to 74 with a mean and standard deviation of 47.31 and 10.17, respectively. Considering the recorded age farmers were classified into three categories namely 'young', 'middle' and 'old' aged following Rashid (2014). The distribution of the farmers in accordance of their age is presented in Table 4.1.

Table 4.1 Distribution of the farmers according to their age

Category	Range (years)		Farmers		Mean (x)	SD (σ)
	Score	Observed	Number	Percent		
Young aged	≤ 35	28-74	14	12.1	47.31	10.17
Middle aged	36-50		62	53.4		
Old aged	> 50		40	34.5		
Total			116	100.0		

Table 4.1 reveals that the middle-aged farmers comprised the highest proportion (53.4 percent) followed by old aged category (34.5 percent) and the lowest proportion were made by the young aged category (12.1 percent). Data also indicates that the middle and old aged category constitute 87.9 percent of total farmers. The middle and young aged farmers were generally more involved in farm activities than the old.

4.1.2 Level of education

The level of educational scores of the farmers ranged from 0 to 17 with a mean and standard deviation of 7.62 and 4.05, respectively. Based on the educational scores, the farmers were classified into five categories. The distributions of farmers according to their level of education are presented in Table 4.2.

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

Category	Range (years)		Farmers		Mean (x)	SD (σ)
	Score	Observed	Number	Percent		
Can't read and sign	0	0-17	6	5.2	7.62	4.05
Can sign only	0.5		8	6.9		
Primary education	1-5		26	22.4		
Secondary education	6-10		55	47.4		
Above secondary	>10		21	18.1		
Total			116	100.0		

Table 4.2 shows that farmers under secondary education category constitute the highest proportion (47.4 percent) followed by primary education (22.4percent).

On the other hand, the lowest 5.2 percent in can't read and sign followed by can sign only category (6.9 percent) and 18.1 percent respondents were above secondary category. Education broadens the horizon of outlook of farmers and expands their capability to analyze any situation related to adopt the BRRI dhan49. An educated farmer is likely to be more responsive to the modern facts, ideas, and information of BRRI dhan49. To adjust with the same, they would be progressive minded to adopt cultivation technologies of BRRI dhan49 as well as involve with modern cultural farm activities.

4.1.3 Effective farm size

The effective farm size scores of the farmers ranged from 0.08 to 2.62 with a mean and standard deviation of 0.96 and 0.54, respectively. Based on their farm size, the farmers were classified into five categories following the categorization provided as DAE. The distribution of the farmers according to their farm size is presented in Table 4.3.

Table 4.3 Distribution of the farmers according to their effective farm size

Category	Range (ha)		Farmers		Mean ($\bar{x}$)	SD (σ)
	Score (ha)	Observed	Number	Percent		
Landless	≤0.02	0.08-2.62 (ha)	-	-	0.96	0.54
Marginal	0.021-0.20		3	2.6		
Small	0.21-1.00		74	63.8		
Medium	1.01-3.0		39	33.6		
Large	>3		-	-		
Total			116	100.0		

Table 4.3 indicates that the small farm holder constitutes the highest proportion (63.8 percent) followed by medium farm holder (33.6 percent). The findings of the study reveal that majority of the farmers were small to medium sized farm holder. The average farm size of the farmers of the study area (0.96 ha) was higher than that of national average (0.60 ha) of Bangladesh (BBS, 2014).

4.1.4 Annual family income

The scores of annual income of the rice cultivators ranged from 100 to 525 with a mean and standard deviation of 223.58 and 81.08, respectively. On the basis of annual income, the rice cultivators were classified into three categories (Mean ± Standard Deviation) namely 'low', 'medium' and 'high' annual family income. The distribution of the rice cultivators according to their annual family income is presented in Table 4.4.

Table 4.4 Distribution of the farmers according to their annual family income

Category	Range ('000' BDT)		Farmers		Mean ($\bar{x}$)	SD (σ)
	Score	Observed	Number	Percent		
Low income	≤ 141	100-525	15	12.9	223.58	81.08
Medium income	142-305		80	69.0		
High income	>305		21	18.1		
Total			116	100.0		

Data revealed that the rice cultivators having medium annual income constitute the highest proportion (69.0 percent), while the lowest proportion in low income (12.9 percent) followed by high income (18.1 percent). Majority (87.1 percent) rice cultivators have medium to high annual family income.

4.1.5 Organizational participation

Organizational participation scores of the rice cultivators ranged from 4 to 16 with a mean and standard deviation of 10.12 and 2.22, respectively. Based on organizational participation score, the rice cultivators were classified into three categories (Mean ± Standard Deviation) namely less, medium and high participation. The distribution of the rice cultivators as per their organizational participation is presented in Table 4.5.

