ADOPTION AND PROFITABILITY OF MODERN BORO RICE CULTIVATION IN SOME SELECTED AREAS OF JAMALPUR DISTRICT

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CERTIFICATE

This is to certify that the thesis entitled " ***ADOPTION AND PROFITABILITY OF MODERN BORO RICE CULTIVATION IN SOME SELECTED AREAS OF JAMALPUR DISTRICT****" submitted to the Faculty of Agribusiness Management, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of* ***MASTER OF SCIENCE in DEVELOPMENT AND POVERTY STUDIES,*** *embodies the result of a piece of bona fide research work carried out by* **AZIDA AKTER**, *Registration No.* **12-05185** *under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.*

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

Dated: 28November, 2019 ***Dr.Bazlul Ameen Ahmad Mustafi***

Place: Dhaka, Bangladesh ***Supervisor***

DEDICATED TO

MY BELOVED
PARENTS

ABSTRACT

The population of Bangladesh is 168 million with a growing rate of 1.37 percent per annum and 76.61 percent of the population live in the rural areas and its population density is 1093 per sq. kilometres (BBS, 2019). It is Asia's 5th and world's 7lh most populous country. The per capita income is about S 1903 and its people have a life expectancy of 72 years (BBS, 2019).The present study was intended to measure the adoption and profitability of modern boro rice cultivation in some selected area of Jamalpur district in Bangladesh. Jamalpur district was selected for the study to calculate the profitability of Boro rice cultivation. The study was confined to randomly selected 60 Boro rice farmers. It revealed that Boro rice production is profitable to the farmers. The productivity of boro rice at farm level was 5951 kg/ha .Boro rice farmers received Tk.142825 as gross return per hectare and total cost was tk. 81954 per hectare. So the Benefit cost ratio (BCR) on cash cost basis is 1.74. Here variable cost is Tk.59004 per hectare. Functional analysis showed that cost of human labor, seed, and fertilizer had positive significant contribution to gross return of Boro rice cultivation. So there is a positive effect of key factors in the production process of year round boro rice cultivation. This study also identified some of the problems and constraints associated with modern boro rice farming. Farmer faces several types of problem from production period to harvesting period. Heavy rainfall, extreme temperature, lack of capital, high input price, shortage of quality seed, shortage of labor in pick period ,high wage rate and lack of capital were some acute problem that the farmer faces most.

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Azida Akter

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ABBREVIATIONS AND ACRONYMS

BRRI	: Bangladesh Rice Research Institute
BBS	: Bangladesh Bureau of Statistic
BCR	: Benefit Cost Ratio
BDT	: Bangladeshi Taka
BER	: Bangladesh Economic Review
DAE	: Department of Agricultural Extension
et al.	: and others (at elli)
GR	: Gross Return
gm	: Gram
ha	: Hectare
HIES	: Household Income and Expenditure Survey
HYV	: High Yielding Variety
IOC	: Interest on Operating Capital
kg	: Kilogram
MoP	: Muriate of Potash
mt	: Metric Ton
NGO	: Non Government Organization
t	: Ton
TC	: Total Cost
TFC	: Total Fixed Cost
Tk.	: Taka
TSP	: Triple Super Phosphate
TVC	: Total Variable Cost
US	: United States
USDA	: United States Department of Agriculture
$	: Dollar

CHAPTER I

INTRODUCTION

1.1 General background

Bangladesh is a developing country with an area of 1, 47,570 sq. kilometres. The major portions of the population live in the rural areas and two-third of her labour forces (40.15 percent) is engaged in agriculture (BBS, 2018). The economy of the country is mainly agrarian accounting for 13.60 percent of GDP (BBS-2019). So, Agriculture plays a vital role in employment, poverty alleviation, food security, standard of living and increase of earnings.

1.2 Importance of Rice in the Economy of Bangladesh

The population of Bangladesh is 168 million with a growing rate of 1.37 percent per annum and 76.61 percent of the population live in the rural areas and its population density is 1093 per sq. kilometres (BBS, 2019). It is Asia's 5th and world's 7th most populous country. The per capita income is about $1903 and its people have a life expectancy of 72 years (BBS, 2019).

Rice plays an important role in the economy of Bangladesh. The country is approaching near to the self-support in rice production still there is some shortage of food. The country imports 22.59 lakh tonnes of the food almost every year (BBS, 2018). At least for food security purpose the rice production should be

increased continuously. About 80% of the total cultivable land is covered with rice which is about 10.5 million hectare (BRRI Report,2018).

Quoted from (World atlas.com , 2017) stated that Bangladesh is the fourth largest rice producing country in the world, following China, India and Indonesia. Per capita consumption of rice is also higher in Bangladesh. In Bangladesh a person on an average uptake 150 kilo of milled rice annually. About 75% calorie comes from rice alone. This ratio is the highest in the world.

Table 1.1: Top rice producing countries

Rank	Country	Rice Produced (millions of hectares)
1	India	43.20
2	China	30.35
3	Indonesia	12.16
4	Bangladesh	12.00
5	Thailand	9.65
6	Vietnam	7.66
7	Myanmar	6.80
8	Philippines	4.50
9	Cambodia	2.90
10	Pakistan	2.85

Source:Worldatlas.com, 2017 (Lanessa cago, 2017)

Due to the introduction of seed-fertilizer-irrigation technologies in Bangladesh agriculture, food grains prodution has almost been double since independence. As a result some of districts which were usually food grains deficit, had been surplus in food grain production and this was possible only for MV rice production throughout the country.

1.3 Contribution of Boro rice to the total production in Bangladesh

There are three seasons of rice grown which are known as Aus, Aman and Boro. Boro is the most important and single crop in Bangladesh in respect of volume of production. Currently Boro occupies about 52 percent of total rice area and contributes 75 percent of total rice production in Bangladesh (BBS, 2019). Total area under Boro crop has been estimated (4.79 Million ha) in 2013-14 as compared to (4.76 Million ha) of the 2012-13. The harvested area has increased by 0.64 percent in the year 2013-14 (BBS, 2015). The growth rate of 27 years of boro rice production is 3.86%. The development of high- yielding modern grain varieties of rice which are highly responsive to inorganic fertilizers and insecticides, effective soil management and water control helped the country to meet the increasing requirement of food grain (Hayami and Ruttan, 1985)

