ADOPTION OF HYBRID RICE SEED PRODUCTION TECHNOLOGIES BY THE FARMERS OF MUKTAGACHA UPAZILA

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CERTIFICATE

This is to certify that the thesis entitled **"ADOPTION OF HYBRID RICE SEED PRODUCTION TECHNOLOGIES BY THE FARMERS OF MUKTAGACHA UPAZILA"** submitted to the department of Agricultural Extension and Information System, Faculty of Agriculture, Sher-e-Bangla Agricultural University, Sher-e-Bangla Nagar, Dhaka in partial fulfillment of the requirements for the degree of Master of Science (M.S.) in Agricultural Extension, embodies the result of a piece of bona fide research work carried out by **KHONDOKER MOQBUL HOSSAIN, Registration No. 18-09060** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

I further certify that any help or source of information, as has been availed of during the course of this investigation has been duly acknowledged by the Author.

Dated:
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Prof. Dr. Md. Rafiquel Islam
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DEDICATED

TO

MY BELOVED

PARENTS

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ABBREVIATIONS

Ag. Ext. Ed.	Agricultural Extension Education
Ag. Ext. and Info. Sys.	Agricultural Extension and Information System
β	Multiple Regression
BBS	Bangladesh Bureau of Statistics
GDP	Gross Domestic Product
DAE	Department of Agricultural Extension
et al.	All Others
USA	United Nations of America
FAO	Food and Agriculture Organization
HYV	High Yielding Varieties
GoB	Government of Bangladesh
MoA	Ministry of Agriculture
UNO	The United Nations
MoYS	Ministry of Youth and Sports
MoP	Muriate of Potash
TSP	Triple Super Phosphate
IPM	Integrated Pest Management
BINA	Bangladesh Institute of Nuclear Agriculture
BADC	Bangladesh Agricultural Development Corporation
STW	Shallow Tube-well
DTW	Deep Tube-well
SAAO	Sub Assistant Agriculture Officer
SAU	Sher-e-Bangla Agricultural University
SPSS	Statistical Package for Social Sciences

ADOPTION OF HYBRID RICE SEED PRODUCTION TECHNOLOGIES BY THE FARMERS OF MUKTAGACHA UPAZILA

KHONDOKER MOQBUL HOSSAIN

ABSTRACT

The purpose of the study was to determine the salient socio-economic characteristics of farmers cultivate hybrid rice seed; to determine the extent of adoption of hybrid rice seed production technology by the farmers and to identify the factors that significantly influences adoption of hybrid rice seed production technologies by the farmers. The study was undertaken purposively in Muktagacha upazila under Mymensingh district. Validated and well-structured interview schedule (questionnaire) was used to collect data from 120 farmers during 15th February to 27th February, 2019. Descriptive statistics, multiple regressions were used for analysis. Half (50%) of the farmers had medium adoption of hybrid rice seed production technologies while 41.67 percent and 8 .33 percent farmers had high adoption and low adoption, respectively. Among 16 selected characteristics of the farmers 7 characteristics namely, experience in hybrid rice seed production, education, total production of hybrid rice seed in last cropping season, training in hybrid rice seed production technology, extension media contact, organizational participation and knowledge in hybrid rice seed production of the respondents had significant positive contribution to their adoption of hybrid rice seed production technologies. The rest 9 characteristics namely, age, farm size, land under hybrid rice seed production, experience in rice farming, family size, annual income from hybrid rice seed production, income before hybrid rice seed production, income after hybrid rice seed production and total production of BRRI dhan 28/29/50 in last cropping season had no significant contribution with their adoption of hybrid rice seed production technologies.

CHAPTER-I
INTRODUCTION

1.1 General Background of the Study

In Bangladesh rice grows under irrigated, rain fed and deep-water conditions in three different rice seasons, namely Aus, Aman and Boro. Rice alone constitutes 95.00 percent of the food grains production in Bangladesh (Julfiquar et al., 1998). Currently the average yield of rice in Bangladesh is around 4-5 t/ha (BBS, 2019), which is less than the world average of 3.1 t/ha and frustratingly much below the highest producing country average in Korea (6.1 t/ha). The average rice yields of some countries are: USA 6.62 t/ha, South Korea 6.87 t/ha, Japan 6.41 t/ha and China 6.32 t/ha (FAO, 2019).

Bangladesh Rice Research Institute (BRRI) during the last 48 years discovered ninety-nine high yielding varieties of rice including package of rice production technologies (BRRI, 2019). Through extension services of Bangladesh HYV of rice and concerned technologies have been diffused among the farmers and accordingly most of the farmers adopted the technologies. The life style and socio-cultural pattern of the farmers are quite different from the plain land farmers.

Modern high-yielding varieties (HYV) of rice were adopted beginning in 1968, yet the rate of adoption remained low till 1975-76. The major sources of growth of food grain production in the 1970s were the expansion of area and the yield of wheat. The rapid diffusion of rice HYVs took place after mid-1984-85s with the liberalization of policies regarding the procurement and distribution of agricultural inputs, and reduction of import duties on agricultural equipment (Hossain and Akash, 1994). Rice area covered by modern varieties has now reached nearly 65% supported by an expansion of minor irrigation by tube wells and pumps that now cover nearly 48% of the cropped area. Traditional varieties are grown only in the

unfavorable ecosystems, the rain fed uplands (Aus), the deep-water areas (broadcast Aman) and the saline affected coastal areas. Rice production increased from 21.4 million MT in 1990-00 to nearly 36 million MT by 2013-2018, and the rice yield increased from 7-8 t/ha during this period.

The adoption of HYV rice technology, which enabled Bangladesh to double the yield rate during 1990-00 to 2001-2015, was not however an unmixed blessing (BBS, 2016).

On the other hand, Bangladesh needs to increase rice yield further to meet the growing demand emanating from population growth. The United Nations (UNO, 1998) project that even by 2020 the Bangladesh population grow at 1.36% per year and 165 million, 31% higher than the present number. Nearly 46% of the population live in urban areas in 2020 compared to 27% now. Farmers will have to generate larger marketable surplus to feed the growing urban population.

The National Commission of Agriculture projected that to remain self-sufficient Bangladesh will need to produce 47 million MT of paddy (31.6 million MT of rice) by year 2020, implying a required rate of growth of production at 1.7% per year. An earlier Agricultural Research Strategy document prepared by the Bangladesh Agricultural Research Council projected the required paddy production by 2020 at 52 million MT (34.7 million MT of rice), which would require a production growth of 2.2% per year. As mentioned earlier, Bangladesh will have to target the yield growth at a higher rate to release some land from rice cultivation for supporting crop diversification and meeting the growing demand for land for housing, industrialization and infrastructure development.

Rice breeders have, therefore, been trying to evolve input-efficient and pest-resistant higher yielding varieties to increase the rice yield while sustaining the

natural resource base. One innovation has been the development of hybrid rice varieties for the tropics, which is expected to shift the yield potential of the rice plant by 15-20% or more with same amount of agricultural input. The technology has attracted the attention of researchers and policy makers in many Asian countries who see it as an opportunity to overcome the yield ceilings reached by many enterprising farmers in the irrigated ecosystem.

1.2 Statement of the Problem

The success of any technology depends on its dissemination among the potential users, which ultimately is measured by its level of adoption. It is assumed that notable improvements can take place in Bangladesh agriculture, if the available technologies are accepted and adopted by the farmers.

Very little is known about the adoption of hybrid rice seed production technologies by the farmers in the country. Generalization from studies conducted home and abroad regarding the adoption of other technologies may not be always applicable due to considerable variation in attributes of the technologies and for various other factors.

For wider adoption of selected rice cultivation technologies, it is necessary to have a clear understanding of the present status of adoption of hybrid rice seed production technologies by the farmers. It is also necessary to have an understanding of the facts that contributed to adoption of hybrid rice seed production technologies by the farmers. An understanding of the relationship of farmers' adoption behavior with their selected characteristics as well as the problems faced by the respondents will be helpful to the planners and extension workers.

In view of the foregoing discussion, the researcher undertook a study entitled "Adoption of Hybrid Rice Seed Production Technologies by the Farmers of Muktagacha upazila." The main purpose of the study was to have an understanding

on the adoption of hybrid seed production technologies by the farmers and about some selected factors contributing in the adoption of hybrid rice seed production technologies. For conducting the research in a planned and appropriate way, the researcher put forwarded the following questions:

1. What are the farmers selected characteristics having relationships with the adoption of selected rice seed production technologies by the farmers?

2. What is the extent the hybrid rice seeds production technologies have been adopted by the farmers?
3. To what extent the selected characteristics of the farmers to their extent of adoption of hybrid rice seed production?

1.3 Specific Objectives of the Study

1. To determine the salient socioeconomic characteristics of farmers, cultivate hybrid rice seed;
2. To determine the extent of adoption of hybrid rice seed production technology by the farmers;
3. To explore the contribution of the factors that significantly influence adoption of hybrid rice seed production technologies by the farmers; and
4. To determine the impact of hybrid rice seed production on farmers income.

1.4 Justification of the Study

Mymensingh district has a rich heritage of the farmers mostly living in hilly areas, except Muktagacha upazila. This area is suitable for hybrid rice seed production considering following aspects i) temperature, ii) wind follow, iii) sun light, iv) rain fall and v) low storm. In that areas deficit of food grains is a chronic problem as the pressure of population is massive. Limitation of cultivable land and lack of knowledge and skill about selective hybrid rice seed production are the major

problem for the farmers. So, to ensure adequate food supply, it is necessary to give thrust to increase food production using hybrid rice seed production technologies. Agricultural intensification, to minimize food shortage and maximize self-sufficiency in food production is possible only when adoption of hybrid rice seed production technologies and their application skills create positive impact on the behavior of ultimate users.

Several research institutes have developed quite a good number of modern agricultural technologies but the farmers have so far adopted a few of them. Technical, biological, environmental and socio-economic barriers are the main hindrances of technology transfer and adoption of hybrid rice seed production technologies. Selected hybrid rice seed production technologies must be simple, demand driven, locally available, economically feasible and socially acceptable to bring desirable changes in attitude of the farmers for their adoption.

It is obviously true that farmers are the key elements of adoption of hybrid rice seed cultivation technologies. At present, there is a lack of adequate understanding as to how the characteristics of the farmers influence their adoption of hybrid rice seed cultivation technologies. These facts indicate the need for an investigation to ascertain the relationships of the characteristics of the farmers with their adoption of hybrid rice seed production technologies. Findings of this study, therefore, would be helpful to the planners and extension personnel in planning and execution of programs for enhancing the rice production yield.

1.5 Assumptions of the Study

In this study, the researcher had the following assumptions in mind while carrying out this study:

1. The farmers included in the sample were competent to furnish proper

responses to the items included in the interview schedule.

2. The researcher who also acted as the interviewer was well adjusted to the socio-cultural environment of the study area. The researcher collected data with utmost care and can be treated as reliable.

3. The responses furnished by the respondents were reliable and they truly expressed their opinion on adoption of hybrid rice seed production technologies and their selected characteristics.

4. The sample size was representative of the whole families of the study area.

5. The findings of the study would be useful for planning and execution of the programmers in connection with adoption of hybrid rice seed production technologies.

6. The measures of the adoption of hybrid rice seed production technologies by the farmers are normally and independently distributed with their respective means and standard deviation.

7. The adoption of hybrid rice seed production technologies by the farmers was linearly related with their selected characteristics.

1.6 Scope of the Study

The findings of the study will particularly be applicable to Muktagacha upazila under Mymensingh district. However, the findings may also be generally applicable to other areas of the district where the social ecosystem is not differing much with those of the study area. Thus, the findings are expected to be useful to the planners for preparation of programmers for rapid adoption of hybrid rice seed cultivation technologies by the farmers. The findings may also be helpful to the extension workers of different national building departments / organizations to improve their

technique and strategy of action for effective working method with the people to generate rural employment and to improve rural economy. Finally, there is a great scope for investigation on farmers' adoption of hybrid rice seed production technologies, because little study was conducted on this so far in greater Mymensingh district.

1.7 Limitations of the Study

The present study was undertaken with a view to have an understanding on the level of adoption of hybrid rice seed production by the farmer of Muktagacha upazila under Mymensingh district. In order to manage the handle, the research program proposal, it became necessary to impose some limitations on certain aspects of the study. Considering time, money and other necessary resources available to the researcher, the following limitations had been observed throughout the study:

1. The study was confined to villages of Muktagacha upazila under Mymensingh district.
2. Eight (8) hybrid rice seed production technologies were selected to examine the extent of adoption among the rice growers of farmers of Muktagacha upazila.
3. Only the farmers who cultivated hybrid rice seed were selected for this study.
4. There are many attributers or characteristics of the growers that always vary but only sixteen (16) were selected for investigation in this study as stated in the objectives. This was done to complete the study within limited resources and time.
5. The researcher relied on the data furnished by the farmers from their memory during interview.
6. Population for the present study was kept confined within the heads of farm families in the study area, because they were the decision makers in their respective rice cultivation technologies.

1.8 Definition of the Terms

In order to avoid confusion and misunderstanding, certain terms used throughout the study are defined as follows:

Improved Seed: Improved seed means standardized quality seed, which possesses the quality of the varietal purity, germination capacity, physical purity, optimum moisture content, optimum size and shape, healthy and vigorous.