Table 4.5 Distribution of the farmers according to their organizational participation

Category	Range (score)		Farmers		Mean ($\bar{x}$)	SD (σ)
	Score	Observed	Number	Percent		
Less participation	≤ 7	4-16	9	7.8	10.12	2.22
Medium participation	8-13		91	78.4		
High participation	>13		16	13.8		
Total			116	100.0		

Data reveals that the highest proportion (78.4 percent) of the rice cultivators had medium organizational participation, while 7.8 percent and 13.8 percent had less and high organizational participation respectively.

4.1.6 Cosmopoliteness

Cosmopoliteness scores of the rice cultivators ranged from 8 to 22 with a mean and standard deviation of 17.12 and 2.22, respectively. Based on the cosmopoliteness score, the rice cultivators were classified into three categories (Mean ± Standard Deviation) namely low, medium and high cosmopoliteness. The distribution of the rice cultivators as per their cosmopoliteness is presented in Table 4.6.

Table 4.6 Distribution of the farmers according to their cosmopoliteness

Category	Range		Rice growers		Mean	SD
	Score	Observed	Number	Percent		
Low cosmopoliteness	≤ 14	8-22	9	7.8	17.12	2.22
Medium cosmopoliteness	15-20		102	87.9		
High cosmopoliteness	>20		5	4.3		
Total			116	100.0		

Data revealed that the highest proportion (87.9 percent) of the rice cultivators had medium cosmopoliteness, and the lowest (7.8 percent) cosmopoliteness.

It might be logical because the respondents of the study area were sincere in their income generating activities. Hence, the cosmopoliteness trend of the rice growers in the study area was medium to high (92.2 percent).

4.1.7 Extension media contact

The observed score of agricultural extension contact of the farmers ranged from 10 to 30 against a possible range of 0 to 40. The average score of the farmers was 22.89 with a standard deviation 3.17 (Table 4.7). The farmers were classified into three categories on the basis of their exposure to farming information (Mean ± Standard Deviation) namely 'low', 'medium' and 'high' agricultural extension media contact of the farmers. Data showed that the highest proportion (79.3 percent) of the farmers had medium extension contact as compared to 11.2 percent of them having low extension contact and 9.5 percent fell in high extension media contact (Table 4.7).

Table 4.7 Distribution of the farmers according to their extension media contact

Category	Range (score)		Farmers		Mean (x)	SD (σ)
	Score	Observed	Number	Percent		
Low contact	≤19	10-30	13	11.2	22.89	3.17
Medium contact	20-26		92	79.3		
High contact	>26		11	9.5		
Total			116	100.0		

From this table, it might be concluded that majority of the farmers had medium extension contact. It could be concluded that extension agent or media of the study area were available to the farmers. The finding was interesting and logical because in general the farmers in the rural areas of Bangladesh are medium cosmopolite in nature and less exposed to different information sources. Finding revealed that 11.2 percent of the farmers had low extension contact which demands for strengthening and improving the communication strategy. Low extension contact might be the reason that some respondent may

think that they have enough knowledge about farming activities. Extension contact pertains to ones contact with multifarious sources of farming knowledge and information. This results in cognitive change of the users with an eventual change in behavior and also in skill. They receive information from their neighbors, relatives etc.

4.1.8 Rice cultivation knowledge

Rice cultivation knowledge scores of the farmers ranged from 10 to 28 against possible score of 0 to 30. The average score and standard deviation were 22.84 and 3.49, respectively. Based on the rice cultivation knowledge scores, the farmers were classified into three categories (Mean ± Standard Deviation) namely, low knowledge, medium knowledge and high knowledge (Table 4.8).

Table 4.8 Distribution of the farmers according to their rice cultivation knowledge

Category	Range (score)		Farmers		Mean (x)	SD (σ)
	Score	Observed	Number	Percent		
Low knowledge	≤ 19	10-28	17	14.7	22.84	3.49
Medium knowledge	20-26		92	79.3		
High knowledge	> 26		7	6.0		
Total			116	100.0		

Data presented in the table 4.8 reveals that 79.3 percent of the farmers had medium rice cultivation knowledge, 14.7percent had low knowledge and 6.0 percent had high rice cultivation knowledge. Thus, an overwhelming majority (79.3%) of the farmers had medium knowledge. This lead to understanding that rice cultivation knowledge would reflected more by the medium knowledge category farmer in the present study. Rice cultivation knowledge of the farmers is definitely affected by the education of the farmers because education helps to enhance the eagerness to be acquainted with new variety or technology. In addition, rice cultivation knowledge of the respondent is definitely affected by the extension contact because with the increase of the communication exposure

new thing can be taught. Rice cultivation knowledge is very important aspects for ensuring adoption of rice. Farmers lives on farming. Hence, they must require skill and modern knowledge to bring more yield and profit to ensure adoption of BRRI dhan49 cultivation.