Table 1.2:Production of Boro rice in Bangladesh

Year	Area (Million Hector)	Production (Million Metric ton)	Yield (Ton/hector)
1990-91	2.55	6.357	2.49
1991-92	2.64	6.804	2.58
1992-93	2.60	6.587	2.53
1993-94	2.58	6.772	2.62
1994-95	2.66	6.538	2.45
1995-96	2.75	7.221	2.62
1996-97	2.78	7.46	2.68
1997-98	2.89	8.137	2.82
1998-99	3.53	10.552	2.99
1999-00	3.65	11.027	3.02
2000-01	3.76	11.920	3.17
2001-02	3.77	11.766	3.12
2002-03	3.85	12.222	3.12
2003-04	3.95	12.837	3.25

2004-05	4.07		13.837	3.40
2005-06	4.07		13.975	3.44
2006-07	4.25		14.965	3.52
2007-08	4.61		17.762	3.85
2008-09	4.72		17.809	3.77
2009-10	4.78		18.341	3.84
2010-11	4.77		18.617	3.90
2011-12	4.81		18.759	3.89
2012-13	5.17		18.778	3.63
2013-14	4.79		19.007	3.97
2014-15	4.84		19.192	3.96
2015-16	4.77		18.937	3.97
2016-17	4.48		18.014	4.02
2017-18	4.86		19.576	4.03
Growth rate (%)		2.09	3.86	1.77

Source: BER, 2018

1.4 Justification of the study

In Bangladesh, the deficit of food grains is a chronic problem due to massive population pressure. So, to ensure adequate food supply, it is necessary to give thrust to increase food production using selected rice production practices. Agricultural intensification for minimizing food shortage and maximizing self-sufficiency in food production is possible only when adoption of selected rice production practices and their application skills create positive impact on the behaviour of ultimate users. Several research institutes have developed a good number of modern agricultural technologies but so far farmers have adopted a few of them. Technical, biological, environmental and socio-economic barriers are the main hindrances of technology transfer and adoption of selected rice production practices. Selected rice production practices must be simple, demand driven, locally available, economically feasible and socially acceptable to bring desirable changes in the attitude of the users for their adoption. At present per hectare yield

of local variety of rice in Bangladesh is very low but per hectare yield of MV is comparatively higher than that of local variety. MV is now available for increasing the adoption of selected rice production practices.

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

1.5 Specific objective of the study are:

1. To describe the socio-economic profile of the rice growers;

2. To assess the relative profitability of BRRI Dhan 28 and BRRI Dhan 29 rice varieties;

3. To determine the extent of adoption of modern rice varieties used by the farmers;

4. To explore the relationships between the selected characteristics of the farmer's and their extent of adoption of selected rice production practices.

5. To estimate the productivity of different resources used in MV boro rice cultivation and

6. To identify the constraints of adoption of modern rice varieties.

1.6 Organization of the Thesis

The thesis divided into five chapters. Chapter I provided the introduction and background of the study, total production of boro rice, justification of the study with objective. Chapter II deals with review the literature, following chapter III describes the methodology whereas the results and discussion are described in chapter IV, and the summery, conclusion and recommendations are contained in chapter V.

CHAPTER II

REVIEW OF LITERATURE

The purpose of this chapter is to provide a selective review of the past research works which are related to the present study. The available literature related to **"Adoption of Modern Rice Varieties of The Farming Household in Some Selected Areas of Jamalpur District."** However, relevant findings directly or indirectly related to this study are briefly described below:

Rahman (2000) conducted a study to determine the economics of Boro paddy production in Melandah Upazilla of Jamalpur district. The major findings of the study were that BR-29 was profitable enterprise from the view points of small medium and large farmers. Per hectare costs or BR-29 were calculated at Tk. 3295.54, Tk. 32485.63 and 33617.40 for small, medium and large farmers respectively. Per hectare Yield of BR- 29 were 6290 kg, 6600 kg and 6100 kg, respectively. In general human labor, power tiller, seedling, fertilizers, Irrigations and insecticides emerged as the very crucial contributors to increased income from BR- 29 Boro production.

Nantu(2000) The government of Bangladesh has given priority to the agriculture sector to increase the production of rice by giving subsidy to the farmers on different inputs such as fertilizer, irrigation etc. The future of rice production in Bangladesh depends very much on the awareness of its profitability and how efficiently the farmers are using their resources. The costs of production of Boro paddy per hectare were BDT 25547, BDT 25857.73, and BDT 27548.07 for small, medium and large farmers respectively. Per hectare yield of Boro paddy under different farm categories were 2875.85 kg, 3230.95kg and 3152.50 kg respectively.

The net returns per hectare were BDT 2075.09, BDT 4986.09 and BDT 2232.48 respectively. BRRI-29 was profitable enterprise from the viewpoints of small medium and large farmers. Per hectare costs or BRRI-29 were calculated at BDT 3295.54, BDT 32485.63 and 33617.40 for small, medium and large farmers respectively. Per hectare Yield of BR-29 were 6290 kg, 6600 kg and 6100 kg, respectively. In general human labor, power tiller, seedling, fertilizers, Irrigations and insecticides emerged as the very crucial contributors to increased income from BRRI-29 Boro production.

Das (2000) conducted a comparative analysis of HYV BRRI-29 and hybrid Alok paddy in Kalihati Upazila of Tangail District. He determined the costs, returns and relative profitability of HYV BRRI-29 and Alok paddy. In order to attain objectives, 66 farmers from 6 villages were selected as sample. Analysis of costs and returns showed that the total cost of BRRI-29 was Tk. 13206.75 and that for Alok varity was Tk. 13894.45. Again, return above full cost for BRRI-29 variety was found to be higher than Alok variety Tk. 6350.61 per acre. Therefore, production of BRRI-29 variety was found to be profitable compared to Alok variety.

Haider et al. (2001) studied **the adoption level of improved package for BRRI Dhan 29 rice cultivation in Gouripur upazila of Mymenshing district.** He found that the adoption level of farmers categories were 5 percent non adoption, 62 percent low adoption, 24.5 percent medium adopter and 8.5 percent high adopter. Vast majority (95 percent) of the farmer's adopted MV programme of BRRI Dhan 29 rice.

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 academic qualifications of the farmers had a significant and positive relationship with their adoption regarding Aalok 6201 hybrid rice.

Kashem (2001) observed that there was positive and significant relationship between the age of the marginal farmers with their adoption of Modern varieties of rice.