Technology: Technology is a design of instrumental action that reduces the uncertainty in the cause-effect relationship involved in achieving a desired outcome (Rogers, 1995). In other words, technology refers to the combination of knowledge, inputs and managed mental practices, which are used together with productive resources to gain a desired output (ILEIA, 1991: 3).

Variable: A general indication in statistical research of characteristic that occurs in a number of individuals, objects, groups etc. and that can take on various values, for example the age of an individual.

Adoption: Adoption is the implementation of a decision to continue the use of an innovation. According to Rogers (1995), "Adoption is a decision to make full use of an innovation as the best course of action available". When an individual takes up a new idea as the best course of action and practices it, the phenomenon is known as adoption (Ray, 1991).

Knowledge on hybrid rice seed production: It is the extent of basic understanding of the growers in different aspects of hybrid rice seed production subject matters i.e. soil, seed, fertilizer, insects and diseases of crops, high yielding variety etc. It includes the basic understanding of the use of different agricultural inputs and practices.

CHAPTER II
REVIEW OF LITERATURE

The purpose of this Chapter is to review of literature having relevance to the present study. The researcher made an elaborate search of available literature for the above purpose. But there is hardly any study dealing with the relationship of the characteristics of farmers and their adoption of hybrid rice seed production technologies. The research attempted to search the literatures on a number of studies. Therefore, the finding of such studies related to the extent of adoption of hybrid rice seed production technologies by the farmers and other partial studies have been reviewed in this chapter.

This Chapter is divided into following three major sections:

Section 1: Review of Literature on General Context of Adoption.

Section 2: The Relationship between Farmer's Characteristics with Their Adoption of Hybrid Rice Seed Production Technologies.

Section 3: The Conceptual Framework of the Study.

2.1 Review of Literature on General Context of Adoption

Adoption is decision to use and continue to use of the innovation for a certain period of time. Adoption is a decision to make full use of innovation as the best course of action available (Ray, 1991). When an individual takes up a new idea as the best course of action and practices it, the phenomenon is known as adoption.

Khan (2019) conducted investigation on adoption of selected hybrid rice production technologies by the farmers of Joypurhat district in Bangladesh. The study revealed that about 68.5 percent of the farmers had medium adoption compared to 9 percent having low adoption and 22.5 percent having high adoption of hybrid rice cultivation technologies.

Jahan (2017) conducted investigation on "Socio-Economic Determinants of Adoption of Sunflower Production by the Farmers of Patuakhali Sadar Upazila" in Bangladesh. The study revealed that the highest proportion (69.1 percent) of the sunflower growers fell under the medium adoption category, while 21.2 percent had high adoption and 9.7 percent had low adoption of sunflower production technologies.

Hussen (2001) conducted investigation on adoption of modem sugarcane cultivation practices by the farmers of Daweangonj Upazila in Jamalpur district. The study revealed that about ninety one percent (91 percent) of the farmers had medium adoption compared to 7 percent having low adoption and only 2 percent having high adoption of modem sugarcane cultivation practices.

Rahman (2001) conducted an investigation on knowledge attitude and adoption of Aalok-6201 hybrid rice by the farmers of sadar upazila in Mymenshingh district. The study revealed that the majority (75 percent) of the farmers had medium adoption while 18 percent and 7 percent had high and low adoption in Aalok-6201 hybrid rice cultivation respectively.

Zegeye *et al*. (2002) studied the determinants of adoption of improved maize technologies in major maize growing region of Ethiopia. He found that the rate of adoption of improved maize varieties and chemical fertilizer, factors affecting the adoption of improved maize varieties and the determinant factors affecting adoption of chemical fertilizers are also highlighted.

Gebre et al. (2002) conducted a study on Maize technology adoption in Ethiopia. This study presents the results of the Sasakawa-Global 2000 Agriculture program

in Ethiopia and its influence on agricultural research and maize production in the region. The Sasakawa-Global 2000 is an international non-government organization initiated in 1986 because of the 1984-85 famine in Ethiopia, with the aim of empowering Africa to produce its own food through the adoption of improved agricultural technologies.

Alexznder and Goodhue (2002) conducted the study on pricing of innovations. They evaluate the producer's returns to planting patented seed innovation, using a calibrated optimization model of a south-central maize producer's adoption decision in Iowa, USA. Their results suggest that patented seed innovations do not increase the market power of biotechnology firm in the relevant market for production system.

Swinkels *et al*. (2002) studied assessing the adoption potential of hedgerow intercropping for improving soil fertility, in western Kenya. They conduct that the average cost of hedgerow intercropping was 10.5 (SD = 5.5) when based on returns to land and 17.5 (SD = 6.5) based on returns to labour. Fifth planted additional hedges and only 14 did so to improve soil fertility. It thus appears that the potential for its adoption as a soil fertility practices. Hedgerow intercropping appears to have greater adopter potential if its aim is to provide feed for an intensive dairy operation or for curbing soil erosion.

Islam (2002) conducted a study on adoption of modem agricultural technologies by the farmers of Sandwip. The study revealed that 69.0 percent of the farmers had medium adoption while 13.0 percent had low adoption and 18.0 percent had high adoption of modem agricultural technologies.

Podder (1999) concluded a research study on the adoption of Mehersagar Banana by the farmers. He found 47.0 percent of the respondents had medfiim adoption compared to 14 percent having low and 39 percent high adoption.

Rahman (1999) conducted an investigation on adoption of balanced fertilizer by the farmers of Ishargonj upazila in Mymensingh district. The study revealed that the majority (71 percent) of the respondents had medium adoption compared to 29 percent having below optimum level.

Chowdhury (1997) conducted an investigation on adoption of selected BINA technologies by the farmers of Boura union in Mymensingh district. The study revealed that the majority (53 percent) of the respondents had no adoption of BINA technologies and 42 percent were adopted BINA technologies.

Sarker (1997) studied the extent of adoption of improved potato cultivation practices by the farmers in Comilla district. The study revealed that more than half (55 percent) of the respondents had medium adoption compared to 23 percent having low adoption and 22 percent high adoption of improved potato cultivation practices.

Akanda (1995) studied the adoption of recommended dose of fertilizer and found that 36.64 percent respondents used recommended dose of urea 6.93 percent used recommended dose of MP, 11.88 percent used T.S.P and only 2 respondents used gypsum in their potato cultivation.

Muttaleb (1995) studied the extent of the adoption of improved technologies of potato cultivation by the farmers in Haibatpur union under sadar thana of Jessore district. The study revealed that 8 percent of the potato growers had high adoption

of improved technologies, 43 percent has medium and 49 percent had low adoption.

Hoque (1993) conducted an investigation on the adoption of improved practices of sugarcane cultivation in Sreepur upazila of Gazipur district. The study revealed that 31 percent of the sugarcane growers had high adoption while 37 percent had medium and 32 percent had low adoption of improved practices in sugarcane cultivation.

Nikhade *et al.* (1993) observed on adoption of improved practices of soybean cultivation that cent percent adopted improved varieties. More than 82 percent had adoption of package practices like line sowing, spacing and intercultural operations. Partial adoption was observed in majority of the soybean growers (74.6 percent) with regard to recommended seed rate.

Hossain (1991) studied the extent of adoption behavior of contact wheat growers in sadar upazila of Jamalpur district. He found that more than half (52 percent) of the growers had medium adoption of improved farm practices compared to 34 percent having low adoption and only 14 percent high adoption.

Bembridge and Williams (1990) studied the personal, sociological, socio-psychological and communication characteristics that influence the adoption of maize practice in Farmer Support Programme in South Africa. The study revealed less than 50 percent of the farmers who adopted practices were implementing them according to recommendations and many did not have a clear concept that the practices were interrelated.

Kariuka (1990) studied the economic impact of the adoption of hybrid maize in Swaziland. The study revealed the sensitivity of hybrid maize adoption to different

farming systems and the limited usefulness of a partial analysis in evaluating the impact of innovations. A macro level cost-benefit analysis was used in an ex-post appraisal if impact of maize research, complemented by an ex-ante projection of the potential benefits and costs of its component maize breeding programme. Moderate increase in production cost would not affect the area of land devoted to maize, farm families are unlikely to produce beyond subsistence requirements without a considerable increase in output prices.

Rai *et al*. (1989) conducted a study on identifying factors responsible for acreage substitution and low yield of maize. This study showed a general downward trend in area and productivity of maize in Haryana, India. It argued that maize acreage in given year was influenced by size of irrigated area, lag year maize acreage and lag year relative income.

Razzaque (1977) studied on the extent of adoption of HYV rice in three villages of Bangladesh Agricultural University Extension Project area. He observed that among the respondent growers, 6.6 percent of the farmers had high adoption of HYV rice, 33.3 percent had medium adoption and 40 percent low adoption.

Sobhan (1975) studied on the extent of adoption of ten winter vegetables namely tomato, radish, lettuce and potato in Boilar union of Mymensingh district. Over all winter vegetable adoption scores of the farmers could range from 0 to 140. Over all adoption scores indicated that 27 percent of the farmers did not adopted winter vegetables cultivation while 28 percent had low adoption and 55 percent high adoption.

Mohammad (1974) studied the extent of adoption of insect control measures by the farmers in Khamar union of Rajshahi district. He found that among the respondent

farmers, 25 percent did not adopt insect control measure; 28 percent had high level of adoption; 32 percent had medium level of adoption and 25 percent had low level of adoption.

2.2 Review of the Studies Concerning the Relationship between Farmers' Characteristics and Their Adoption

2.2.1 Age and Adoption

Khan (2019) conducted a study on adoption of hybrid rice production technologies by the farmers of Kalai upazila under Joypurhat district. He found that age of the farmers had no significant relationship with their adoption of hybrid rice production technologies.

Jahan (2017) conducted investigation on "Socio-Economic Determinants of Adoption of Sunflower Production by the Farmers of Patuakhali sadar upazila" in Bangladesh. She found that age of the farmers had no significant contribution with their adoption of improved practices of sunflower production.

Islam (2002) conducted a study on adoption of modem agricultural technologies by the farmers of Sandwip. He found that age of the farmers was not related to their adoption of modem agricultural technologies.

Aurangozeb (2002) conducted a study on adoption of integrated homestead farming technologies by the rural women in RDRS. He found that there was a significant negative relationship between age and adoption of integrated homestead farming Technologies.

Sardar (2002) conducted a study on adoption of IPM practices by the farmers under PETRRA project of RDRS. He found that age of the farmers had a negatively significant relationship with their adoption of IPM practices.

Rahman (2001) observed that there was no significant relationship between age and adoption of Aalok-6201 hybrid rice cultivation practices.

Podder (1999) and Hossain (1999) are found similar results in their respective studies.

Hussen (2001) conducted a study, which concluded that age of the sugarcane growers had a significant negative relationship with their adoption of modem sugarcane cultivation practices. Rahman (1999) also found similar result in this study. Chowdhury (1997) observed that the age of the farmers had no significant relationship with their adoption of selected BINA technologies. Sarkar 1997) observed that there was no significant relationship between age of the farmers and their adoption of improved potato cultivation practices. Similar finding were observed by Singh (1989) and Kher (1992) in their respective studies. Hamid (1995) conducted a study on adoption of recommended sugarcane cultivation practices by the farmers. He found that age had a significant negative relationship with the adoption of recommended sugarcane cultivation practices.

However, researchers cannot come to a unified decision on farmers' age and adoption of hybrid rice production technology relationship, which requires further research.

2.2.2 Education and Adoption

Khan (2019) conducted a study on adoption of hybrid rice production technologies by the farmers of Kalai upazila under Joypurhat district. He found that education of the farmers had a positive significant relationship with their adoption of hybrid rice production technologies.

Jahan (2017) conducted investigation on "Socio-Economic Determinants of Adoption of Sunflower Production by the Farmers of Patuakhali sadar upazila" in Bangladesh. She found that education of the farmers had significant contribution with their adoption of improved practices of sunflower production.

Islam (2002) conducted a study on adoption of modem agricultural technologies by the farmers of Sandwip. He found that education of the farmers had a positive significant relationship with their adoption of modem agricultural technologies.

Sardar (2002) conducted a study on adoption of IPM practices by the farmers under PETRRA project of RDRS. He found that education of the farmers had a positive significant relationship with their adoption of IPM practices.

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

Hussen (2001) conducted a study on farmers' knowledge and adoption of modem sugarcane cultivation practices. He found that education of the growers had a positive significant relationship with their adoption of modem sugarcane cultivation

practices.

Rahman (2001) conducted a study on knowledge, attitude and adoption of the farmers regarding AaIok-6201 hybrid rice in sadar upazila in Mymensingh district. He found that academic qualification of the farmers had a significant positive relationship with their adoption regarding Aalok-6201 hybrid rice.

Chowdhury (1997) found a positive significant relationship between the education of the farmers and their adoption of selected BINA technologies. Similar results were found by Barkatullah (1985), Ali *et al.* (1986), Hoque (1993), Bashar (1993) Khan (1993), Pal (1995) and Sarkar (1997) in their respective studies.