4.1.9 Attitude towards BRRI dhan49

Attitude towards BRRI dhan49 of the farmers' scores ranged from 1 to 3. The average and standard deviation were 2.46 and 0.65 respectively Table 4.9. On the basis of attitude towards BRRI dhan49, the respondents were categorized into three classes' (Mean ± Standard Deviation) namely poorly favorable attitude, moderately favorable attitude and highly favorable attitude.

Table 4.9 Distribution of the farmers according to their attitude towards BRRI dhan49

Category	Range (score)		Farmers		Mean (x)	SD (σ)
	Score	Observed	Number	Percent		
Poorly favorable attitude	≤ 1	1-3	10	8.6	2.46	0.65
Moderately favorable attitude	2-3		106	91.4		
Highly favorable attitude	>3		0	0		
Total			116	100.0		

The observed data showed that most of the farmers (91.4 percent) had a moderately favorable attitude towards rice cultivation while 8.6 percent of them had poorly favorable attitude. No respondent was found in highly favorable attitude category. The attitude of the respondents expressed their perception about rice cultivation. It helped the researcher to judge or measure the acceptance/rejection of rice cultivation in the rural area.

4.2 Adoption of BRRI dhan49

Adoption of BRRI dhan49 by the rice cultivators is the dependent variable of this study and it was measured by computing scores according to extent of adoption. Adoption of rice cultivation by the rice cultivators scored varied from 34.58 to 68.04 with the mean and standard deviation of 44.48 and 5.32 respectively. On the basis of adoption scores, the rice cultivators were classified into three categories (Mean ± Standard Deviation) namely low, medium and high adoption of BRRI dhan49. The distribution of the cultivators according to their adoption of BRRI dhan49 score under the study is given in Table 4.10.

Table 4.10 Distribution of the rice cultivators according to their adoption of BRRI dhan49

Category	Range		Farmers		Mean	SD
	Score	Observed	Number	Percent	(x)	(σ)
Low adoption	≤ 39	34.58-68.04	12	10.3	44.48	5.32
Medium adoption	39.1-50		91	78.4		
High adoption	≥ 50		13	11.2		
Total			117	100.0		

Table 4.10 indicates that among the respondents, the highest 78.4 percent rice cultivators belongs to the group of medium adoption and the lowest percentage 10.3 percent in low adoption followed by high adoption (11.2 percent) by the rice cultivators in adoption of BRRI dhan49. Among the cultivators most of the rice cultivators (89.6 percent) have medium to high adoption in BRRI dhan49.

4.3 Factors related to the adoption of BRRI dhan49

In order to estimate the adoption of BRRI dhan49 by the rice cultivators from the independent variables, multiple regression analysis was used which is shown in the Table 4.11.

Table 4.11 Multiple regression coefficients of contributing factors related to the farmers' adoption of BRRI dhan49

Dependent variable	Independent variables	B	*p*	R^2	Adj. R^2	F	*p*
Farmers' adoption of BRRI dhan49	Age	0.059	0.203	0.538	0.507	20.75	0.000**
	Level of education	0.296	0.037*				
	Effective farm size	0.584	0.702				
	Annual family income	2.041	0.034*				
	Organizational participation	0.151	0.573				
	Cosmopoliteness	-.138	0.507				
	Extension media contact	0.447	0.020*				
	Rice cultivation knowledge	0.398	0.003**				
	Attitude towards BRRI dhan49	3.383	0.000**				

** Significant at $p < 0.01$;

* Significant at $p < 0.05$;

Table 4.11 shows that there is a significant contribution of respondents' level of education, annual family income, extension media contact, rice cultivation knowledge and attitude towards BRRI dhan49. Of these, rice cultivation knowledge and attitude towards BRRI dhan49 were the most important contributing factors (significant at the 1% level of significance). Level of education, annual family income and extension media contact (significant at the 5% level of significance), while coefficients of other selected variables don't have any contribution on adoption of BRRI dhan49.

The value of R^2 is a measure of how of the variability in the dependent variable is accounted for by the independent variables. So, the value of R^2 =0.538 means that independent variables accounts for 53.81% of the variation

in adoption of BRRI dhan49. The adjusted R^2 indicates the loss of predictive power or shrinkage. Therefore, the adjusted value (0.507) tells us how much variance in Y (adoption of BRRI dhan49) would be accounted if the model has been deprived from the populations from which the sample was taken. The F ratio is 20.75 which is highly significance ($p<.001$). This ratio indicates that the regression model significantly improved the ability to predict outcome variable.