Hossain (2003) studied the extent **"Adoption of Modern Rice as BRRI Dhan 28 and other related aspect in Bhabakhali of Mymensingh district."** He observed that among the respondent farmers, 54 percent had high adoption of Modern rice and 46 percent had medium adoption of MV rice as BRRI Dhan 28. Adoption of MVs is expected to be highest on medium-high land, followed by high land and very low land. During Boro, MV adoption is highest on very low and medium-high land, because of the availability of surface water and groundwater irrigation. He concluded that education of the farmers had a significant and positive relationship with their adoption and modern Boro rice cultivation practices. He found that academic qualifications of the farmers had a significant and positive relationship with their adoption regarding BRRI Dhan 29. He also revealed that age of the farmers had a significant and positive relationship with their adoption of modern Boro rice cultivation practices.

Rahman (2003) revealed that about half 47 percent of the growers had medium adoption, 44 percent had low and 9 percent had high adoption of year-round. He found that there was strong positive relationship between attitude towards development and perceived adoption of selected technologies.

Asaduzzaman and Mandal (2003) studies on factors affecting the adoption of MV in Bangladesh have noted that socioeconomic factors, such as the predominance of small and marginal farmers and tenancy cultivation in the agrarian structure, did not impede the adoption of MV in Bangladesh. Adoption reduces production risk and increases income because of higher yields.

Rahman (2003) examined the profit efficiency among Bangladeshi rice farmers. Production inefficiency is usually analyzed by its three components—technical, allocative, and scale efficiency. In this study, we provide a direct measure of production efficiency of the Bangladeshi rice farmers using a stochastic profit frontier and inefficiency effects model. The data, which are for 1996, include seven predictable inputs and several other background factors affecting production of modern or high yielding varieties (HYVs) of rice spread across 21 villages in three agro-ecological regions of Bangladesh. The results show that there are high levels of inefficiency in modern rice cultivation. The mean level of profit efficiency is 77% suggesting that an estimated 23% of the profit is lost due to a amalgamation of technical, allocative and scale inefficiency in modern rice production. The efficiency differences are explained largely by infrastructure, soil fertility, experience, extension services, tenancy and share of non-agricultural income.

Khan et al. (2004) conducted research on productivity & resource use efficiency of Boro rice cultivation in some selected haor areas of Kishoreganj district. The authors showed that in the haor area Boro rice cultivation is profitable. Boro-Fallow-Fallow is the common land use pattern of the study area. The author also found that the technical efficiency of the study area was 87.27 %. Fertilizer and irrigation significantly increase the production level of Boro rice in the haor area.

Nikhade et al. (2005) observed in their study on adoption of improved practices of Boro cultivation that cent percent adopted improved varieties. As the adoption of modern varieties (MV) of rice is reaching a plateau, particularly for the irrigated ecosystem, an important issue is whether the research system will be able to sustain the growth of production.

Mustafi et.al (2006) conducted a study on**"**Adoption and Productivity Impact of Modern Rice Varieties in Bangladesh."The result of the study stated that during the first two decades of the green revolution the increase in yield came mostly from gradual replacement of the low-yielding traditional varieties (TVs) with the high-yielding modern ones. Farmers have been slow in replacing the old MVs. In the1990s, however, there has been an increase in yield in the season-specific MVs and an increase in profitability due to the spread of agricultural mechanization. A production function analysis shows higher technical efficiency in successive generations of MVs.

Karim and Mahboob (2006) studied the adoption of HYV rice in Kushtia union of Mymensingh district. They found that among the respondent rice farmers 74 percent adopted HYV rice cultivation and 26 percent farmers were non-adopters.

Hossain , Bose ,and Mustafi (2006) this finding is consistent with our hypothesis that cultivating an MV may reduce varietal diversity, since MVs contribute to reducing production risk because of their higher yields, improved resistance to pests and diseases, and better grain quality. Farmers value these traits, as demonstrated by the rapid diffusion of BR-28 and BR-29 (i.e., coverage of MVs in the dry boro season increased rapidly from 29 percent in the 1980s to 57 percent in the 1990s and reached 81 percent in 2000–2001.

Asadullah and Rahman (2009) through education, the adoption of technological innovations in agriculture significantly influences agricultural productivity in general and especially that of rice. Cultivating MVs reduces rice varietal diversity, as MV adoption reduces production risk and increases income because of higher yields.

F. Nargis and T.H Miah (2009) the costs items for producing MV *Boro* paddy, human labour was the vital one. Cost of irrigation was the second highest which is essential for MV *Boro*paddy production. The yield of MV *Boro* paddy was quite satisfactory in the study areas. Farmers earned a significant profit from MV *Boro* paddy. Specialized, experienced and educated farmers earned comparatively higher profit than those of other diversified, less experienced and lower educated farmers. Specialized farming, knowledge sharing and education of the farmers could be the ways of increased farm profit. In such way, the farmers earn a handsome amount which contributed around 29 per cent of total household income. *Boro* rice contributed 55 per cent of total rice production in 2004/05. So, increase of *Boro* rice production would be a significant possible way to remove food deficiency in the country.

Jabbar Alam (2013) this paper reviewed the farm level adoption rate and yield of modern rice varieties. This study used both primary and secondary data. The analysis shows that 46 percent of the total rice area were devoted to grow modern rice varieties in 2005. Among all MVs, BR 29 was predominant variety which covered 63.03 percent of the total MV area and gave the highest yield in Boro season.

N. Chhogyel and Y. Bajgai (2015) to increase rice productivity, interventions like vigorous promotion of modern varieties, providing increased access to irrigation water and farm mechanization, capacity development of farmers and extension

staff, and so on are pursued. Despite all the efforts and initiatives, technology adoption is still quite low and use of modern rice varieties needed a thorough review to reenergize and launch intensified rice development program in the major rice growing areas. The need of the hour is to have higher yielding varieties with resilience to biotic and abiotic stresses. The national rice variety adoption rate is 42% (Ghimiray, 2012) and it is imperative to assess the impacts of technology promotion drives initiated and implemented over the years. Since the promotion of modern varieties was the cornerstone of the development agenda, this article investigates the rate of adoption of modern rice varieties, an important impact of the various initiatives.

Islam *et al.*, (2017) studied on Evaluation of Boro Rice (Oryza sativa L.) Production in Less Irrigated Situation in Northern Region of Bangladesh. They found that About 20 to 60% higher grain yield was observed in different farmer's field with BRRI dhan48 over BRRI dhan28, which indicated that BRRI dhan48 is a potential rice variety during Boro season. BRRI dhan48 can be cultivated after Boro harvest or as Boro, Aus after potato harvest. The variety could also reduce the pressure on ground water utilization for rice cultivation during dry season.