Kaur (1988) found that education influenced the opinion of the women about adoption of vegetable gardening animal husbandry etc.

Krishna (1969) conducted a research study on the adoption of hybrid maize in Karimnagar, India. He found significant negative relationship between the education of the respondents and their adoption of hybrid maize.

Under above circumstance, we hypothesized that there is positive relation between education and adoption.

2.2.3 Farm size and Adoption

Khan (2019) conducted a study on adoption of hybrid rice production technologies by the farmers of Kalai upazila under Joypurhat district. He found that farm size of the farmers had a positive significant relationship with their adoption of hybrid rice production technologies.

Jahan (2017) conducted investigation on "Socio-Economic Determinants of Adoption of Sunflower Production by the Farmers of Patuakhali sadar upazila" in Bangladesh. She found that farm size of the farmers had no significant contribution with their adoption of improved practices of sunflower production.

Islam (2002) conducted a study on adoption of modem agricultural technologies by the farmers of Sandwip. He observed that farm size of the farmers had a positive significant relationship with their adoption of modem agricultural technologies. Technologies by the farmers under PETRRA project of RDRS. He found that farm size of the farmers had a positive significant relationship with their adoption 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 had no relationship between homestead area and their adoption of integrated homestead farming technologies.

Gogoi and Gogoi (1989) in their study observed that size of land holding of farmers had a significant relationship and positive effect on their adoption of plant protection practices.

Rahman (2001) conducted an investigation on knowledge, attitude and adoption of Aalok-6201 hybrid rice by the farmers of sadar upazila in Mymenshigh district. He observed that there was a significant positive relationship between farm size of the farmers and their adoption of Aalok-6201 hybrid rice.

Hussen (2001) conducted an investigation on adoption of modem sugarcane cultivation practices by the farmers' of Dewangonj upazila in Jamalpur district. He observed that there was a significant positive relationship between farm size of the farmers and their adoption of modem sugarcane cultivation practices.

Chowdhury (1997) conducted a research on adoption of selected BINA technologies by the farmers. He indicated that farm size of the farmers had a strongly positive significant relationship with their adoption of selected BINA technologies. Okoro and Obibuak. (1992), Khan (1993). Hoque (1993) and Sarkar (1997) observed similar results in their respective studies.

2.2.4 Family size and Adoption

Jahan (2017) conducted investigation on "Socio-Economic Determinants of Adoption of Sunflower Production by the Farmers of Patuakhali sadar upazila" in Bangladesh. She found that family size of the farmers had no significant contribution with their adoption of improved practices of sunflower production.

Hossain (2003) revealed that family size of the farmers had a significant and positive relationship with their adoption of modern Boro rice cultivation practices.

Sardar (2002) found that the family size of the farmers had significant positive relationship with their adoption of IPM practices.

Hossain (1999) conducted a study to determine the farmers' perception of the effects of agro-chemicals on environment. He found no relationship between the farmer's family sizes with their adoption of fertilizer.

Chowdhury (1997) conducted a research study on adoption of selected BINA technologies by the farmers of Boira union in Mymensingh district. He observed that family size of the farmers had positive and significant relationship with the adoption of selected BINA technologies.

Hossain (1991) in his study in sadar thana of Jamalpur observed that family size of the farmers had no significant effect on their adoption of improved farm practices. Similar results were observed by Sobhan (1975), Hoque (1993), Bashar (1993), Hossain (1999) also found that family size of the farmers had positive significant relationship with the adoption of agro-chemical. Similar results were also observed by Pal (1995), Muttalab (1995), Sarker (1997), Chowhdury (1997), Hoque (1993) and Khan (1993).

2.5.5 Annual income and Adoption

Sardar (2002) conducted a study on adoption of IPM practices by the farmers under PETRRA project of RDRS. He found that the annual income of the farmers had no relationship with their adoption 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 annual income of the respondents and their adoption of integrated homestead farming Technologies.

Rahman (2001) conducted an investigation on knowledge; attitude and adoption of Alok-6201 hybrid rice fry the farmers of sadar upaziia in Mymensingh district. He observed that there was a significant positive relationship between annual income of the farmers and their adoption of Alok-6201 hybrid rice.

Hussen (2001) conducted an investigation on adoption of modem sugarcane cultivation practices by the farmers of Dewangonj upazila in Jamalpur district. He observed that there was a significant positive relationship between annual income of the farmers and their adoption of modem sugarcane cultivation practices.

Islam (2002) conducted a study on adoption of modem agricultural technologies by the farmers of Sandwip. He observed that the annual income of the farmers had no relationship with their adoption of modem agricultural technologies.

Chowdhury (1997) found a significant and positive relationship between annual income and adoption of selected BINA technologies. Okoro and obibuak (1992), Khan (1993), Sarker (1997) observed similar result in their respective studies. Tolawar and Hirevenkaragouder (1989) studied on factors of adoption of poultry management practices. They revealed that the farmers having high income tend to own bigger size of poultry unit and possess more knowledge of improved practices leading to higher level of adoption.

2.2.6 Organizational Participation and Adoption

Khan (2019) conducted a study on adoption of hybrid rice production technologies by the farmers of Kalai upazila under Joypurhat district. He found that organizational participation of the farmers had a positive significant relationship with their adoption of hybrid rice production technologies.

Jahan (2017) conducted investigation on “Socio-Economic Determinants of Adoption of Sunflower Production by the Farmers of Patuakhali sadar upazila” in Bangladesh. She found that organizational participation of the farmers had significant contribution with their adoption of improved practices of sunflower production.

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 a 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 had a significant and positive relationship with their adoption regarding Aalok 6201 hybrid rice.

Mostafa (1999) conducted a study on adoption of recommended mango cultivation practices by the mango growers of Nawabganj Sadar thana. He found that organizational participation of mango growers had a significant positive relationship with their adoption of recommended mango cultivation practices.

Sarker (1997) conducted a study on correlates of selected characteristics of potato growers with their adoption of improved potato cultivation practices in five village of Comilla district. He observed that organizational participation of the potato growers had no relationship with their adoption of improved potato cultivation practices.

Kher (1992) carried out a research 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.

2.2.7 Training and Adoption

Rahman (2001) observed in study that training received of the farmers had a significant and positive relationship with their adoption regarding Aalok-6201 hybrid rice.

Islam (2002) conducted a study on farmers‟ knowledge and adoption of ecological agricultural practices under the supervision of Proshika. He found that agricultural training exposure of the farmers had no significant relationship with their adoption of ecological agricultural practices.

2.2.8 Extension Media Contact and Adoption

Khan (2019) conducted a study on adoption of hybrid rice production technologies by the farmers of Kalai upazila under Joypurhat district. He found that extension media contact of the farmers had a positive significant relationship with their adoption of hybrid rice production technologies.

Jahan (2017) conducted investigation on "Socio-Economic Determinants of Adoption of Sunflower Production by the Farmers of Patuakhali sadar upazila" in Bangladesh. She found that extension media contact of the farmers had significant contribution with their adoption of improved practices of sunflower production.

Islam (2002) conducted a study on adoption of modem agricultural technologies by the farmers of Sandwip. He found that extension media, contact of the farmers had no significant relationship with their adoption of modem agricultural technologies.

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 contact with extension media of the respondents and their adoption of integrated homestead farming technologies.

Slade *et al*. (1988) studied that adoption rates among farmers receiving one or more view visits per month were generally higher than those farmers who were not visited by view's contact farmers were better adopter of some technologies that non-contact

farmers.

Osunloogun *et al*. (1996) studied adoption of improved Agricultural practices by co-operative farmers in Nigeria. The findings of the study indicated a positive relationship between extension contact and adoption improved practices.

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

Rahman (2001) conducted an investigation on knowledge, attitude and adoption of Aalok-6201 hybrid rice by the farmers of sadar upazila in Mymensingh district. He observed that there was a significant positive relationship between extension contact of the farmers and their adoption of Aalok-6201 hybrid rice.

Sardar (2002) conducted a study on adoption of IPM practices by the farmers under PETRRA project of RDRS. He observed that contact with RDRS personnel of the farmers had a positive significant relationship with their adoption of IPM practices.

Hussen (2001) conducted an investigation on adoption of modem sugarcane cultivation practices by the farmers of Dewangonj upazila in Jamalpur district. He observed that there was a positive significant relationship between extension contact of the farmers and their adoption of modem sugarcane cultivation practices. Sarker (1997) observed a positive and significant relationship between extension contact and adoption of improved potato cultivation practices. Kashem and Islam (1990). Kher (1992), Pal (1995), Haque (1984) also found the similar results in their respective studies.

Nahar (1996) found that there was a significant positive relationship in agricultural knowledge on farm women in homestead farming and their level of contact with information sources. Heong (1990) observed that the lack of adoption of IPM technologies in rice was frequently attributed to lack of sufficient extension.

However, researchers can't come to a unified decision on farmers' agricultural extension contact and adoption of hybrid rice production technology relationship, which requires further research.

2.2.9 Knowledge and Adoption

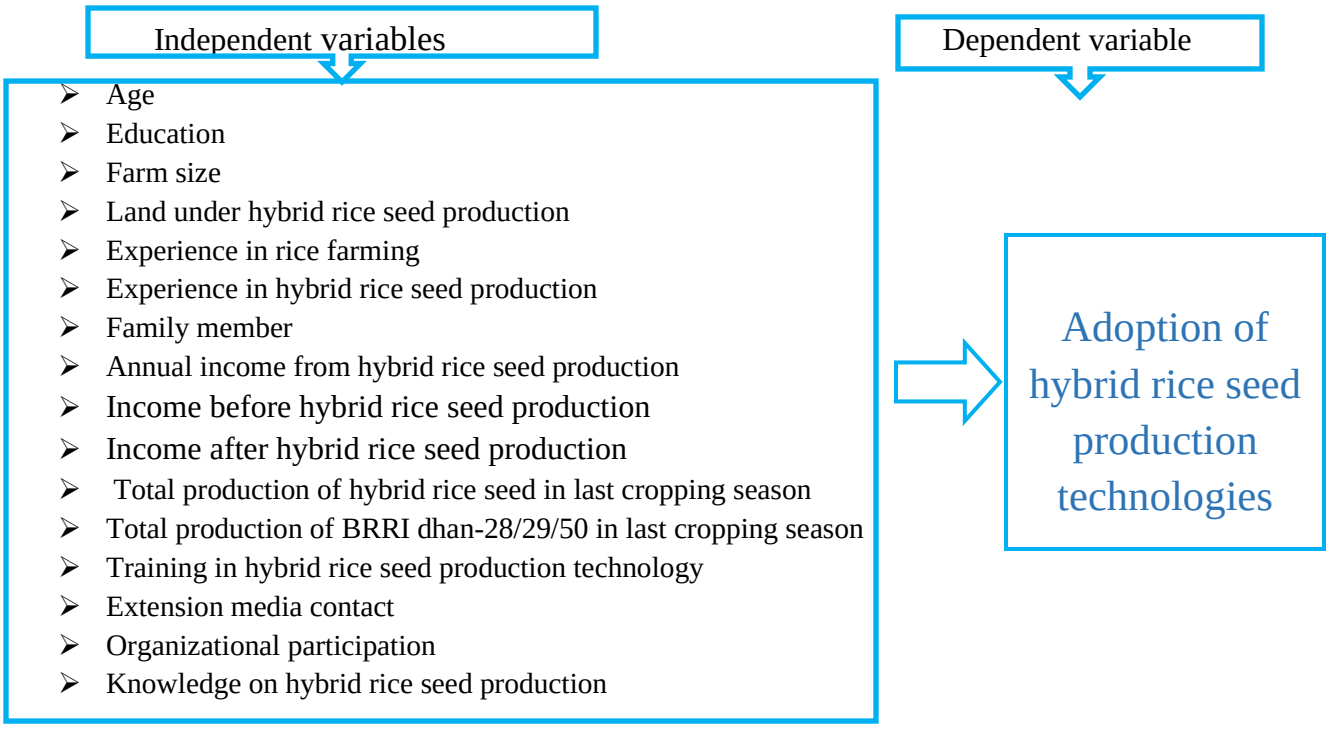
Khan (2019) conducted a study on adoption of hybrid rice production technologies by the farmers of Kalai upazila under Joypurhat district. He found that Knowledge on hybrid rice production of the farmers had a positive significant relationship with their adoption of hybrid rice production technologies.

Jahan (2017) conducted investigation on "Socio-Economic Determinants of Adoption of Sunflower Production by the Farmers of Patuakhali Sadar upazila" in Bangladesh. She found that knowledge of the farmers had significant contribution with their adoption of improved practices of sunflower production.

Sarkar (1997) found that potato production knowledge of potato growers had a positive and significant relationship with their adoption of improved potato cultivation practices. Ali et at. (1986), Muttaleb (1995) observed similar results in their respective studies. Reddy et al. (1987) found significant association between knowledge and use of improved package of practices in paddy production by participant and non- participant farmers.