The B-values indicate the individual contribution of each predictor to the model. Almost all predictors have positive b-values indicates if scores/ values of predictors (e.g. level of education) increases so do the extent of adoption of BRRI dhan49 production technologies. However, each predictor may explain some of the variance in respondents' adoption of BRRI dhan49 conditions simply by chance. In summary, the models suggest that the respective authority should consider farmers' level of education, annual family income, extension media contact, rice cultivation knowledge and attitude towards BRRI dhan49.

4.3.1 Significant contribution of rice cultivation knowledge on adoption of BRRI dhan49

The contribution of rice cultivation knowledge on adoption of BRRI dhan49 was measured by testing the following null hypothesis;

a. The b-value of rice cultivation knowledge is 0.398. So, it can be stated that as rice cultivation knowledge increase by one unit, adoption of BRRI dhan49 increase by 0.398 units. This interpretation is true only if the effects of all other predictors are held constant.

Based on the above finding, it can be said that clear understanding of the different aspects of an innovation increases cultivators' knowledge about a new technology which helps him/her to adopt it for own benefit. So, rice cultivation knowledge influenced significantly on the adoption of BRRI dhan49.

4.3.2 Significant contribution of attitude towards BRRI dhan49 on adoption of BRRI dhan49

The contribution of attitude towards BRRI dhan49 on adoption of BRRI dhan49 was measured by testing the following null hypothesis;

a. The b-value of attitude towards BRRI dhan49 is 3.383. So, it can be stated that as attitude towards BRRI dhan49 increase by one unit, adoption of BRRI dhan49 increase by 3.383 units. This interpretation is true only if the effects of all other predictors are held constant.

Based on the above finding, it can be said that attitude towards BRRI dhan49 increases cultivators' willingness which helps him/her to adopt it for own benefit. So, attitude towards BRRI dhan49 influenced significantly on the adoption of BRRI dhan49.

4.3.3 Significant contribution of level of education on adoption of BRRI dhan49

The contribution of level of education on adoption of BRRI dhan49 was measured by testing the following null hypothesis;

a. The b-value of level of education is 0.296. So, it can be stated that as level of education increase by one unit, adoption of BRRI dhan49 increased by 0.296 units. This interpretation is true only if the effects of all other predictors are held constant.

Based on the above finding, it can be said that level of education increases cultivators' willingness which helps him/her to adopt it for own benefit. So, level of education influenced significantly on the adoption of BRRI dhan49.

4.3.4 Significant contribution of annual family income on adoption of BRRI dhan49

The contribution of annual family income on adoption of BRRI dhan49 was measured by testing the following null hypothesis;

a. The b-value of annual family income is 2.041. So, it can be stated that as annual family income increase by one unit, adoption of BRRI dhan49 increased by 2.041 units. This interpretation is true only if the effects of all other predictors are held constant. Based on the above finding, it can be said that annual family income increases cultivators' willingness to adopt new technology for own benefit. So, annual family income influenced significantly on adoption of BRRI dhan49.

4.3.5 Significant contribution of extension media contact on adoption of BRRI dhan49

The contribution of extension media contact on adoption of BRRI dhan49 was measured by testing the following null hypothesis;

a. The b-value of extension media contact is 0.447. So, it can be stated that as extension media contact increase by one unit, adoption of BRRI dhan49 increased by 0.447 units. This interpretation is true only if the effects of all other predictors are held constant.

Based on the above finding, it can be said that extension media contact increases cultivators' willingness which helps him/her to extension media contact influenced on adoption of BRRI dhan49.

4.4 Categorization of BRRI dhan49 adopters

The BRRI dhan49, as measured by the time at which an individual adopt BRRI dhan49, is continuous. Based on their adoption score, the adopters were classified into five categories following the categorization according to Roger (1995). The distribution of the adopters according to adoption is presented in following Table 4.12.

Table 4.12 Distribution of the BRRI dhan49 adopters according to adoption

Categories	Basis of Categories	Frequency of adopters	Mean of adoption period (x)	Standard Deviation (σ)
Innovator	$(x - 2\sigma)$	4	3.16	0.927
Early adopter	$(\underline{x} -2\sigma)$ to $(\underline{x} -\sigma)$	19		
Early majority	$(x - \sigma)$ to (x)	45		
Late majority	(x) to $(x + \sigma)$	39		
Laggards	$(\underline{x} + \sigma)$ to $(\underline{x} +2\sigma)$	9		
Total		116		

This is, however, may be partitioned into five adopter categories by lying off standard deviation from the mean time of adoption in a bell-shaped curve in the figure 4.1.