CHAPTER III

METHODOLOGY OF THE STUDY

This chapter deals with the methodology used for collecting the obligatory information for the study. It also addresses the methodology through which the collected data were analyzed in order to realize the objective of the study. The design of research occupied for the present study has been described in the following section.

3.1 Selection of the study area

The Melandaha upazila of Jamalpur district was the local of this study. Melandaha upazila is located at 16.8 k.m. north of Jamalpur town and 82.3 k.m. north of Mymensingh district. Fifteen villages of Melandaha were selected as study area and those are Deflapara, Kangalkursha, Daudkura, Poragoli, Tonki, Tarakandi, Valuka, Dhalir vita, Ruknai, Khudiakanda, Durmut, Kulia, Sadipati, Sorulia, Jangalia. The study areas were mostly inhibited by a good number of Middle farmers.

3.2 Sampling technique and data collection procedure

There are different types of sampling techniques depending on the nature of population, objectives of the study and degree of accuracy desired. Data collection procedures are the activities involved in collecting the preferred data from the

sample. The desired data can be collected through the interview schedule, questionnaire and direct observation. The following sampling techniques and data collection procedures were followed for the present study.

3.2.1 Sampling technique

An up to date list of all farm family heads of the selected villages were prepared with the help of Agricultural Officer. Each village was randomly selected as representative sample by using random number. The total sample size of 60 farmers. In case, the individuals included in the original samples were available at the time of data collection.

3.2.2 Preparation of the interview schedule

In accordance to the objectives of the study, a preliminary interview schedule was designed for the farmers. It was then pre-tested to verify the relevance of the questions and the nature of responses of the farmers.

The interview schedule contained the following items:

- Socioeconomic characteristics of the growers.
- Cost and return of BRRI Dhan 28 and BRRI Dhan 29 rice varieties cultivation.
- Agronomic practices done in the rice plot.
- Problems and constraints of rice growers, and
- Suggestion with respect to the problems faced by the rice farmers

3.2.3 Study and survey period

The data were collected covering the Boro rice growing period, December to May 2018-2019.The survey was conducted for one month (10 June to 10 July, 2019).

3.2.4 Methods of data collection

Data were collected personally by the researcher himself by interviewing the sample of 60 MV rice growers with the help of an interview schedule. The researcher made all possible efforts to explain the purpose of the study to the farmers. Relationship was established with the farmers prior to interview and the objectives were clearly explanted by using local language as far as possible. As a result, the respondents did not hesitate to furnish proper responses to the questions and statements, which were collected during the period from June 10 to July 10, 2019.The researcher sought the help from the local leaders and Sub-Assistant Agricultural Officer for this purpose. Excellent co-operation was obtained from the respondents, the concerned local leaders and the Sub-Assistant Agricultural Officer.

3.2.5 Problems faced by the researcher in data collection

- The farmers did not keep record of their farm activities so the researcher had to depend on the memory of the farmers.
- Most of the farmers initially hesitate to answer the questions since the author is unknown to them.

- They were afraid of tax imposition , therefore they hesitated to provide sufficient information relating to their income, expenses and land holding.
- There are limitation of time & fund. Therefore necessary information was collected within the shortest possible time.
- Sometimes the respondents were not available at home which led two or three time used to conduct a single interview.

3.2.6 Problems faced by the farmers

Farmers in the study area might have faced various types of problems in the way of adopting high yielding varieties of rice cultivation. But the investigator gained an experience through personal contact regarding common problems faced by the respondents before collection of data.

3.3 Analytical technique

In this study, a statistical tool and technique was used to analyze the data specially analysis the Cob-Douglas production function. Besides, a descriptive tool and technique tabulation was also used in the study. Both tabular and functional methods of analysis were employed in this study. At first, the collected data were edited and summarized for analysis. The tabular method of analysis involved different descriptive statistics like mean, percentage, ratio, etc. Land use cost was calculated on the basis of per year lease value of land. Cob-Douglas production function analysis was used to estimate the productivity and resource use efficiency of Boro rice cultivation.

To determine the contribution of the most important variables in the production process, the following specification of the model was applied:

The cob-Douglas form of production function was used for analyzing productivity in boro rice cultivation.

The Cobb-Douglas function was specified as:

$Y=ax_1^{b1}\ x_2^{b2}\ x_3^{b3}\ x_4^{b4}\ x_5^{b5}\ e^u$

The function was linearized by transforming it in the following logarithmic form:

$\ln Y = a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + Ui$

Specification of the variables

Y = Gross yield per hectare yield in kilogram;

X_1 = Human labor (tk/ha);

X_2 = Seed (tk/ha);

X_3 = Cost of fertilizer (tk/ha);

X_4 = Power tiller (tk/ha);

X_5= Insecticide cost (Tk/ha);

a = Intercept; b_1, b_2 -------- b_5 coefficients of the respective variables to be estimated. Ui = Error term.

3.4. Processing and tabulation of data

The collected data were subsequently compiled, coded, edited, summarized and scrutinized carefully. The computer packages EXCEL was used for data entry, aggregation and analysis. MS word was used for the word processing.

3.5 Selection of the variables of the study

Before setting the variable of the study, the researcher herself visited the study area and talked to the farmers and she was able to observe the selected characteristics of the farmers (in the study area) which might have influence on the adoption of selected rice varieties. Based on this experience, review of literature, discussion with the relevant experts and academicians and also with the research supervisor, the researcher selected the dependent and independent variables. An independent variable is that factor which is manipulated by the researcher in his attempt to ascertain its relationship to an observed phenomenon. A dependent variable is that factor which appears, disappears or varies as the researcher introduces, removes or varies the independent variables. The dependent variable is often called ‘criterion or predicted variable’ whereas independent variable is called ‘treatment, experimental or antecedent variable’.

3.5.1 Independent variables

The Research Advisory Committee and the researcher selected ten characteristics of the farmers as independent variables of the study. These were age, education, farm size, annual family income, training received, cosmopoliteness, attitude

towards modern varieties rice cultivation, innovativeness communication behavior and knowledge on rice cultivation.

3.5.2 Dependent variable

A dependent variable is that factor which appears, disappears or varies as the experimenter introduces, removes or varies the independent variables. “Adoption of modem varieties rice by the farmers” was selected as dependent variable of the study.