2.4 The Conceptual Framework of the Study

This study is concerned with the adoption of hybrid rice seed production technologies by the farmers of Muktagacha upazila. Thus the adoption was the main focus of the study and 16 selected characteristics of the farmers' were considered as those might have relationship with adoption. It is not possible to deal with all the factors in a single study. Therefore, it was necessary to limit the factors, which included age, education, farm size, experience in rice farming, experience in hybrid rice seed production, family member, annual income from hybrid rice seed production, total production of hybrid rice seed in last cropping season, total production of BRRI dhan-28/29/50 in last cropping season, training in hybrid rice seed production technology, extension media contact, organizational participation and knowledge on hybrid rice seed production. The conceptual framework of the study has been presented in Fig. 2.1.



2.1 The conceptual framework of the study

CHAPTER-III
METHODOLOGY

In conducting a research study, methodological issue is one of the prime considerations for yielding of valid and reliable findings. Appropriate methodology enables the researcher to collect valid and reliable information and to analyze the information properly in order to arrive at correct conclusions. However, the methods and operational procedures followed in conducting this study has been described in the subsequent sections of this chapter.

3.1 Locale of the Study

Muktagachha upazila is located in Mymensingh district with a total area of 314.70 sq km, whereas 282.35 sq. km is the total land area and located 18 km away from district head quarter. The upazila is situated in between 24°36' and 24°52' north latitudes and in between 90°04' and 90°20' east longitudes. It is surrounded by Jamalpur Sadar and Mymensingh Sadar upazila on the north, Phulbaria upazila on the south, Mymensingh Sadar and Phulbaria upazila on the east, Madhupur and Jamalpur Sadar upazilas on the west.

The sub-district is consistent with one Municipality with 9 wards, 10 (ten) unions, 273 villages under 261 mouzas. According to the population census 2011, the total population living is 4,15,473 with 1.48% annual population growth out of which male 206,199 (49.63%) and female 209,274 (51.37%) and the population density is 1,342/sq.km. There are 101 numbers of government primary schools, 39 of higher secondary schools, 4 colleges and 51 numbers of madrasas. The literacy rate is 43.50% (BBS, 2013).

The total agricultural land of this sub-district is 22,768 hectares out of which single cropped area, double cropped area and triple cropped areas are 2,958; 14,567 and 5,243 hectares of land, respectively (BBS, 2020). This upazila has one seed extension farm owned by BADC (Bangladesh Agricultural Development Corporation). About 176712 hectares of the land is cultivated through irrigation by 495 deep tubewell (DTW), 2065 nos. of shallow tube wall (STW) and 201 numbers of power pumps (PP). There are 15405 number of ponds and 2 *dighee* adjacent to homestead and local bazaar and 3 river flows which are used for fish culture and supplementary irrigation (BBS, 2013).

The cropping intensity of the sub-district is 205% and the productivity of crop is 192 (BBS, 2020). About 66693 hectares of the cultivable land is under paddy cultivation in each year, whereas only 40980 hectares of paddy area are under irrigation. The other major crops beyond paddy are wheat (581 hectares) and potato (509 hectares). The chief fruit trees of the district are the mango, jackfruit, litchi, tamarind, peach, guava, lemon, jambura, plantains, pineapples, custard-apple, nona, wood apple, papaya and various kinds of plums which grow practically wild. Among the fruits, the most important are certainly the plantain and the jack-fruit, both are among the chief commodities at every bazar, and the latter is so prolific and grows to such an immense size that it forms a staple article of diet with poorer people. The major vegetables are brinjal, teasel gourd, yard long bean, hyacinth bean, cucumber, pumpkin, cabbage, cauliflower, bitter gourd, snake gourd, ridge gourd etc (BBS, 2013).

The sub-district comprises Old Brahmaputra floodplain under AEZ-9 and having mostly 81% medium high land, 10% high land and 9% low land. In broad soil classification, doash 39.9%, bele 7.8%, etel 7.7% and 44.6% of soil categorised as other classification. The soil is neutral in condition pH ranges from 5.6 to 6.7 which

are mostly suitable for paddy, jute, wheat, potato, different vegetables and fruits like citrus, jackfruit, burmese grapes, guava, banana, papaya etc (BBS, 2013.

Muktagacha is under sub-tropical and sub-humid monsoon climatic conditions. Annual rainfall of this sub-district is about 2,153 mm; the annual average temperature is about 25.7°C. In the month of January sometimes temperatures fall down up to 10.8°C despite it sometimes raises up to 42.2 °C in the month of April & May (BBS, 2013).

3.2 Sampling Procedures and Sampling Size

The sample for this study was drawn from all the farmers involved in hybrid rice seed production. Three stages random sampling procedure was used for the selection of sample household heads. In the first stage, Mymensingh district was selected purposely based on the potential of rice seed production. In the second stage, with the consultation of DAE (Department of Agricultural Extension), Muktagacha upazila and 3 potential unions belong to this upazila randomly selected. People who permanently reside in the selected union constituted the active population of the locality. The head of the farm families of Kumarghata, Kashimpur and Kheruajani unions of Muktagacha upazila under Mymensingh district were considered as the population of the study. However, representative samples from the population were taken for collection of data following random sampling technique. The head of the farm families was counted as the respondents of the study. Updated lists of all farm families who were involved in cultivating hybrid rice seed of the selected unions were prepared with the help of SAAO and respective local village leaders (Matobbor).

The total number of hybrid rice seed cultivators in these unions was 4323; whereas 1443, 1592 and 1288 farm family heads were listed from Kumarghata, Kashimpur and Kheruajani union of Muktagcha upazila respectively. Thus, 4323 number of

hybrid rice seed cultivators constituted the population size of the study which is shown in the following Table 3.1

According to the modified formula of Yamane (1967), the sample size was 120.03. Accordingly, the required sample size at 95% confidence level with degree of variability of 5% and level of precision equal to 9% are used to obtain a sample size required which represents a true population (Table 3.1).

$$n = \frac{N}{1+N(e^2)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(1)}$$

Where, n = sample size, N= population size (sampling frame) and e = level of precision considered 9%.

From the 120 elected households, 40 were selected from Kumarghata union, 44 were selected from Kashimpur union and 36 households belonged to Kheruajani union. There was no listed female seed producer in the selected unions of the study area. Hence a purposive male sampling method was used to select from specified markets.

Table 3.1: Sample distribution of hybrid rice producers in selected unions of Muktagacha upazila

No.	Union	Total number of seed producers (N)	Number of sampled households (n)	Distribution of sample size
1	Kumarghata	1443	120	40
2	Kashimpur	1592		44
3	Kheruajani	1288		36
Total		4323		120

* n was calculated from the total number of ‘N’, not from the ‘N’ separately for each union.

** The distribution of samples to each union was done randomly.

A reserve list of 12 rice cultivators (10% of the sample size) were also prepared so that this list could be used during the interview in case of any mislead, misconduct, mismatch or unavailability of the respondents counted on the original list.

3.3 Methods and Tools of Data Collection

Data were collected from primary and secondary sources. Primary data were collected from the sampled respondents of the study area through a structured questionnaire. Data revealed to respondent’s demographic such as household, land size, production, production methods, experience, buying and selling, pricing, input, determinants of production and market supply, problems encountered and variety of paddy and the yield.

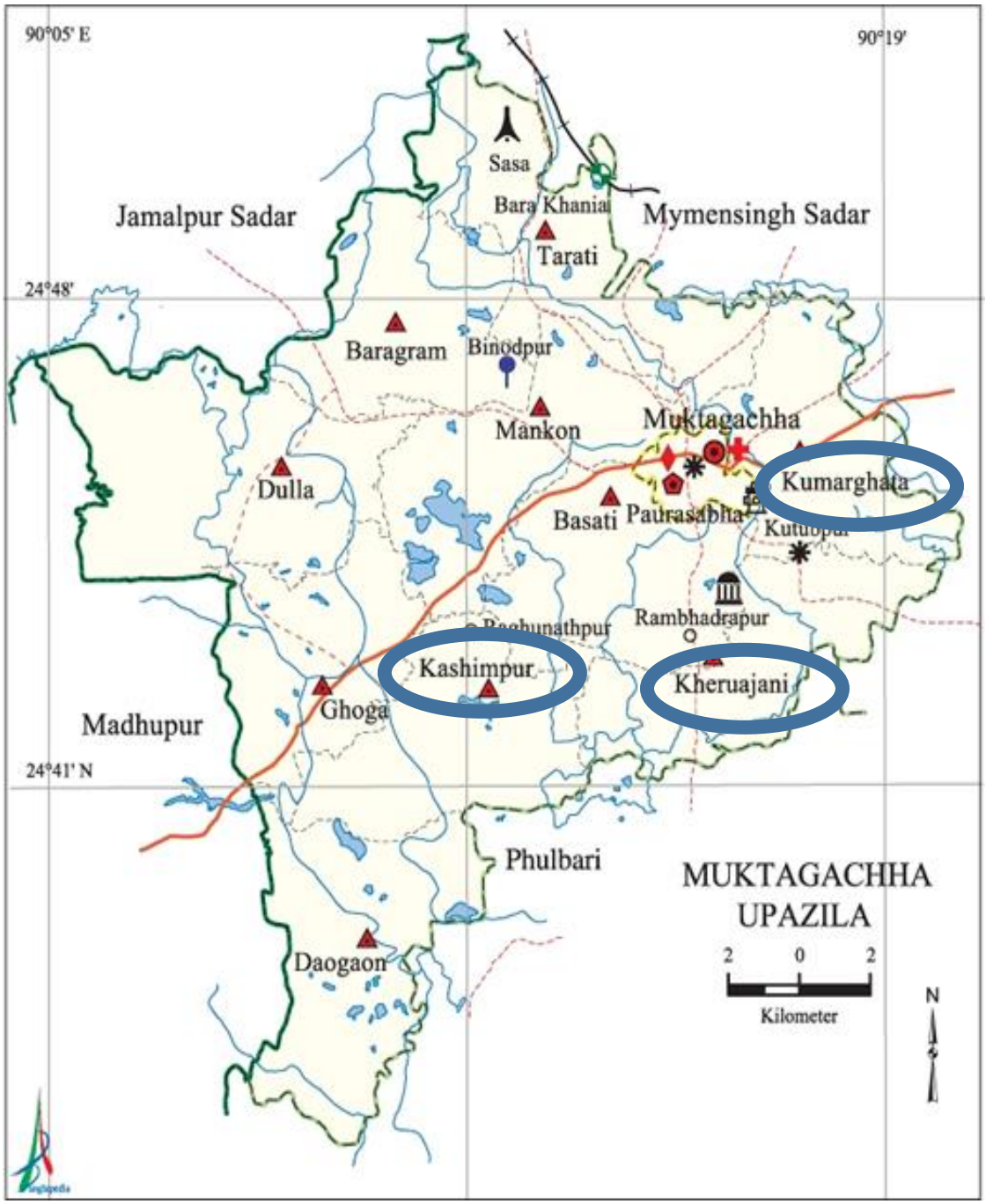


Figure 3.1: Geographical Map of Muktagacha, Mymensingh

3.3.1 Data Collection Method

The survey was used to collect quantitative data that allow to answer the framed research questions and to gain an understanding of the determinants of adoption of hybrid rice seed production technologies by farmers.

3.3.2 Data Collection Tools

A structured interview schedule was prepared to reach the objectives of the study containing mostly closed questions. 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 instrument was first developed in English and then translated into Bengali. The survey tool was initially constructed based on extensive literature reviews and pre-tested. The schedule was pretested with 15 randomly selected farmers in the study area in identifying faulty questions and statements. Thus, necessary additions, deletions, modifications and adjustments were made accordingly in the schedule. The questionnaires were also checked for validity by supervisors and other 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, NGOs and local leaders. The field data collection was started from 15 February and completed on 27 February, 2019.

3.4 Measurement of Variables

A variable is any characteristic, which can assume varying, or different values in successive individual cases (Ezekiel and Fox, 1959). An organized research usually contains at least two important variables, viz. an independent and a dependent variable. An independent variable is that factor which is maintained 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). According to the relevant research area, the researcher selected 13 characteristics of the farmers as the independent variable and adoption of hybrid rice seed production technologies as the dependent variable. It was pertinent to follow a methodological procedure for measuring the variables in order to conduct the study in accordance with the objectives already formulated. The procedures for measuring the variables are described below:

3.4.1 Measurement of independent variables

3.4.1.1 Age

The age of the respondents was measured in terms of years, on the basis of the responses of the respondents. Age was measured by the period of time from the birth of a respondent to the day of interviewing.

3.4.1.2 Education

Education of a respondent is measured in term of grades (classes) passed by are respondent. One score was assigned for one year of successful schooling. For example, if a respondent passed the final examination of class six, his education score was taken as '6'; if a respondent had education outside the school and if the level of education was through equivalent to that of class four of the school, then his education score was taken as '4' as the same way illiterate person was given a score zero. A score of 0.5 was assigned for those who don't read and write but can sign his name only.

3.4.1.3 Farm size

Farm size of a respondent was measured by the area being estimated in terms of full benefit to him. It was expressed in hectare and computed by using the following formula. $FS=A_1 + A_2+1/2(A_3+A_4) +A_5$

Where,

A_1=Homestead area

A_2= Own land under own cultivation

A_3= Own land given to others as borga

A_4= Land taken from others as borga

A_3= Land taken from others as lease

3.4.1.4 Land under hybrid rice seed production

Land under hybrid rice seed production of a respondent was measured in terms of area covered by hybrid rice seed production by the respondent. It was expressed in decimal.