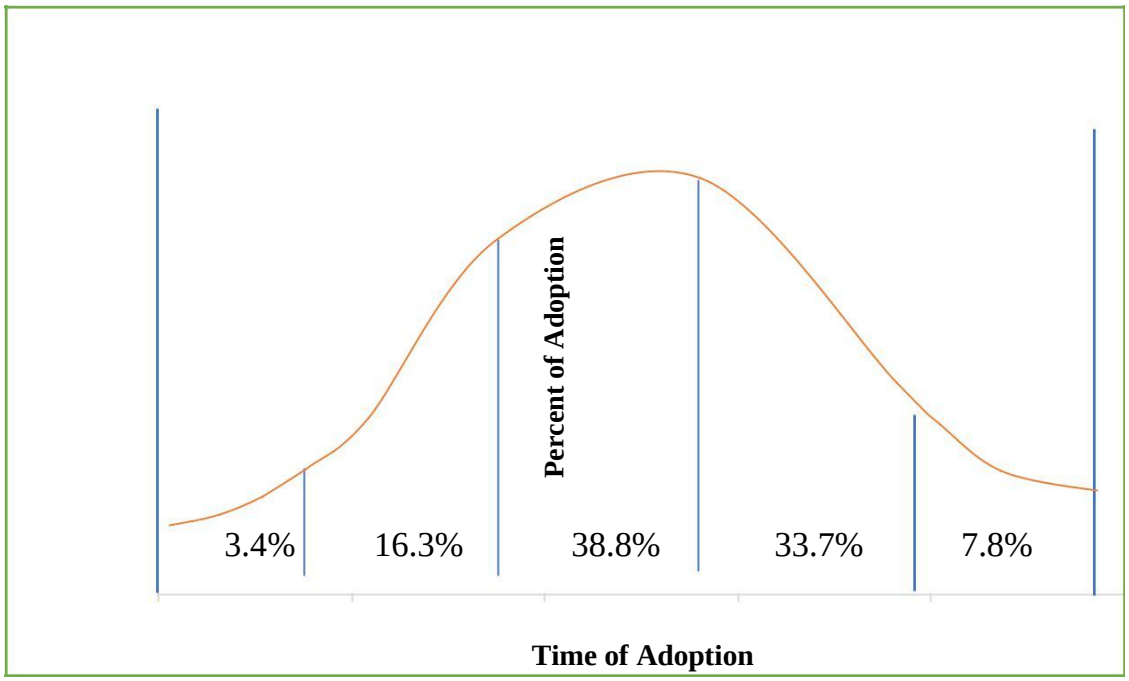

Figure 4.1 Categorization of farmers on the basis adoption of BRRI dhan49 in a bell-shaped curve.

Data presented in figure 4.2 indicate that 3.4% of the respondent farmers were innovators, 16.3% early adopters, early majority 38.8%, 33.7% were late majority and last category was laggards 7.8%. This category is almost same as Roger's category and this type of category support to Roger's category. From this figure, it may be said that BRRI dhan49 had been properly diffused by the diffusion channel and farmers got sufficient information about adoption of BRRI dhan49. It also says that Roger's findings regarding adopter category are almost similar to our environment.

CHAPTER V

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

The study was conducted in the Ashokola, Polikukrul, Teldhap, Shashibadoni, Darial and Ontahar villages of Noongol union under sadar upazila of Bogra district to find out the adoption of BRRI dhan49. Total 4910 rice cultivators selected from the study area are the population according to Yamane's formula, the respondents comprised of 116 BRRI dhan49 cultivators constituted the sample of the study. A well-structured interview schedule was developed based on objectives of the study for collecting information. The independent variables were: age, level of education, effective farm size, annual family income, organizational participation, cosmopoliteness, extension media contact, rice cultivation knowledge and attitude towards BRRI dhan49. The dependent variable of this study was the adoption of BRRI dhan49. Data collection was started in 21 January, 2017 and completed in 20 February, 2017. Various statistical measures such as frequency counts, percentage distribution, average, and standard deviation were used in describing data. In order to estimate the contribution of the selected characteristics of BRRI dhan49 cultivators in the adoption of BRRI dhan49, multiple regression analysis (B) was used. The major findings of the study are summarized below:

5.1 Summary of Findings

5.1.1 Selected characteristics of the rice cultivators

Age: The middle-aged rice cultivators comprised the highest proportion (53.4 percent) and the lowest proportion by the young aged category (12.1 percent).