3.6 Measurement of variables

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

3.6.1 Measurement of independent variables

The selected characteristics of the respondent growers constituted the independent variables of the study. To keep the research within the manageable sphere, ten independent variables were selected for the study. The procedures of measurement of the selected variables were as follows:

3.6.1.1 Age

The age of individual is one of the important factors pertaining to his personality make up which can play an important role in his adoption behaviour. The age of respondent growers was measured by counting the actual years from his birth to the time of interview on the basis of his statement. It was measured in terms of

actual years. No fraction of year was considered. A score of one (1) was assigned for each years of age. Age was placed in item no. 1 of the interview schedule.

3.6.1.2 Education

Education was measured in terms of grades of formal education (school/college) completed by an individual. It was expressed in terms of years of schooling. A score of one (1) was assigned for each year of schooling completed. For example, if the respondent passed the S.S.C. examination, his education score was given as 10, if passes the final examination of class Seven (VII), his education scores was given as 7. If the respondent did not know how to read and write, his education score was given as '0' (zero). A score of 0.5 (half) was given to that respondent who could sign his name only.

3.6.1.3 Farm size

Farm size of the respondent was measured as the size of his farm (including rice and others crops) on which he continued his farm practices during the period of study. Each respondent was asked to mention the homestead area, the land under his own cultivation, own and given to others on borga (share cropping) system, land taken from others on borga system, land given to others on lease system, land taken from others on lease system, own pond, own garden and miscellaneous fallow land. The area was estimated in terms of full benefit to the growers or his family. The following formula was used in measuring the farm size:

Farm size = Aj + A2 + Vi (A3 + A4) + A5

Where, Aj = Homestead area

A2 = Own land under own cultivation

A3 = Own land given to others on borga

A4 = Land taken from others on borga

A5 = Land taken from others on lease. The unit of measurement was hectare.

3.6.1.4 Annual family income

Annual family income refers to the total earnings in taka of the respondent and all family members of a farm family from agriculture, livestock, fisheries and other sources (service, business etc.) during the previous year. The methods of ascertaining income from different sources were involved three phases. In the first phase, the yield of all the crops in the previous year was noted. Then all the yields were converted into cash income according to the prevailing market price. In the second phase, the prices of other enterprises (livestock, poultry. fisheries etc.) were also added to the price of crops. In the third phase, earning of each respondent himself or other members of his family from different sources (like service, business, and labors) were also included in calculating the income. Yearly earning from farming and other sources were added together to obtain total family annual income of a respondent. In case of business or service their monthly income was multiplied by twelve to determine annual family income. Annual family income of an individual was expressed in 1,000 Taka. A score of one was given for each Tk. 1000 to compute the annual income scores of the respondents. Data obtained in response to item no. 5 of the interview schedule were used to determine the annual family income of the respondents.

3.6.1.5 Agricultural training

Agricultural training of the respondents was calculated by the number of days that a respondent had received agricultural training in his entire life. It was indicated by

the total number of days of receiving agricultural training by a respondent under different training programs.

3.6.1.6 Non- localite behaviour

Non- localite behaviour of a respondent was measured in terms of his nature of visits to the eight different places external to his own social system and as shown in item number 6 in the interview schedule. The respondents indicated whether they visited those places frequently, occasionally, rarely and never. Weights assigned to these visits were 3, 2, 1 and 0 respectively. A respondent's non- localite behaviour score was obtained by summing the weights for his visits to all the places 35 listed in the instrument. The non-localite behaviour score of the respondents could range from 0 to 24, where 0 indicating no non- localite behaviour and 24 indicating high non- localite behaviour.

3.6.1.7 Attitude towards modern varieties rice cultivation

An attitude may be defined as tendency to act towards an object in a certain manner. Attitude of a grower towards rice cultivation was used to refer to his belief, feelings and action towards the various aspects of rice cultivation. It was measured by constituting 10 statements (five positive and five negative). A statement was considered positive if it possessed an idea favourable towards the modern varieties rice cultivation. On the other hand, a statement was considered negative if it was unfavourable towards the modern varieties rice cultivation. The respondents were asked to express their opinion in the form of ‘strongly agree’, ‘agree’, ‘no opinion’, ‘disagree’ and ‘strongly disagree’. A score of 4 was given to ‘strongly agree’, 3 to ‘agree’, 2 to ‘no opinion’, 1 to ‘disagree’ and 0 to ‘strongly disagree’, if the statement was positive. A reverse scoring method was followed in case of statements considered negative. Attitude score of a respondent was

determined by summing the scores obtained by him for all the items in the scale. The index scores of respondents could range from 0 to 48 where 0 indicating unfavorable and 48 for favourable attitude towards rice cultivation.

3.7 Procedure for evaluating crop production costs

For any profitability analysis the cost incurred in various inputs need to be analyzed. There are two types of cost, variable and fixed cost. The variable costs are those which vary directly with the level of production. The fixed costs are those which are to be borne even when no production is carried out. The costs were calculated on the basis of prices prevailed in the study area during the period of study. The cost items were specified as follow:

3.7.1 Cost of labor inputs

Any effort of mind or body undergone partly or wholly with a view to some good other than the pleasure derived directly from it is called labor (Marshall 1936). So the cost, which was incurred by both human and animal labor in rice production, were précised as cost of labor input. It included:

- Cost of human labor
- Cost of animal labor

i) Human labor

In the traditional agriculture in Bangladesh human labor is one of the most important inputs. The costs which were paid for using human labor both in cash or kind were considered as human labor cost. Human labor was classified into two different categories namely, i) Family labor for which no cash payment was made ii) Hired labor for which the farmers were to make payment in cash. The cost of

family labor was estimated on the basis of principle of the opportunity cost. The existing wage rate was considered for computing the cost of labor hired. Labor requirement was calculated in terms of man-days, which generally considered 8 hours of working in a day.

ii) Cost of animal labor and power tiller

In Boro rice cultivation animal labor was mainly used for land preparation and in some cases for threshing. Animal pair day refers to an animal that works for 6 hours a day. Power tiller was used for only land preparation.