3.4.1.5 Experience in rice farming

In a measuring score of one (1) was assigned for each year of working experience of a respondent either in his own farm or to that of his parents. This variable appears in item number 5a in the interview schedule as presented in Appendix-A.

3.4.1.6 Experience in hybrid rice seed production

In a measuring score of one (1) was assigned for each year of working experience of a respondent either in his own farm or to that of his parents. This variable appears in item number 5b in the interview schedule as presented in Appendix-A.

3.4.1.7 Family size

Family size was operationally measured by assigning a score of one for each member of the family who jointly lived and ate together. The members included the respondent himself, his wife, children and other dependent members.

3.4.1.8 Annual income from hybrid rice seed production

Annual income from hybrid rice seed production of a respondent was measured in thousands taka on the basis of total yearly earning of the respondent. For determining the annual income from hybrid rice seed production of the families from all the sources were added together. It was expressed in thousands taka.

3.4.1.9 Income before hybrid rice seed production

Income before hybrid rice seed production of a respondent was measured in thousands taka on the basis of total yearly earning of the respondents from hybrid rice seed production.

3.4.1.10 Income after hybrid rice seed production

Income after hybrid rice seed production of a respondent was measured in thousands taka on the basis of total yearly earning of the respondents from hybrid rice seed production.

3.4.1.11 Total production of hybrid rice seed in last cropping season

Total production of hybrid rice seed in last cropping season of a respondent was measured in M. Ton on the basis of total yearly production of the respondents in last cropping season.

3.4.1.12 Total production of BRRI dhan- 28/29/50 in last cropping season

Total production of BRRI dhan- 28/29/50 in last cropping season of a respondent was measured in M. Ton on the basis of total yearly production of the respondents in last cropping season.

3.4.1.13 Training on hybrid rice seed production technology

Training on hybrid rice seed production technology was determined by the total number of days a respondent received training in his/her entire life on hybrid rice

seed production technology from different organizations. In a measuring score of 1 was assigned for each days of training. This variable appears in item number 10 in the interview schedule as presented in Appendix-A.

3.4.1.14 Extension media contact

The extension media contact of a respondent was measured by computing an extension contact score on the basis of his extent of contact with 9 selected extension media. The respondents were asked to mention his response to four alternative nature of contact for each media. The score for each respondent was determined by adding his responses to all the items on the basis of his frequency of contact as not at all, rarely, occasionally, often and regularly with a score of 0, 1, 2, 3 and 4 respectively. Extension media contact score of the respondents could range from 0 to 36, where 0 indicating no extension contact and 36 indicating very high extension media contact.

3.4.1.15 Organizational participation

Organizational participation of respondents was measured on the basis of the nature of their participation in 5 selected organizations. Following scores were assigned for nature of participation:

Nature of participation	Scores assigned
No participation	0
Ordinary Member	1
Executive Member	2
Executive Officer (President, Secretary, Treasurer)	3

Finally, organizational participation score of a respondent was computed by adding all the scores obtained by him/her against all the selected organizations

3.4.1.16 Knowledge on hybrid rice seed production

Knowledge on hybrid rice seed production of the farmers referred to the knowledge gained by the respondent in hybrid rice seed production activities. A scale consisting of 10 questions was used to determine the hybrid rice seed production knowledge score of the respondents. The questions were selected from different dimensions of hybrid rice seed production after thorough consultation with the relevant experts and review of relevant literatures as shown in Appendix A. The score allotted for each question was 2. A respondent could get 2 marks against each question for correct response and 0 for wrong or no response and partial score was assigned for partially correct answer. Thus, hybrid rice seed production knowledge score of the respondents could range from 0 to 20, where 0 indicated very low knowledge on hybrid rice seed production and 20 indicated very high knowledge on hybrid rice seed production.

3.5 Measurement of Dependent Variable

Adoption of selected hybrid rice seed production technologies was the dependent variable of this study. It was measured on the basis of the extent of adoption of 8 selected hybrid rice seed production technologies by the farmers for three year.

For example, a farmer is using 8 hybrid rice seed production technologies with its cluster of technologies for the subsequent years 2016-17, 2017-18 and 2018-19 such as

a) Use of modern hybrid varieties
b) A- line /R- line transplanting
c) GA_3 application
d) Line transplanting
e) Roughing
f) Fertilizer management
g) Integrated pest management (IPM)/ Integrated Crop Management (ICM)

h) Postharvest management

In this case adoption can be measured in the following ways for a single technology.

Land uses	Year of the adoption			∑ l/L	X adoption
	2016-17	2017-18	2018-19		
Allocated area for production (l)	5	3	6	2.44	0.81
Potential area (L)	6	4	7		
Proportion of area coverage (l/L)	0.83	0.75	0.86		

Total adoption score of a respondent was found by adding one's adoption scores on seven aspects of adoption and then dividing by number of aspects. In this case the adoption score for single technology is 0.81. Adoption of multiple technologies is measured by the proportion of summation of mean area coverage (l) out of mean potential area (L) by the number of practices for particular time period; it is expresses in percentage resulting mean (X) area coverage. The formula calculating the adoption stands as Ray (1998);

$$\text{Adoption scores} = \frac{\sum X}{\text{No. of technologies}} x100$$

The adoption was expressed in percentage. The adoption of a hybrid rice seed production could range from 0 to 100, where '0' indicate no adoption and '100' indicate highest adoption.

3.6 Statement of Hypothesis

As defined by Goode and Hatt (1952), "A hypothesis is a proposition which can be put to a test to determine its validity. It was seemed to be contrary to, or in accord with common sense. It may prove to be correct or incorrect. In any event, however, it leads to an empirical test". A hypothesis simply means a mere assumption or some supposition to be proved or disproved. But for a researcher, hypothesis is a formal question that he intends to resolve. According to Kerlinger (1973), "A hypothesis is a conjectural statement of the relation between two or more variables. Hypothesis

is always in declarative sentence form, and they relate either generally or specifically variables to variables". Hypothesis may be broadly divided into two categories, namely, research hypothesis and null hypothesis. In studying relationships between variables, an investigator first formulates research hypothesis which states anticipated relationships between the variables. However, for statistical test it becomes necessary to formulate null hypothesis. A null hypothesis states that there is no relationship between concerned variables.

The null hypothesis was developed in this study to explore the relationships between dependent and independent variables. There are twelve independent variables and a single depended variable. The null hypotheses were formulated to explore the relationships between each of the characteristics of farmers and their adoption of selected rice seed production technologies. Twelve null hypotheses were developed in the following manner:

"There was no contribution of the farmers selected characteristics to their adoption of hybrid rice seed production technologies". The characteristics were: age, education, farm size, experience in rice farming, experience in hybrid rice seed production, family member, annual income from hybrid rice seed production, total production of hybrid rice seed in last cropping season, total production of BRRI dhan- 28/29/50 in last cropping season, training in hybrid rice seed production technology, extension media contact, organizational participation and knowledge on hybrid rice seed production. "There is no contribution to adoption of a hybrid rice seed production technologies and each of the independent variables of the study."

3.7 Data Processing and Analysis

3.7.1 Compilation of data

After completion of field survey, data from all the interview schedules were coded, compiled, tabulated and analysed in accordance with the objectives of the study. In this process, all responses in the interview schedule were given numerical coded values. Local units were converted into standard units and qualitative data were converted into quantitative data by assigning suitable scores whenever necessary. The responses of the questions in the interview schedule were transferred to a master sheet to facilitate tabulation.

3.7.2 Categorization of data

For describing the different characteristics and their use of technologies, the respondents were classified into several categories. These categories were developed by considering the nature of distribution of data, general understanding prevailing in the social system and possible observed scoring system. The procedure for categorization of data in respect of different variable is elaborately being discussed while describing those variables in Chapter IV.

3.8 Statistical Technique

The analysis was performed using SPSS (Statistical Package for Social Sciences) computer package. Descriptive analyses such as range, number, percentage, mean, standard deviation was used whenever possible. Linear model of regression (β) was used in the order to identifying contributory variables. Throughout the study, at least five percent (0.05) level of probability was used as basis of rejecting a null hypothesis. Co-efficient values significant at 0.05 level is indicated by one asterisk (*), and that at 0.01 level by two asterisks (**).

CHAPTER-IV
RESULTS AND DISCUSSION

In this Chapter the findings of the study and its interpretation are presented in four sections according to the objectives of the study. The first section deals with the selected characteristics for the farmers, while the second section deals with extent of adoption of hybrid rice seed production. The third section deals with the relationships between the selected characteristics of the farmers and their adoption of hybrid rice seed production.

4.1 Selected Characteristics of the Hybrid Rice Farmers

In this section the results of the farmers selected characteristics have been discussed. The salient feature of the respondents with their 16 selected characteristics has been presented in Table 4.1.

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

Categories	Measuring unit	Rang		Mean	S D
		possible	observed		
Age	Years	-	18-66	41.17	7.67
Education	Year of schooling	-	.00-18	7.75	4.27
Farm Size	Hectare	-	0.58-6.78	3.52	1.48
Land under hybrid rice seed production	Hectare		0.52-6.31	3.33	1.52
Experience in rice farming	Score	-	1-20	11.65	2.99
Experience in hybrid rice seed production	Score	-	1-12	7.05	2.75
Family member	Person	-	2-11	4.49	1.51
Annual income from hybrid rice seed production	(‘000’ tk)	-	122-1130	360.37	239.89
Income before hybrid rice seed production	(‘000’ tk)	-	56-260	125.54	35.25
Income after hybrid rice seed production	(‘000’ tk)	-	100-264	168.55	39.45

Total production of hybrid rice seed in last cropping season	Score	-	1.58-17.68	9.35	4.09
Total production of BRRI dhan 28/29/50 in last cropping season	Score	-	0-3.50	1.33	.62
Training in hybrid rice seed production technology	Days	-	1-11	4.28	2.25
Extension media contact	Score	0-36	9-35	26.70	5.04
Organizational participation	Score	-	0-23	12.10	8.69
Knowledge in hybrid rice seed production	Score	0-20	7-19	13.97	3.19

4.1.1 Age

The age score of the farmers ranged from 18 to 66 with an average of 41.17 and a standard deviation of 7.67. Considering the recorded age farmers were classified into three categories namely young, middle and old aged following (MoYS, 2012).

Table 4.2 Distribution of the farmers according to their age

Categories (years)	**Farmers**		Mean	S D
	Number	Percent		
Young aged (up to 35)	27	22.50	41.17	7.67
Middle aged (36-50)	82	68.33		
Old aged (above 50)	11	9.17		
Total	**120**	**100**		

Table 4.2 indicates that the majority (68.33 percent) of the respondents fell into the middle-aged category while 22.50 percent and 9.17 percent were found young and old aged categories respectively. The mean value (41.17) rightly indicates the reality.

4.1.2 Education

Educational qualification of the respondents had been categorized as done by Poddar (2015). Education of the farmers ranged from 0 to 18 years of schooling having an

average of 7.75 years with a standard deviation of 4.27. On the basis of their education, the respondents were classified into five categories as shown in Table 4.3.

Table 4.3 Distribution of the farmers according to their education

Categories	Farmers		Mean	SD
	Number	Percent		
Illiterate (0)	6	5.00	7.75	4.27
Can sign only (0.5)	2	1.67		
Primary education (1-5 class)	39	32.50		
Secondary education (6-10 class)	40	33.33		
Above secondary level	33	27.50		
Total	**120**	**100**		

Data contained in Table 4.3 indicates that the highest 33.33 percent of the farmers had secondary level of education. It was found that 32.50 percent had primary level of education, 27.50 percent had above secondary level of education, and 1.67 percent had can only sign category. Only 5.00 percent were illiterate (don't read and write).

4.1.3 Farm size

Land possession of the respondents varied from 0.58 to 6.78 hectare and the average being 3.52 hectare and standard deviation of 1.48. Depending on the land possession the respondents were classified into three categories according to DAE (1999) as appeared in table 4.4.

Table 4.4 Distribution of the farmers according to their farm size

Categories (hectare)	Farmers		Mean	SD
	Number	Percent		
Small land (up to 0-1 ha)	6	5.00	3.52	1.48
Medium land (1.01-3 ha)	39	32.50		
Large land (above 3 ha)	75	62.50		
Total	**120**	**100**		

Data contained in table 4.4 indicates the 62.50 percent of the farmers had large land while 32.50 percent of them had medium land and only 5.00 percent of them were small farm size.

4.1.4 Land under hybrid rice seed production

Land under hybrid rice seed production of the farmers varied from 0.52 to 6.31 hectare. The average land under hybrid rice seed production was 3.33 hectare with the standard deviation of 1.52. Based on land under hybrid rice seed production, the farmers are classified into three categories as shown in Table 4.5.

Table 4.5 Distribution of the farmers according to their land under hybrid rice seed production

Categories (ha)	**Farmers**		Mean	SD
	Number	Percent		
Small land (up to 0-1 ha)	8	6.67	3.33	1.52
Medium land (1.01-3 ha)	44	36.67		
Large land (above 3 ha)	68	56.66		
Total	**120**	**100**		

Data contained in Table 4.5 indicates that the largest proportion (56.66 percent) of farmers had large hybrid rice seed production land compared to 36.67 percent having medium and 6.67 percent had medium hybrid rice seed production land. It was again found that most (93.33 percent) of the farmers had medium to large hybrid rice seed production land.