Level of education: Secondary education constituted the highest proportion (47.4 percent) and the lowest 5.2 percent in can't read and sign category.

Effective farm size: The small farm holder constituted the highest proportion (63.8 percent), whereas the lowest 2.6 percent in marginal farm holder.

Annual family income: Medium annual family income constituted the highest proportion (69.0 %), while the lowest proportion in low annual family income (12.9 percent) category.

Organizational participation: The highest proportion (78.4 percent) of the rice cultivators had medium organizational participation, while 7.8 percent and 13.8 percent had less and high organizational participation respectively.

Cosmopoliteness: The highest proportion (87.9 percent) had medium cosmopoliteness category and the lowest proportion (4.3 percent) had high cosmopoliteness.

Extension media contact: The highest proportion (79.3 percent) of the farmers had medium agricultural extension media contact as compared to 11.2 percent of them having less and 9.5 percent fell in high extension media contact.

Rice cultivation knowledge: The majority (79.3 percent) of the rice cultivators fell in medium knowledge category, whereas the lowest is 6.0 percent in high knowledge category.

Attitude towards BRRI dhan49: Most of the farmers (91.4 percent) had a moderately favorable attitude towards rice cultivation while 8.6 percent of them had poorly favorable attitude respectively.

5.1.2 Adoption of BRRI dhan49

The highest 78.4 percent rice cultivators belong to the group of medium adoption and the lowest percentage 10.3 percent in low adoption followed by high adoption (11.2 percent) by the rice cultivators in adoption of BRRI dhan49.

5.1.3 Variables related on the adoption of BRRI dhan49

Rice cultivation knowledge and attitude towards BRRI dhan49 were the most important contributing factors (significant at the 1% level of significance). Level of education, annual family income and extension media contact are (significant at the 5% level of significance) while coefficients of other selected variables do not have any contribution on adoption of BRRI dhan49.

5.2 Conclusions

The findings and relevant facts of research work prompted the researcher to draw following conclusions.

i. It may be concluded that the adoption of BRRI dhan49 is adequate however needs further advancement for maintaining.

ii. Level of education of the farmers showed the most important contributing factor in adoption of BRRI dhan49. This means that high literacy and educational level among the farmers might influence BRRI dhan49 adoption. Conclusion could be drowned that these farmers could be more ameliorated in all aspects of socio-economic life if government takes more educational project to make then more educated.

iii. Annual family income of the farmers had a significant contribution in adoption of BRRI dhan49. The above facts lead to conclude that necessary arrangements (business, job etc) should be made to increase the annual family income of farmers which would ultimately increase the adoption of selected rice cultivation.

iv. Extension media contact of the farmers had a significant contribution in adoption of BRRI dhan49. Through extension media contact an individual farmer became facilitated of the information on the various aspect of selected rice cultivation. The above facts lead to conclude that necessary arrangements (field day, result demonstration) should be made to increase the extension media contact of farmers which would ultimately increase the adoption of selected rice cultivation.

v. Rice cultivation knowledge of the farmer had a significant contribution in adoption of BRRI dhan49. The above facts lead to the conclusion that necessary arrangements (training, meeting etc) should be made to increase the knowledge of farmers which would ultimately increase the adoption of selected rice cultivation.

vi. Farmer's attitude towards BRRI dhan49 had a significant contribution in adoption of BRRI dhan49. It is important to realize about the temperament of human behavior which is very complex. It is, therefore, concluded that extension workers should vocation adequately with the farm people through various teaching methods and correctly envisaging those characteristics of the farmers which have some changes on their attitude towards the adoption of selected rice cultivation.

5.3 Recommendations

5.3.1 Recommendations for policy implications

On the basis of observation and conclusions drawn from the findings of the Studies, following recommendations are made:

i. It is, recommended that an effective step (training, discussion) should be taken by the Department of Agricultural Extension (DAE) and Non-Government Organizations (NGOs) for strengthening the farmers' interest in favor of adoption of BRRI dhan49 to a higher degree.

ii. Level of education of the farmers had a significant contribution in adoption of BRRI dhan49. It indicates the importance of education of the BRRI dhan49 cultivators for rapid adoption of cultivation technologies. It may be recommended that education arrangements should be made available for enhancing the education level of the BRRI dhan49 cultivator by the concerned authorities (Government) through the establishment of night school, adult education and possible extension method.

iii. It is recommended that extension organizations and other support services should be conscientious of to facilitate annual family income of farmers through different income generating activities. So, concerned extension organizations and other sponsor services must settle training and arrange discussion as well as some meetings so that farmers can change their decision to adopt the BRRI dhan49 to a higher degree.