3.7.2 Cost of material inputs

The material inputs cost for Boro rice cultivation were specified as below:

i) Cost of seed

ii) Cost of fertilizer

iii) Cost of irrigation

iv) Cost of insecticides

v) Land use cost

vi) Interest on operating capital

i) Cost of seed

In the study area most of the rice growers used home supplied seeds/seedlings rather than from the market. The cost of home supplied seeds/ seedlings were

charged at the average market price. The cost of purchased seeds/ seedlings were deliberate in proportion to the payment made.

ii) Cost of fertilizer

The farmers used different types of fertilizer namely Urea, Triple super phosphate (TSP), Murate of potash (MOP), Gypsum. The cost of fertilizers were calculated on the basis of actual price paid by the farmers.

iii) Irrigation cost

Farmers were mainly used irrigation in their fields for Boro rice cultivation. If rainfall is not favour, irrigation cost would rise.

iv) Cost of insecticides

The farmers used different insecticides in producing Boro rice. The cost of insecticides were computed on the basis of actual cost incurred per hectare of land in producing Boro rice.

v) Land use cost

Value of land was found to be different for different plots, depending on the location, fertility and topography of the soil. Cost of land can be computed in different way. The following three ways are mostly used:

i) The rental value

ii) Interest on value of land, and

iii) Opportunity cost from the best alternative use.

v) Interest on operating capital

Interest on operating capital was computed taking into account all costs incurred for the production of different crops.

Hence interest was charged at the rate of 10% per annum and was estimated for 4 month interest on operating capital, and was calculated by the following formula:

Interest on operating capital =

(Operating capital* interest rate* time considered)

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CHAPTER IV

RESULT AND DISCUSSION

The result of the study and interpretations of the results have been presented in this Chapter. The first section deals with the selected characteristics of the respondents, while the second section deals with the adoption of selected MV rice. In the third section, the relationships between the degree of adoption of selected MV rice and the selected characteristics of farmers have been discussed. The final section deals with the problems faced by the farmers in adopting of selected MV rice.

4.1. Selected Characteristics of the Farmers (independent variables)

Four characteristics of the farmers were selected to find out their relationships with the adoption of selected MV rice. The selected characteristics included age, level of education, family size, farm size. These characteristics of the farmers are described in this section. The results on the selected characteristics of the presented in Table 4

Table 4.1 Relevant features of the respondents with their characteristics

Characteristics	Measuring units	Range	Categories	Farmers		Mean
				Number (N=60)	Percent	
Age	Actual years	27-67	Young aged up to 35	11	18.33%	45.9
			Middle aged 36-50	29	48.33%	
			Old >51	20	33.33%	
Level of education	Year of schooling	2-16	Primary(1-5)	15	25%	8.47
			Secondary(6-10)	29	48.33%	
			Above Secondary>11	16	26.67%	
Family size	Rated score	3-9	Small family up to 4	19	31.67 %	5.47
			Medium family(5-6)	25	41.67%	
			Large family (7&above)	16	26.66%	
Farm size	Actual (in ha)	0.12-0.81	Small up to 0.99	60	100%	0.41
			Medium(1-2.99)	0	0%	
			Large (3&above)	0	0%	

Source: Field Survey, 2019

4.1.1. Age

Age of the respondents ranged from 27 to 67 years, the average being 45.9 years. On the basis of age, the farmers were classified into three categories: Young aged

(up to 35), middle aged (36-50) and old aged (>51). Table 4.1 contains the distribution of the respondents according to their age.

Data presented in Table 4.1 indicated that the highest proportion (48.33 percent) of the respondents fell in the middle aged category compared to 18.33 percent young and 33.33 percent old aged category.

The findings designate that a large proportion of 48.33 percent of the farmers were middle aged. Young people are usually receptive to new ideas and things. They have a favourable attitude towards new ideas. However, the older farmers because of their longer farm experience might have valuable opinions in regard to adoption of selected MV rice cultivation.

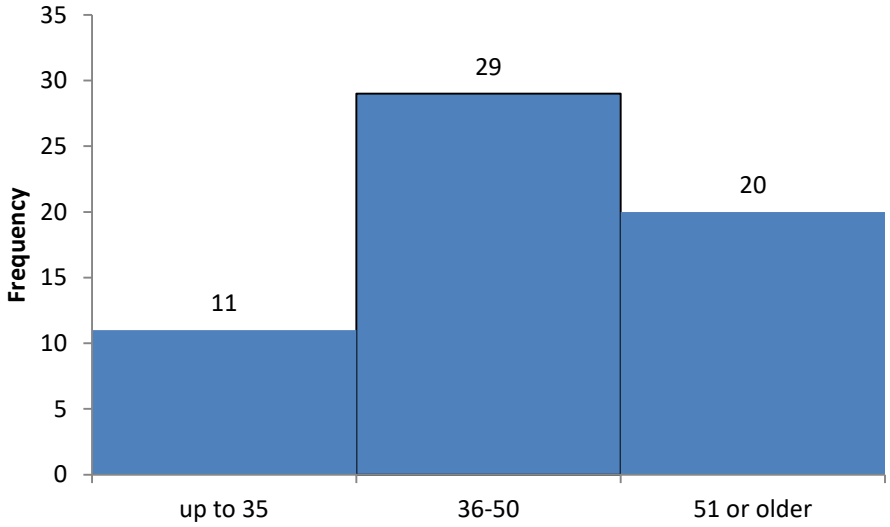

Figure 1: Participant age characteristics

4.1.2. Level of Education

Education of a respondent was measured by the level of his formal education i.e. highest grade (class) passed by him. The education score of the respondents ranged from 2 to 16, the average being 8.47. Based on their level of education, the respondents were grouped into three categories: primary education (1-5), Secondary education (6-10), and above secondary education (>11). Data presented in Table 4.1 indicate that a large proportion (48.33 percent) of the respondents fell under category of secondary education compared to 25 percent having primary education and 26.67 percent having above secondary education. As education can enlighten a family, it may contribute to the adoption of selected MV rice. The results indicate that education of an individual is likely to be more receptive to the modern facts and ideas, they have much mental force in deciding on a matter related to problem solving or adoption of technologies in their daily life. Thus, farming society in the area may be well considered as a suitable ground for the adoption of technologies, or execution of change programme whatever required.