4.1.5 Experience in rice farming

The experience score of the respondents ranged from 1 to 20. The mean score was 11.65 with the standard deviation 2.99. On the basis of experience, the respondents were classified into three categories namely, low experience, medium experience and high experience, as shown in Table 4.6.

Table 4.6 Distribution of the farmers according to their experience in rice farming

Categories (Scores)	Farmers		Mean	SD
	Number	Percent		
Low (up to 9)	28	23.33	11.65	2.99
Medium (10-13)	62	51.67		
High (above 13)	30	25.00		
Total	**120**	**100**		

Data contained in the Table 4.6 revealed that the majority (51.67 percent) of the farmers had medium experience as compared to (23.33 percent) and (25.00 percent) having low and high experience in rice farming respectively. The majority (76.67 percent) of the respondents had medium to high experience in rice production.

4.1.6 Experience in hybrid rice seed production

The experience score of the respondents ranged from 1 to 12. The mean score was 7.05 with the standard deviation 2.75. On the basis of experience, the respondents were classified into three categories namely, low experience, medium experience and high experience, as shown in Table 4.7.

Table 4.7 Distribution of the farmers according to their experience in hybrid rice seed production

Categories (Scores)	Farmers		Mean	SD
	Number	Percent		
Low (up to 5)	35	29.17	7.05	2.75
Medium (6-9)	64	53.33		
High (above 9)	21	17.50		
Total	**120**	**100**		

Data contained in the Table 4.7 revealed that the majority (53.33 percent) of the farmers had medium experience as compared to (29.17 percent) and (17.50 percent) having low and high experience in hybrid rice seed production respectively. The majority (82.83 percent) of the respondents had low to medium experience in hybrid rice seed production

4.1.7 Family size

To describe the family size of the respondents, the category has been followed as represented by Poddar (2015). Family size scores of the farmers ranged from 2 to 11 with an average of 4.49 and standard deviation of 1.51. According to family size, the respondents were classified into three categories (Mean±SD) as shown in Table 4.8.

Table 4.8 Distribution of the farmers according to their family size

Categories	Farmers		Mean	S D
	Number	Percent		
Small family (up to 3)	23	19.17	4.49	1.51
Medium family (4 -5)	76	63.33		
Large family (above 5)	21	17.50		
Total	**120**	**100**		

Data contained in Table 4.8 indicates that 63.33 percent of the farmers had medium family while 17.50 percent of them had large family and 19.17 percent of them had small family. Thus, about two third 80.83 percent of the farmers had medium to large family.

4.1.8 Annual income from hybrid rice seed production

The Annual income from hybrid rice seed production of the farmers ranged from Tk.122 thousand to Tk. 1130 thousand with an average of Tk. 360.37 thousand and standard deviation of 239.89 thousand. Based on the annual income, the farmers were divided into three categories (Mean±SD) as shown in Table 4.9.

Table 4.9 Distribution of the farmers according to their income from hybrid rice seed production

Categories ('000' Tk.)	Farmers		Mean	S D
	Number	Percent		
Low (up to 250)	56	46.67	360.37	239.89
Medium (251-400)	31	25.83		
High (above 400)	33	27.50		
Total	120	100		

From the Table 4.9 it was observed that the highest portion (46.67 percent) of the farmers had low income from hybrid rice seed production compared to 25.83 percent having medium and 27.50 percent had high income from hybrid rice seed production.

4.1.9 Income before hybrid rice seed production

The Income before hybrid rice seed production of the farmers ranged from Tk. 56 thousand to Tk. 260 thousand with an average of Tk. 125.54 thousand and standard deviation of 35.25 thousand. Based on the observed range, the farmers were divided into three categories as shown in Table 4.10.

Table 4.10 Distribution of the farmers according to their income before hybrid rice seed production

Categories ('000' Tk.)	Farmers		Mean	S D
	Number	Percent		
Low (up to 90)	24	20.00	125.54	35.25
Medium (91-160)	82	68.33		
High (above 160)	14	11.67		
Total	120	100		

From the Table 4.10 it was observed that the highest portion (68.33 percent) of the farmers had medium income before hybrid rice seed production compared to 20.00 percent having low and 11.67 percent had high income before hybrid rice seed production.

4.1.10 Income after hybrid rice seed production

The income after hybrid rice seed production of the farmers ranged from Tk. 100 thousand to Tk. 264 thousand with an average of Tk. 168.55 thousand and standard deviation of 39.45 thousand. Based on the observed range, the farmers were divided into three categories as shown in Table 4.11.

Table 4.11 Distribution of the farmers according to their income after hybrid rice seed production

Categories ('000' Tk.)	Farmers		Mean	S D
	Number	Percent		
Low (up to 129)	15	12.50	168.55	39.45
Medium (130-207)	80	66.67		
High (above 207)	25	20.83		
Total	120	100		

From the Table 4.11 it was observed that the highest portion (66.67 percent) of the farmers had medium income before hybrid rice seed production compared to 12.50 percent having low and 20.83 percent had high income before hybrid rice seed production.

4.1.11 Total production of hybrid rice seed in last cropping season

The score of total production of hybrid rice seed in last cropping season of the farmers ranged from 1.58 to 17.68, the mean being 9.35 and standard deviation of 4.09. Based on training exposure, the farmers were classified into three categories (Mean±SD) as shown in Table 4.12.

Table 4.12 Distribution of the farmers according to their total production of hybrid rice seed in last cropping season

Categories (scores)	Farmers		Mean	SD
	Number	Percent		
Low (upto 11)	74	61.67	13.14	2.70
Medium (12-15)	35	29.17		
High (above 15)	11	9.16		
Total	**120**	**100**		

Data contained in Table 4.12 indicates that the highest 61.67 percent of the farmers had low total production of hybrid rice seed in last cropping season; while 29.17 percent of the farmers had medium total production of hybrid rice seed in last

cropping season and 9.16 percent had high total production of hybrid rice seed in last cropping season. Thus, about 90.84 percent of farmers had low to medium total production of hybrid rice seed in last cropping season.

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4.1.12 Total production of BRRI dhan 28/29/50 in last cropping season

The score of total production of BRRI dhan 28/29/50 in last cropping season of the farmers ranged from 1.58 to 17.68, the mean being 1.33 and standard deviation of 0.62. Based on training exposure, the farmers were classified into three categories (Mean±SD) as shown in Table 4.13.

Table 4.13 Distribution of the farmers according to their total production of BRRI dhan 28/29/50 in last cropping season

Categories (scores)	Farmers		Mean	SD
	Number	Percent		
Low (upto 1)	35	29.17	1.33	0.62
Medium (1.01-2)	70	58.33		
High (above 2)	15	12.50		
Total	**120**	**100**		

Data contained in Table 4.13 indicates that 58.33 percent of the farmers had medium total production of BRRI dhan 28/29/50 in last cropping season; while 29.17 percent of the farmers' low total production of BRRI dhan 28/29/50 in last cropping season and 12.50 percent had high total production of BRRI dhan 28/29/50 in last cropping season. Thus, about 87.50% of farmers had low to medium total production of BRRI dhan 28/29/50 in last cropping season.

4.1.13 Training on hybrid rice seed production technology

The score of training exposure of the farmers ranged from 1 to 11 days, the mean being 4.28 and standard deviation of 2.25. Based on observed range, the farmers were classified into three categories as shown in Table 4.14.

Table 4.14 Distribution of the farmers according to training on hybrid rice seed production technology

Categories (days)	Farmers		Mean	SD
	Number	Percent		
Low training (up to 2)	33	27.50	4.28	2.25
Medium training (3-6)	62	51.67		
High training (above 6)	25	20.83		
Total	**120**	**100**		

Data contained in Table 4.14 indicates that 51.67 percent of the farmers had medium training on hybrid rice seed production technology; while 27.50 percent of the farmer's low training on hybrid rice seed production technology and 20.83 percent had high training on hybrid rice seed production technology. Thus, about 78.17 percent of farmers had low to medium training on hybrid rice seed production technology.

4.1.14 Extension contact

The observed extension contact scores of the farmers ranged from 9-35 against the possible range of 0 to 36, the mean being 26.70 and standard deviation of 5.04. According to their observed ranged of extension contact scores, the farmers were classified into three categories (Mean±SD) as shown in Table 4.15.

Table 4.15 Distribution of the farmers according to extension contact

Categories	Farmers		Mean	SD
	Number	Percent		
Low (upto 21)	15	12.50	026.70	5.04
Medium (22-31)	75	62.50		
High (above 31)	30	25.00		
Total	**120**	**100**		

Similar result was observed Poddar (2015) where highest respondents were medium extension contact. Data presented in the Table 4.15 indicated that 62.50 percent of the

farmers had medium extension contact compared to having 12.50 percent low and 25.00 percent high extension contact. Findings again revealed that almost all (87.50 percent) of the farmers had medium to high extension contact.

4.1.15 Organizational participation

The score of organizational participation of the farmers ranged from 0 to 23, the mean being 12.10 and standard deviation of 8.69. Based on observed range, the farmers were classified into three categories as shown in Table 4.16.

Table 4.16 Distribution of the farmers according to organizational participation

Categories (Scores)	Farmers		Mean	SD
	Number	Percent		
No participation (0)	17	14.17	12.10	8.69
Low participation (1-4)	21	17.50		
Medium participation (5-20)	45	37.50		
High participation (above 20)	37	30.83		
Total	**120**	**100**		

Information contained in Table 4.16 indicates that 37.50 percent of the farmers had medium participation; while 30.83 percent of the farmer's high organizational participation and 14.17 percent had no organizational participation and 17.50 percent of the farmers had low organizational participation. Thus, about 54.00 percent of farmers had low to medium organizational participation.

4.1.16 Knowledge on hybrid rice seed production technologies

Knowledge on hybrid rice seed production ranged from 7 to 19. The average was 13.97 with a standard deviation of 3.19. On the basis of their knowledge, the farmers were classified into the following three categories (Mean ±SD): "low knowledge" (up to13), "medium knowledge" (14-15) and "high knowledge" (above 15). Table 4.17 contains the distribution of the hybrid rice farmers according to their

knowledge.

Table 4.17 Distribution of farmers according to their knowledge on hybrid rice seed production technologies

Categories	Farmers		Mean	SD
	Number	Percent		
Low (up to 13)	53	44.17	14.50	1.90
Medium (14-15)	30	25.00		
High (>15)	37	30.83		
Total	**120**	**100**		

Table 4.17 showed that the majority of the 44.17 percent of the hybrid rice farmers had low knowledge compared to more different than 30.83 percent of them having high knowledge. The proportion of medium knowledge was 25.00 percent. Thus 55.83 percent of the farmers had medium to high knowledge on hybrid rice seed production technologies.

4.2 Adoption of Hybrid Rice Seed Production Technologies

Adoption of hybrid rice seed production technologies score of the respondents was found to be varying from 34.67 to 82.69 with an average of 58.19 and standard deviation of 12.12. Based on their score, the farmers were classified into three categories (Mean ±SD) as shown in Table 4.18.

Table 4.18 Distribution of the farmers according to their adoption of hybrid rice seed production

Categories	**Farmers**		**Mean**	**SD**
	Number	**Percent**		
Low adoption (up to 44)	10	8.33	53.86	9.15
Medium adoption (45-62)	60	50		
High adoption (above 62)	50	41.67		
Total	**120**	**100**		

Table 4.18 indicate that the majority (50 percent) of the farmers had medium adoption of hybrid rice seed production technologies that comprised by 41.67 percent and 8.33 percent farmers have high adoption and low adoption of hybrid rice seed production technologies. The majority (91.67 percent) of the respondents had medium to high adoption of hybrid rice seed production technologies.

4.3 Contribution of the Selected Characteristics of the Respondents to Their Adoption of Hybrid Rice Seed Production Technologies

In order to estimate the adoption of hybrid rice seed production technologies, the multiple regression analysis was used which is shown in the Table 4.19**.**

Table 4.19 Multiple regression coefficients of the contributing variables related to adoption of hybrid rice seed production technologies

Dependent variable	Independent Variable	β	P	R^2	Adj. R^2	F
Adoption of hybrid rice seed production technologies	Age	0.094	$.573^{NS}$	0.607	0.546	9.94
	Education	0.693	.009**			
	Farm Size	3.400	$.273^{NS}$			
	Land under hybrid rice seed production	0.222	$.910^{NS}$			
	Experience in rice farming	0.419	$.285^{NS}$			
	Experience in hybrid rice seed production	0.917	.006**			
	Family member	1.027	$.110^{NS}$			
	Annual income from hybrid rice seed production	.003	$.475^{NS}$			
	Income before hybrid rice seed production	-0.035	$.151^{NS}$			
	Income after hybrid rice seed production	0.029	$.179^{NS}$			
	Total production of hybrid rice seed in last cropping season	1.056	.026*			
	Total production of BRRI dhan 28/29/50 in last cropping season	0.426	$.746^{NS}$			

	Training in hybrid rice seed production technology	.858	.027*			
	Extension media contact	.326	.037*			
	Organizational participation	.225	.045*			
	Knowledge in hybrid rice seed production	.612	.049*			

** Significant at p<0.01; *Significant at p<0.05 and ^{NS}Not significant

Results presented in the Table 4.19 show that education, experience in hybrid rice seed production, total production of hybrid rice seed in last cropping season, training in hybrid rice seed production technology, extension media contact, organizational participation and knowledge in hybrid rice seed production of the respondents had significant positive contribution with their adoption of hybrid rice seed production technologies. Of these, education and experience in hybrid rice seed production were the most important contributing factors (significant at the 1% level of significant) and total production of hybrid rice seed in last cropping season, training in hybrid rice seed production technology, extension media contact, organizational participation and knowledge in hybrid rice seed production of the respondents were less important contributing factors (significant at 5% level of significant).Coefficients of other selected variables don't have any contribution on their adoption of hybrid rice seed production technologies.