iv. It is recommended that support services and extension organizations (DAE) should be conscientious of to facilitate farmer's extension media contact. So, concerned extension organizations and other sponsor services must settle training and arrange discussion as well as some meetings so that farmers can change their decision to adopt the BRRI dhan49 to a higher degree.

v. Farmers having medium to high knowledge about rice cultivation. It should be selected on priority basis for any motivational training by Department of Agricultural Extension (DAE) and Non-Government Organizations (NGOs) for gaining sustainable rice cultivation knowledge.

vi. It was observed that higher (91.4 percent) number of the farmers had moderate favorable attitude score towards BRRI dhan49. It may be recommended that massive demonstration programs, training programs, field trips etc. should be implemented to bring about considerable changes in the farmers' attitude.

5.3.2 Recommendations for further study

On the basis of scope and limitations of the present study and observation made by the researcher, the following recommendations are made for future study.

i. It is recommended that similar studies should be conducted in other areas of Bangladesh to adopt BBRI dhan49 large scale.

ii. It is recommended that further study should be conducted with other characteristics of the farmers with their adoption.

iii. Studies need to be undertaken to ascertain the principles and procedures for installation, patronization of association in rural areas of Bangladesh.

iv. It is therefore suggested that future studies should be included more reliable measurement of concerned variables.

v. The study was based on the farmers' adoption of BRRI dean 49. Further studies may be conducted in respect of adoption of other crop cultivation technologies.

vi. It is suggested that there should be continuous adoption research in various aspects for agricultural development in Bangladesh to adopt new innovation easily by the farmer.

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APPENDIX-I

ENGLISH VERSION OF THE INTERVIEW SCHEDULE

Department of Agricultural Extension and Information System
Sher-e-Bangla Agricultural University
Dhaka-1207

An Interview Schedule for the Study Entitled

ADOPTION OF BRRI DHAN49 BY THE FARMERS OF BOGRA SADAR UPAZILA

Name of the respondent: …… Serial No: ……

Union: …….

Village: ……..…….….

(Please provide following information. Your information will be kept confidential and will be used for research purpose only)

1. Age

How old are you? _____years.

2. Level of education

Please mention your level of education.

a) I can't read and write ☐

b) I can sign only ☐

c) I have passed…….class.

3. Effective farm size

What is your total farm size according to use?

Sl. No.	Use of land	Land possession	
		Local unit	Hectare
1.	Homestead area (A)		
2.	Own land under own cultivation *(B)*		
3.	Land taken from others on borga system*(C)*		
4.	Land given to others on borga system (D)		
5.	Land taken from others on lease (E)		
Total			

Total farm size = A + B + ½ (C + D) + E

4. Annual family income

Please mention the amount of annual income from the following sources:

a) Income from Agricultural Crops

SL. No.	Crop Name	Cultivation (Kg or Maund)	Cost/Kg or Maund	Total Cost
1.	Rice			
2.	Wheat			
3.	Maize			
4.	Jute			
5.	Potato			
6.	Pulse crop			
7.	Oil crop			
8.	Spice crop			
9.	Vegetables			
10.	Fruits			
Total (a)				

b) Income from animals and fish resources

Sl. No.	Income resources	Cultivation (Kg or Maund/Number)	Cost/Unit (Tk)	Total Cost(Tk)
1.	Livestock			
2.	Poultry			
3.	Fish resources			
Total (b)				

c) Income from other resources

Sl. No.	Income resources	Total Income (Tk.)
1.	Service	
2.	Business	
3.	Day labor	
4.	Other family members	
5.	Others income source	
Total (c)		

Grand Total = a + b + c

5.Organizational participation

Please mention the nature of your participation in the following organizations:

Sl. No.	Name of organizations	Not involved (0)	Nature of participation		
			Ordinary Member (1)	Executive Member (2)	Executive officer (3)
1.	Religious committee				
2.	School committee				
3.	Irrigation committee				
4.	Mohila samabay samity				
5.	Mass literacy samity				
6.	Local samity of NGO"s (BRAC, ASA, GB)				
7.	Union parishad				
8.	Upazila parishad				
9.	IPM club				
10.	Others				

6. Cosmopoliteness

Please mention the extent of your visit in the following place:

SL. No.	Places of visit	Extent of Visits				
		Regularly (4)	Frequently (3)	Occasion-ally (2)	Rarely (1)	Not at all (0)
1.	Visit of market near own village	≥ 10 times/ month	5-9 times/ month	2-4 times /month	Once / month	Not once
2.	Visit of relatives/ friends	≥ 6 times/ month	4-5 times/ month	2-3 times/ month	Once/ month	Not once
3.	Visit to Upazila sadar	≥ 6 times/ month	4-5 times/ month	2-3times/ month	Once / month	Not once
4.	Visit to other Upazila sadar	≥ 4 times/ month	2-3 times/ 2 month	1-2 times/ 3month	Once / 6 month	Not once
5.	Visit to upazila agricultural officer	≥ 1 time / month	2-3 times/ 4 month	1-2 times/ 6 month	Once/ 6 month	Not once
6.	Visit to upazila/district agricultural fair	≥ 1 time/ year	1-2 times/ 3 year	2-3 times/ 6 year	Once / 6 year	Not once

7. Extension media contact

Please state the extent of your contact with the following ones:

Sl. No.	Name of information sources	Extent of contact				
		Regularly (4)	**Frequently (3)**	**Occasion -ally (2)**	**Rarely (1)**	**Not at all(0)**
1.	Input dealers	>9times/ year	7-9 times/year	4-6 times/year	1-3 times/ year	0 time /year
2.	Contact with NGO officer	>9times/ year	7-9 times/year	4-6 times/year	1-3 times/ year	0 time /year
3.	Agricultural Extension Officer (AEO)	>5times/ year	4-5 times/year	2-3 times/year	1 times/ year	0 time /year
4.	Sub Assistant Agriculture Officer (SAAO)	>7times/ year	5-7 times/year	3-4 times/year	1-2 times/ year	0 time /year
5.	Group discussion	Once in a month	Once/ 2 months	Once/ 3 months	Once/ 4 months	0 time/6 months
6.	Watching agril. related programs on TV	Daily	Weekly	Fortnightly	Once/ month	0 time/6 months
7.	Listening agril. related programs on radio	Daily	Weekly	Fortnightly	Once/ month	0 time/6 months
8.	Reading agril. related leaflet, booklet	>7times/ year	5-7 times/year	3-4 times/year	1-2 times/ year	0 time /year
9.	Participation in agricultural training	>9times/ year	7-9 times/year	4-6 times/year	1-3 times/ year	0 time /year
10.	Conducted result demonstration	>9times/ year	7-9 times/year	4-6 times/year	1-3 times/ year	0 time /year
Total						

8. Rice cultivation knowledge

Please answer the following questions:

Sl. No.	Questions	Total Marks	Marks Obtained
1.	Name of three high yielding varieties of rice that you cultivated in Aman season	2	
2.	Mention two major insects of rice	2	
3.	What are the qualities of good rice seeds?	2	
4.	What type of soil is suitable for rice cultivation?	2	
5.	Name two major diseases of rice	2	
6.	Mention two harmful weeds of rice	2	
7.	What precautions should be followed at the time of pesticide application?	2	
8.	Mention at least one insecticide, one fungicide and one herbicide of rice	2	
9.	How much farmyard manure is required for rice cultivation per bigha?	2	
10.	Mention the intercultural operations in rice seedbed	2	
11.	Mention fertilizer doses in rice cultivation (Urea, TSP and MP)	2	
12.	Mention two important machineries used in rice cultivation	2	
13.	Mention the optimum age of seedlings for transplanting in case of Aman season.	2	
14.	Mention seedling age for transplanting main field	2	
15.	Mention the duration of Aus, Aman and Boro season.	2	
Total		30	

9. Attitude towards BRRI dhan49

Please express your opinion on the following issues:

Sl. No.	Statement	Extent of agreement/disagreement				
		SA (+2)	A(+1)	NO (0)	D(-1)	SD (-2)
1(+)	BRRI dhan49 yields 20% higher than other Aman varieties					
2(+)	Less life duration compare to other Aman varieties					
3(+)	BRRI dhan49 is highly disease resistance					
4 (+)	It requires less amount urea					
5(+)	Paddy and rice color is attractive					
6(-)	Adoption of this variety is slowly					
7(+)	The grain is medium course and tasty compare to Mamun variety					
8(-)	BRRI dhan49 need additional irrigation requirement					
9(-)	BRRI dhan49 is more labor intensive					
10(-)	No serious insect infestation was found in BRRI dhan49					

N.B: SA= Strongly Agreed; A=Agreed; NO= No Opinion;
D=Disagreed; SD= Strongly Disagreed;

10. Adoption

Please answer following questions:

When BRRI dhan49 was first introduced in your village?

When you heard about BRRI dhan49?

Do you cultivate it? Yes ☐ No ☐

When you started cultivation?

10.1 Adoption of BRRI dhan49 in last three years

Year	Potential area (p)	Effective area (e)	e/p
2013-2014			
2014-2015			
2015-2016			

Thanks for your kind co-operation.

Dated: (Signature of interviewer)