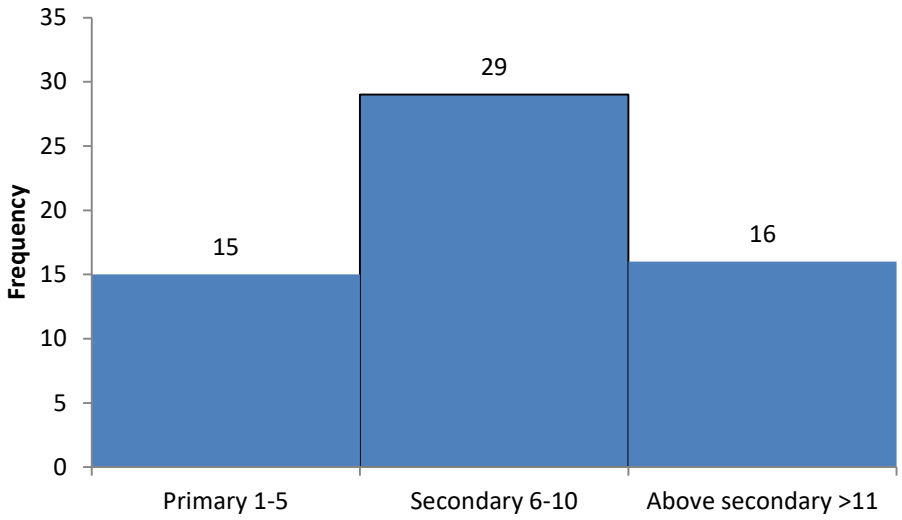

Figure 2: Participants Education Characteristics

4.1.3. Family size

The family size of the farmers ranged from 3 to 9in numbers with an average 5.47. On the basis of their family size, the farmers were classified into three categories, Small Family (up to 4), Medium Family (5-6) and Large (7 and above)

Data presented in Table 4.1 reveal that the highest proportion (41.67percent) of the farmers under number the medium family categories compared to 31.67 percent and 26.66 percent having small and medium family categories respectively. These findings indicate that more than 67 percent of the respondents had medium family size.

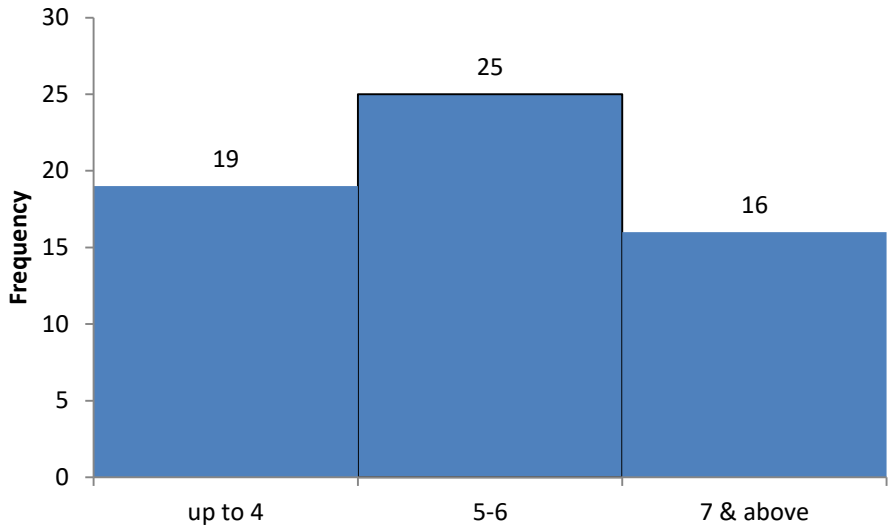

Figure 3: Participants family size characteristics

4.1.4. Farm size

The study farm size varied from 0.12 to 0.81 hectares. The average farm size was 0.41 hectares .The respondents were classified into three categories based on their farm size: small farm size (up to 0.99 ha) medium farm size (1-2.99 ha) and large farm size (3.00 and above). The distribution of the respondents according to their farm size is shown in Table 4.1.

Data presented in the Table 4.1 show that the highest proportion (100 percent) of the farmers had small farm compared to 0 percent had medium farm and 0 percent having large farm.

4.2. Adoption of MV rice

Table 4.2. Distribution of the respondents according to their adoption:

Name of varieties	Number of growers	Percentage
BRRI Dhan 28	22	36.67%
BRRI Dhan 29	38	63.33%

Source: Field Survey, 2019

The researcher studied with two MV rice varieties i.e. BRRI 28, and BRRI 29. In case of varieties BRRI Dhan-28 it was found that 36.67% farmers cultivated this variety. In case of BRRI Dhan-29 it was found that 63.33%farmers cultivated this variety.

Form the above discussion it was found most of the farmers (63.33 percent) adopted the variety BRRI Dhan-29.

4.3 Profitability of MV Boro paddy

Human labor cost was one of the most important and largest cost items in the production process of MV *Boro* paddy. It required for different farm operations like land preparation, transplanting, weeding, application of fertilizers and insecticides, supplying irrigation water, harvesting and carrying, cleaning, drying, storing, etc. Both human and hired labors were used to cultivate *Boro* paddy in the study areas. To produce one hectare of *Boro* paddy, 40 man-days hired labors and 13 man-days family labors were utilized. The average wage rate was Tk. 500per man-day, although it varied during different intercultural operation in the same irrigation season (Table 4.3). Farmers generally paid higher wages during transplanting and harvesting period. The marginal farmers, who produced *Boro* paddy in rented in land they mainly used family labor to cultivate their plots. But the rich farmers highly depended on hired labor.

Table 4.3 Per hectare cost of MV Boro paddy cultivation

Cost Items	Quantity	Unit Price (Tk)	Total cost (Tk)	Per cent of total cost
Human labor	53 man-days	500	26500	32.34
Power tiller	-	-	8450	10.31
Seedlings (kg)	166	30	4993	6.09
Urea (kg)	250	18	4500	5.49
TSP (kg)	138	22	3036	3.70
MP (kg)	80	15	1200	1.46
Gypsum (kg)	50	10	500	0.61
Irrigation	-	-	7625	9.30
Insecticide and herbicide	-	-	2200	2.68
Total variable cost	-	-	59004	72.06
Interest on OC	-	-	3126	3.81
Rental Value			19824	24.19
Gross cost	-	-	81954	100.00

Source: Field Survey, 2019

The use of power tiller for land preparation has currently been increasing rapidly in the study villages. Most of the farmers used hired power tiller. There was a competitive ploughing rate of power tiller in the study areas as a good number of PTs were rented to plough the crop fields. Average per hectare tillage cost was Tk. 8450 for two cross ploughings by power tiller (PT) at Tk. 40 per decimal per ploughing in Boro season.