The value of R^2 is a measure of how of the variability in the dependent variable is accounted by the independent variables. So, the value of $R^2 = 0.607$ means that independent variables account for 60.7% of the variation with their adoption of hybrid rice seed production technologies. The F ratio is 9.94 which is highly significant ($p<0$).

However, each predictor may explain some of the variance in respondents their

adoption of hybrid rice seed production technologies simply by chanced. The adjusted R^2 value penalizes the addition of extraneous predictors in the model, but value 0.546 is still show that variance is farmers their adoption of hybrid rice seed production technologies can be attributed to the predictor variables rather than by chanced (Table 4.19). In summary, the models suggest that the respective authority should be considers the farmers' experience in hybrid rice seed production, education, total production of hybrid rice seed in last cropping season, training in hybrid rice seed production technology, extension media contact, organizational participation and knowledge in hybrid rice seed production of the farmers in adoption of hybrid rice seed production technologies and in this connection some predictive importance has been discussed below:

4.3.1 Contribution of experience in hybrid rice seed production of the farmers to their adoption of hybrid rice seed production technologies

From the multiple regression, it was concluded that the contribution of experience in hybrid rice seed production to the farmers' adoption of hybrid rice seed production technologies was measured by the testing the following null hypothesis; "There is no contribution of experience in hybrid rice seed production to the farmers' on adoption of hybrid rice seed production technologies".

The following observations were made on the basis of the value of the concerned variable of the study under consideration.

a. The contribution of the experience in hybrid rice seed production was significant at 1% level (.006)
b. So, the null hypothesis could be rejected.
c. The direction between experience in hybrid rice seed production and adoption of hybrid rice seed production technologies was positive.

The β-value of experience in hybrid rice seed production is (0.917). So, it can be stated that as experience in hybrid rice seed production increased by one unit,

farmers' adoption of hybrid rice seed production technologies increased by 0.917 units.

Based on the above finding, it can be said that farmers' had more experience in hybrid rice seed production increased farmers' adoption of hybrid rice seed production technologies. So, experience in hybrid rice seed production has high significantly contributed to the farmers' adoption increased. Experience in hybrid rice seed production increase farmer's knowledge about various aspects which helps farmers make enough reduce their problem in hybrid rice seed production technologies.

4.3.2 Significant contribution of education of the farmers to their adoption of hybrid rice seed production technologies

The contribution of education of farmers to their adoption of hybrid rice seed production technologies was measured by the testing the following null hypothesis;

"There is no contribution of education of the farmers' to their adoption of hybrid rice seed production technologies".

The following observations were made on the basis of the value of the concerned variable of the study under consideration.

a. The contribution of the education was at 1% significance level (.009).
b. So, the null hypothesis could be rejected.
c. The direction between education and adoption was positive.

The β-value of level education is (0.693). So, it can be stated that as education increased by one unit, farmers' adoption of hybrid rice seed production technologies increased by 0.693 units.

Based on the above finding, it can be said that farmers' education increased the farmers' adoption of hybrid rice seed production technologies. So, education has significantly contributed to the farmers' adoption of hybrid rice seed production technologies. Education plays an important role to reduce problems in adoption of hybrid rice seed production technologies in many cases. Education enhances knowledge on many aspects such as training, participation, extension contact and so on.

4.3.3 Significant contribution of total production of hybrid rice seed in last cropping season to their adoption of hybrid rice seed production technologies

From the multiple regression, it was concluded that the contribution of Total production of hybrid rice seed in last cropping season to their adoption of hybrid rice seed production technologies was measured by the testing the following null hypothesis;

"There is no contribution of total production of hybrid rice seed in last cropping season to their adoption of hybrid rice seed production technologies".

The following observations were made on the basis of the value of the concerned variable of the study under consideration.

a. The contribution of the total production of hybrid rice seed in last cropping season was significant at 5% level (0.026)
b. So, the null hypothesis could be rejected.
c. The direction between training exposure and adoption was negatives.

The β-value of total production of hybrid rice seed in last cropping season was (1.056). So, it can be stated that as total production of hybrid rice seed in last cropping season increased by one unit, farmers' adoption of hybrid rice seed

production technologies increased by 1.056 units.

Based on the above finding, it can be said that farmers had higher total production of hybrid rice seed in last cropping season increased the adoption of hybrid rice seed production technologies. So, total production of hybrid rice seed in last cropping season has high significantly contributed to the farmers' adoption.

4.3.4 Significant contribution of training in hybrid rice seed production technology to their adoption of hybrid rice seed production technologies

From the multiple regression, it was concluded that the contribution of training in hybrid rice seed production technology to their adoption of hybrid rice seed production technologies was measured by the testing the following null hypothesis;

"There is no contribution of training in hybrid rice seed production technology to their adoption of hybrid rice seed production technologies".

The following observations were made on the basis of the value of the concerned variable of the study under consideration.

a. The contribution of the training was significant at 5% level (0.027)
b. So, the null hypothesis could be rejected.
c. The direction between training and adoption was positive.

The β-value of training in hybrid rice seed production technology was (0.858). So, it can be stated that as training in hybrid rice seed production technology increased by one unit, farmers' adoption of hybrid rice seed production technologies increased by 0.858 units.

Based on the above finding, it can be said that farmers had more training increased the adoption of hybrid rice seed production technologies. So, training has high

significantly contributed to the farmers' adoption. Training helps farmers to gather more knowledge on adoption of hybrid rice seed production technologies which ultimately helps farmers to reduce their problems in hybrid rice seed production technologies.

4.3.5 Significant contribution of extension contact to their adoption of hybrid rice seed production technologies

From the multiple regression, it was concluded that the contribution of extension contact to their adoption of hybrid rice seed production technologies was measured by the testing the following null hypothesis;

"There is no contribution of extension contact to their adoption of hybrid rice seed production technologies".

The following observations were made on the basis of the value of the concerned variable of the study under consideration.

a. The contribution of the extension contact was significant at 5%level (.037)
b. So, the null hypothesis could be rejected.
c. The direction between extension contact and adoption was positive.

The β-value of extension contact was (0.326). So, it can be stated that as extension contact increased by one unit, farmers' adoption of hybrid rice seed production technologies increased by 0.326 units.

Based on the above finding, it can be said that farmers had more extension contact increased farmers' adoption of hybrid rice seed production technologies. So, extension contact has high significantly contributed to the farmers' adoption of hybrid rice seed production technologies increased.

4.3.6 Contribution of organisational participation to their adoption of hybrid rice seed production technologies

From the multiple regression, it was concluded that the contribution of organizational participation to their adoption of hybrid rice seed production technologies was measured by the testing the following null hypothesis;

"There is no contribution of organizational participation to their adoption of hybrid rice seed production technologies".

The following observations were made on the basis of the value of the concerned variable of the study under consideration.

d. The contribution of the organizational participation was significant at 5% level (.045)
e. So, the null hypothesis could be rejected.
f. The direction between organizational participation and adoption of hybrid rice seed production technologies was positive.

The β-value of organisational participation is (0.225). So, it can be stated that as organizational participation increased by one unit, farmers' adoption of hybrid rice seed production technologies increased by 0.225 units.

Based on the above finding, it can be said that farmers had more organizational participation increased farmers' adoption of hybrid rice seed production technologies. So, Organizational participation has high significantly contributed to the farmers' adoption increased. Organizational participation increase farmer's knowledge about various aspects which helps farmers make enough reduce their problem in hybrid rice seed production technologies.

4.3.7 Significant contribution of knowledge in hybrid rice seed production to their adoption of hybrid rice seed production technologies

From the multiple regression, it was concluded that the contribution of knowledge in hybrid rice seed production to their adoption of hybrid rice seed production technologies was measured by the testing the following null hypothesis;

"There is no contribution of knowledge in hybrid rice seed production to their adoption of hybrid rice seed production technologies".

The following observations were made on the basis of the value of the concerned variable of the study under consideration.

a. The contribution of the knowledge in hybrid rice seed production was significant at 5% level (.049)

b. So, the null hypothesis could be rejected.

c. The direction between knowledge in hybrid rice seed production and adoption was positive.

The β-value of knowledge in hybrid rice seed production was (0.612). So, it can be stated that as knowledge in hybrid rice seed production increased by one unit, farmers' adoption of hybrid rice seed production technologies increased by 0.612 units.

Based on the above finding, it can be said that farmers had more knowledge in hybrid rice seed production increased farmers' adoption of hybrid rice seed production technologies. So, knowledge in hybrid rice seed production has high significantly contributed to the farmers' adoption of hybrid rice seed production technologies increased.

4.4 Comparison between before income and after income of hybrid rice seed production of farmers

The calculated "t" value was 39.012 which were significant at .000 levels. The result of 't' value supported to reject the null hypothesis and clearly indicated that improvement of income after hybrid rice seed production of farmers than before income of hybrid rice seed production.

Table 4.20 Results of t-test showing the mean of before and after income of hybrid rice seed production of farmers

Items	N	Mean	SD
Before income	120	125.54	35.25
After income	120	168.55	39.45

CHAPTER V
SUMMARY OF THE FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of the Findings

5.1.1 Individual characteristics of the farmers

Age

The age score of the farmers ranged from 18 to 66 with an average of 41.17 and a standard deviation of 7.67. The majority (68.33 percent) of the respondents fell into the middle-aged category while 22.50 percent and 9.17 percent were found young and old aged categories.

Education

Education of the farmers ranged from 0 to 18 years of schooling having an average of 7.75 years with a standard deviation of 4.27. The highest 33.33 percent of the farmers had secondary level of education. It was found that 32.50 percent had primary level of education, 27.50 percent had above secondary level of education, and 1.67 percent had can only sign category. Only 5.00 percent were illiterate (don't read and write).

Farm size

Land possession of the respondents varied from 0.58 to 6.78 hectare and the average being 3.52 hectare and standard deviation of 1.48. Majority of 62.50 percent of the farmers had large land while 32.50 percent of them had medium land and only 5.00 percent of them were small farm size.

Land under hybrid rice seed production

Land under hybrid rice seed production of the farmers varied from 0.52 to 6.31

hectare. The average land under hybrid rice seed production was 3.33 hectare with the standard deviation of 1.52. The largest proportion (56.66 percent) of farmers had large hybrid rice seed production land compared to 36.67 percent having medium and 6.67 percent had medium hybrid rice seed production land.

Experience in rice farming

The experience score of the respondents ranged from 1 to 20. The mean score was 11.65 with the standard deviation 2.99. The majority (51.67%) of the farmers had medium experience as compared to (23.33%) and (25.00%) having low and high experience in rice farming.

Experience in hybrid rice seed production

The experience score of the respondents ranged from 1 to 12. The mean score was 7.05 with the standard deviation 2.75. The majority (53.33%) of the farmers had medium experience as compared to (29.17%) and (17.50%) having low and high experience in hybrid rice seed production respectively.

Family size

The highest proportion (63.33%) of the farmers had medium family while 17.50 percent of them had large family and 19.17 percent of them had small family.

Annual income from hybrid rice seed production

The highest portion (46.67 percent) of the farmers had low income from hybrid rice seed production compared to 25.83 percent having medium and 27.50 percent had high income from hybrid rice seed production.

Income before hybrid rice seed production

The highest portion (68.33 percent) of the farmers had medium income before hybrid rice seed production compared to 20.00 percent having low and 11.67

percent had high income before hybrid rice seed production.

Income after hybrid rice seed production

The highest portion (66.67 percent) of the farmers had medium income before hybrid rice seed production compared to 12.50 percent having low and 20.83 percent had high income before hybrid rice seed production.

Total production of hybrid rice seed in last cropping season

The highest 61.67 percent of the farmers had low total production of hybrid rice seed in last cropping season; while 29.17 percent of the farmers' had medium total production of hybrid rice seed in last cropping season and 9.16 percent had high total production of hybrid rice seed in last cropping season.

Total production of BRRI dhan 28/29/50 in last cropping season

About 58.33 percent of the farmers had medium total production of BRRI dhan 28/29/50 in last cropping season; while 29.17 percent of the farmers' low total production of BRRI dhan 28/29/50 in last cropping season and 12.50 percent had high total production of BRRI dhan 28/29/50 in last cropping season.

Training on hybrid rice seed production technology

Majority 51.67 percent of the farmers had medium training on hybrid rice seed production technology; while 27.50 percent of the farmer's low training on hybrid rice seed production technology and 20.83 percent had high training on hybrid rice seed production technology.

Extension contact

About 62.50 percent of the farmers had medium extension contact compared to having 12.50 percent low and 25.00 percent high extension contact.

Organizational participation

The score of organizational participation of the farmers ranged from 0 to 23, the mean being 12.10 and standard deviation of 8.69. The majority of the farmers 37.50 percent had medium participation; while 30.83 percent of the farmer's high organizational participation and 14.17 percent had no organizational participation and 17.50 % of the farmers had low organizational participation.

Knowledge on hybrid rice seed production technologies

Knowledge on hybrid rice seed production ranged from 7 to 19. The average was 13.97 with a standard deviation of 3.19. The majority of the 44.17 percent of the hybrid rice farmers had "low knowledge" compared to more different than 30.83 percent of them having "high knowledge". The proportion of "medium knowledge" was 25.00 percent.

5.1.2 Adoption of hybrid rice seed production technologies

Adoption of hybrid rice seed production technologies score of the respondents was found to be varying from 34.67 to 82.69 against the possible score ranged of 0 to 30 with an average of 58.19 and standard deviation of 12.12. The majority (50%) of the farmers had medium adoption of hybrid rice seed production technologies that comprised by 41.67 percent and 8 .33 percent farmers have high adoption and low adoption of hybrid rice seed production technologies.

5.1.3 Contribution of the selected characteristics of the farmers to their adoption of hybrid rice seed production technologies

Among sixteen selected characteristics of the farmers seven characteristics namely, education, experience in hybrid rice seed production, total production of hybrid rice seed in last cropping season, training in hybrid rice seed production technology, extension media contact, organizational participation and knowledge in hybrid rice seed production of the respondents had significant positive contribution with their adoption of hybrid rice seed production technologies. and the rest nine characteristics namely, age, farm size, land under hybrid rice seed production, experience in rice farming, family size, annual income from hybrid rice seed production, income before hybrid rice seed production, income after hybrid rice seed production and total production of BRRI dhan 28/29/50 in last cropping season had no significant contribution with their adoption of hybrid rice seed production technologies.

5.2 Conclusions

Following conclusions were drawn on the basis of findings, logical interpretation and other relevant facts of the study:

1. Among the farmers, the highest proportion (50 percent) belonged to the medium group of adoption compared to 41.67 percent and 8.33 percent in high and low adoption of hybrid rice seed production technologies. Therefore, it may be concluded that there is scope to increase the extant of adoption of hybrid rice seed production technologies by the farmers.
2. About 6.67 percent of the farmers was illiterate. There existed a positive significant contribution with their adoption of hybrid rice seed production technologies. Therefore, it may be concluded that an appreciable proportion of the farmers will not continue to face problems in adoption of hybrid rice seed production technologies, if suitable steps are taken to remove illiteracy

from the farmers.

3. Almost 75 percent of the farmers had low to medium extension media contact. Findings expressed that extension media contact of the farmers had significant positive contribution with their adoption of hybrid rice seed production technologies. So, it may be concluded that if the farmer come in more contact of extension provider, electronics, and printed media, they will face less problems in adoption of hybrid rice seed production technologies.

4. Most of the farmers (79.17 percent) had low training to medium training. Findings expressed that training exposure of the farmers had significant positive contribution with their adoption of hybrid rice seed production technologies. So, it may be concluded that the farmers having higher training exposure might be interested to adopt hybrid rice seed production technologies more.

5. Organizational participation of the farmers had positive significant contribution to adoption of hybrid rice seed production technologies by the farmers in Mymenshing district. It is therefore, concluded that if the organizational participation increases the adoption of hybrid rice seed production technologies.

6. Farmer's knowledge on hybrid rice seed production technologies had significant contribution to the adoption of hybrid rice seed production technologies in the study area. The majority (55.83%) of the farmers had medium to high knowledge on hybrid rice seed production technologies. It is therefore concluded that if the farmer's knowledge is increase, the adoption of hybrid rice seed production technologies will increase.

7. Experience in hybrid rice seed production of the growers showed positive significant contribution with their adoption of hybrid rice seed production technologies in the study area. About 82.50 percent of the hybrid rice seed growers had low to medium experience in hybrid rice seed production. This means the higher experience of the growers; the higher be their adoption hybrid rice seed production technologies.

8. Total production of hybrid rice seed in last cropping season of the growers showed positive significant contribution with their adoption of hybrid rice seed production technologies in the study area. About 90.84 percent of the hybrid rice seed growers had low to medium production. This means the higher production of the growers; the higher be their adoption hybrid rice seed production technologies.

5.3 Recommendations

Recommendations based on the findings and conclusions of the study have been presented below:

5.3.1 Recommendation for policy implication

1. The level of adoption of hybrid rice seed production technologies was encouraging. However, there is a need of efforts for even wide adoption of hybrid rice seed production technologies by the growers. So, it may be recommended that favorable initiated taken by the concerned authorities like DAE, BADC and other private providers may lead to more adoption of hybrid rice seed production technologies by farmers.

2. The findings of the study indicated that education had significant positive contribution with their adoption of hybrid rice seed production technologies. Therefore, it may be recommended that the concerned authorities should take the

special mass education program for the illiterate and low lettered farmers for solving their problems.

3. The findings extension media contact had a significant positive contribution with their adoption of hybrid rice seed production technologies. So, it may be recommended that the extension workers of the concerned authority should increase the contact with farmers personally and motivate them to be connected with electronic and printed media that can help them to exchange related information which will reduce their problems in adoption of hybrid rice seed production technologies.

4. The findings revealed that the training exposure had a significant positive contribution with their adoption of hybrid rice seed production technologies. So, it may be recommended that the concerned authority should increase training facilities to develop skills of the farmers technologically so that they can minimize their problems in adoption of hybrid rice seed production technologies.

5. The findings indicated that organizational participation had a positive significant contribution with their adoption of hybrid rice seed production technologies. Therefore, it may be recommended that the extension provider of concerned authority should select those farmers with priority that has more attraction, eagerness and attention toward new technologies of more yield and income so that they can overcome their problems in adoption of hybrid rice seed production technologies.

6. The experience in hybrid rice seed production of the growers had high significant positive contribution with their adoption of hybrid rice seed production technologies. It leads to the recommendation that extension service should provide adequate farm management advice to the growers for increasing their farming

experience. It is a fact that if experience were increased, growers' receptive capacity to adoption of hybrid rice seed production technologies will be increased and thereby production will be increased.

7. The knowledge on hybrid rice seed production technologies of the growers had significant positive contribution with their adoption of hybrid rice seed production technologies. It is a fact that if knowledge on hybrid rice seed production technologies will increased, growers' receptive capacity to adoption of hybrid rice seed production technologies will be increased and thereby production will be increased.

8. The total production of hybrid rice seed in last cropping season of the growers had significant positive contribution with their adoption of hybrid rice seed production technologies. It is a fact that if total production of hybrid rice seed in last cropping season will increased, growers' receptive capacity to adoption of hybrid rice seed production technologies will be increased and thereby production will be increased.

5.3.2 Recommendations for further study

1. The study was conducted on the farmers of only one selected area of Muktagacha upazila under Mymenshing district. Finding of the study need verification by similar research in other areas of the country including areas where adoption of hybrid rice seed production is yet to get popularity.

2. Contributions of sixteen characteristics of farmers with their adoption of hybrid rice seed production technologies have been investigated in this study. Further research should be conducted to find out contribution of the other personal characteristics of the farmers with their others problems.

3. In addition to adoption of hybrid rice seed production technologies, those might have other factors relative to their social, economic, housing, sanitation, nutrition and domestic etc. Therefore, it may be recommended that research should be conducted relation to other factors of the farmers.

4. Research should also be undertaken to identify the factors causing hindrance towards the adoption of hybrid rice seed production technologies. Further research should be taken related to other issues like inter cropping, other crops adoption etc.

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APPENDICES

Appendix -A

English version of the Interview Schedule
Department of Agricultural Extension & Information System
Sher-e-Bangla Agricultural University
Dhaka – 1207

Interview Schedule for data collection for the Research on
"ADOPTION OF HYBRID RICE SEED PRODUCTION TECHNOLOGIES BY THE FARMERS OF MUKTAGACHA UPAZILA"

(This interview schedule is entitled for a research. Collected data will only be used for research purpose and will be published aggregately)

Serial No.…….
Name of the respondent ……..
Village …….Union ……
Upazila ……District ……..

1. Age: What is your present age? …… Years.
2. Education:

a) Cannot read and write …….. b) Can sign only…….
c) I read up to class …….

3. Farm size: Please indicate area of your lands according to the following items

Sl. No.	Use of land	Measuring unit	
		Local unit	Hectare
1	Homestead area (A_1)		
2	Own land under own cultivation (A_2)		
3	Land taken from others on borga system (A_3)		
4	Land given to others on borga system (A_4)		
5	Land taken from others on lease (A_5)		
Total farm size = $A_1+A_2+1/2(A_3+A_4)+A_5$			

4. Land under hybrid rice seed production ……. Ha.
5. a) Experience in rice farming …… Years

b) Experience in hybrid rice seed production ……. Years.

6. How many members in your family? a) Male ……b) Female …….
   c) Children …….d) Total …….
7. a) Annual income from hybrid rice seed production …… (Thousand taka.)

b) Income before hybrid rice seed production …… (Thousand taka.)
c) Income after hybrid rice seed production …….. (Thousand taka.)

8. Total production of hybrid rice seed in last cropping season …….. (M. Ton)

9. Total production of BRRI dhan 28/29/50 in last cropping season …… (M. Ton)

10. Training in hybrid rice seed production technology (Have you participated in any professional training program regarding hybrid rice seed production? Yes /No, If yes furnish the following information:

Sl. No.	Name of the training	Sponsoring Organization	No. of Days
1			
2			
3			
4			
5			

11. Extension media contact: Please indicate the extend of your contact with the following information sources for Hybrid rice production technologies:

Sl. No.	Sources	Not at all (0)	Extent of Contact			
			Rarely (1)	Occasionally (2)/	Often (3)	Regularly (4)
1	Peer farmers /Neighbors		1 time /month	2-3 times /month	4 - 5 times /month	More than 5 times /month
2	SAAO		1 time /month	2-3 times /month	4 - 5 times /month	More than 5 times /month
3	AAEO/AEO		1-2 times /year	3-4 times /year	5- 6 times /year	More than 6 times /year
4	UAO		1-2 times /year	3-4 times /year	5- 6 times /year	More than 6 times /year
5	NGO workers		1 time /month	2-3 times /month	4 - 5 times /month	More than 5 times /month
6	Inputs dealers (Fertilizer, Pesticides, Irrigation)		1 time /month	2-3 times /month	4 - 5 times /month	More than 5 times /month
7	Farm Radio Program listening		1 time /month	2-3 times /month	4 - 5 times /month	More than 5 times /month

8	Farm TV program watching		1 time /month	2 - 3 times /month	4 - 5 times /month	More than 5 times /month
9	Agril. Info. Centre (eg. AISS, DISC)		1 time /month	2-3 times /month	4 - 5 times /month	More than 5 times /month

12. Organizational participation: Please mention the nature and duration of your participation in the following organizations.

Sl. No	Duration and Nature of participation				
	Name of the organizations	No participation	Ordinary Member	Executive Member	Executive Officer (President, Secretary, Treasurer)
1	NGO (eg. BRAC, PROSHIKA, ASA, Grameen Bank)				
2	IPM/ICM Club				
3	Farmers' Cooperative Society				
4	Youth Club				
5	Bazar Committee				

13. Knowledge in hybrid rice seed production: Please answer the following questions regarding hybrid rice seed production:

Sl. No.	Questions	Full marks (2)	Obtained Marks
Remembering			
1.	Mention the age of the seedlings of hybrid rice requires to transplant in main field?	2	
2.	What are the basic criteria for hybrid rice seed production?	2	
Understanding			
3.	Which type of land is suitable for hybrid rice seed production?	2	
4.	Why hybrid rice is more preferable than inbreed rice?	2	
Appling			
5.	Describe the transplanting method for hybrid rice?	2	

6.	Describe the management of hybrid rice production?	2	
Analyzing.			
7.	How management of hybrid rice production is different from traditional rice seed production?	2	
8.	Tell at least to differences between the characteristics of hybrid seed and inbred seed.	2	
Evaluating.			
9.	What is the negative effect of hybrid rice compare to inbred rice?	2	
10.	How does hybrid rice seed production impact on local economy?	2	
Total Score			

14. Adoption of Hybrid rice seed production technologies: Please give information about the use of following of hybrid rice seed production technologies:

Sl. No	Technologies	Potential Area (L)	Allocated Area (L)	Years of the adoption		
				2016-17	2017-18	2018-19
1	Use of modern high yielding varieties					
2	A- line /R- line transplanting					
3	Gibberellin Acetic Acid (GA_3) application					
4	Line transplanting					
5	Roughing					
6	Fertilizer Management					
7	IPM/ICM					
8	Postharvest management					

$$\text{Adoption scores} = \frac{\sum x}{\text{No. of technologies}} \times 100$$