Farmers used both home supplied and purchased seedlings. The average price of MV Boro seedling was Tk. 30.00 per kg. It was found that per hectare cost of MV Boro paddy seedlings was Tk. 4993 which constituted 6.09 per cent of total costs (Table 4.3). Most of the farmers mainly used three types of fertilizer namely Urea, Tripple Super Phosphate (TSP) and Murate of Potash (MP). The prices of fertilizers were Tk. 18.00 per kg for Urea, Tk. 22.00 per kg for TSP and Tk.15.00

per kg for MP. The farmers used 250 kg, 138 kg and 80 kg of Urea, TSP and MP, respectively, which represent 5.49, 3.70 and 1.46 per cent of total costs. Farmers had to use lower doses of fertilizer in the plots which were used for mustard cultivation just before Boro. Normally there has been a residual effect of fertilizer on the Boro rice as the farmers usually apply higher doses of fertilizer in mustard cultivation. The farmers generally did not apply any manure in their plots.

Irrigation was a leading input for MV Boro cultivation. The cost of irrigation water was charged at fixed rate per unit of area. In the study area, farmers paid their irrigation charge in two installments. One installment was paid before harvesting and another installment was paid after harvesting. Thus the per hectare water charge for irrigation water was Tk. 7625 for MV Boro cultivation which represent 9.30 per cent of total cost.

Only a few farmers used insecticides in producing MV *Boro* paddy in the study area. Almost all the selected farmers, who used insecticides for their MV *Boro* paddy, were not sure about the name, brand, quantity and or/per unit price of the insecticides. Sometimes, they even did not know which insecticides should be used. In the most cases they used insecticides as per suggestions of insecticide traders, neighboring farmers, friends and relatives. This cost includes the actual costs incurred by farmers for purchasing insecticides from the dealers or retailers. It was found that per hectare cost of insecticide and herbicide for farmers was Tk. 2200 respectively, which was 2.68 per cent of total costs. Major farmers in the study areas did not use any insecticide and herbicide in their plots and for this reason the cost of insecticide and herbicide was very low.

The price of land was different for different plots depending upon location and topography of the soil. Land use cost considered the land renting arrangement prevailed in the study areas. Interest on operating capital (OC) included all costs in the process of growing MV Boro paddy excluding which interest had already been charged. Interest on OC was estimated considering 10 per cent bank interest rate. The Interest on OC on an average was Tk. 3126 for MV Boro paddy production.

Table 4.4. Per hectare yield, cost and return of MV Boro paddy cultivation

Particulars	Yield (kg/ha)
Yield (main product/paddy) (kg/ha)	5951
Unit price (Tk/kg)	20.00
Value of main product (Tk/ha)	119020
Value of by product/Straw (Tk/ha)	23805
Gross returns (Tk/ha)	142825
Total variable cost (Tk/ha)	59004
Gross margin (Tk/ha)	80296
Total cost (Tk/ha)	81954
Net return (Tk/ha)	60871
Benefit Cost Ratio(BCR)	1.74

Source: Field Survey, 2019

Per hectare costs for producing MV Boro paddy was Tk. 81954. Per hectare yield of Boro rice was 5951 kg and average price of Boro rice at harvesting period was Tk. 20 per kg (Table 4.4). Per hectare gross margin of MV Boro paddy was Tk. 80296 and net returns was Tk. 60871 per hectare.

Table 4.5.Cobb-Douglas Regression Estimates for Boro Rice Production

Explanatory Variable	Co-efficient	Standard Error	t-value
Intercept	2.091	2.203	0.949
Power tiller cost (X1)	0.219*	0.139	1.585*
Quantity of seed (X2)	-0.039**	0.0181	-2.155**
Quantity of Fertilizer (X3)	0.026***	0.007	3.714***
Irrigation cost (X4)	-0.099**	0.042	-2.357**
Pesticide cost (X5)	0.870***	0.277	3.140***
R^2	0.74		
F value	10.82		

Source: Field Survey, 2019

Note: *** Significant at 1 percent level; ** Significant at 5 percent level;
* Significant at 10 percent level; and NS: Not Significant

Factors Affecting the Yield of Boro rice

Here an endeavor has been made to recognize and measure the effects of different factors on yield of Boro rice in the framework of production function analysis. Five explanatory variables were taken into consideration for production function analysis. The effects of each of the variables on the yield of Boro rice are interpreted below.

Effect of power tiller cost (X1):

From the table 4.5 it can be seen that the value of the coefficient was positive and significant at 10 percent level of significance. One percent level of significant indicates that the 1 percent increase in the cost of power tiller keeping others factor remaining constant would increase the return of Boro rice by 0.219 percent.

Effect of seed(X2):

From the table the value of coefficient of seed was negative and significant at 5 percent level of significance. One percent level of significant indicates that the 1 percent increase in the cost of seed keeping others factor remaining constant would decrease the return of Boro rice by 0.039 percent.

Effect of fertilizer (X3)

It was observed from the regression that the coefficient of the use of urea was positive and significant at 1 percent level of significance. One percent level of significant indicates that the 1 percent increase in the cost of urea keeping others factor remaining constant would increase the return of Boro rice by 0.026 percent.

Effect of irrigation cost (X4)

It was observed from the regression that the coefficient of the irrigation was negative and significant. One percent level of significant indicates that the one percent increase in the cost of irrigation keeping others factor remaining constant would decrease the return of Boro rice by 0.099 percent. Because use of excessive water in times of need.

Effect of pesticides (X5)

From the table it can be seen that the value of the coefficient was positive and significant at 1 percent level of significance. One percent level of significant indicates that the one percent increase in the cost of pesticides keeping others factor remaining constant would increase the return of Boro rice by 0.870 percent.

Value of R square

The multiple co-efficient of determination (R^2) is a summary measure which tells how the sample regression line fits with the data (Gujarati, 1995). In this table the value of R^2 was 0.74 that means the variables considered in the models can explain 74 percent of the variation in yield explained by independent variables include in the model.

Value of F

In the table the F value was found 10.82 which is significant at one percent level implying that the explanatory variables included in the model were important for explaining the variation in gross return of Boro rice production the variation of yield mainly depends on the explanatory variables include in the model.

4.6. Relationships between the Selected Characteristics of the Farmers and their Adoption of Selected MV rice

This section deals with the relationship between the selected characteristics of the farmers and their adoption of selected MV rice. The selected characteristics constituted independent variable and adoption of selected MV rice by the farmers constituted the dependent variable.

Pearson's product moment correlation co-efficient 'r' has been used to test the hypothesis concerning the relationships between two variables. Five percent and one percent level of significance was used as the basis of acceptance or rejection of a hypothesis. The summary of the results of the correlation co-efficient between the selected characteristics of the respondent farmers and their adoption of selected HYV rice is shown in Table 4.6

Table 4.6 Co-efficient of correlation of the selected characteristics of the respondents and their adoption of selected MV rice

Dependent variable	Independent variable	Computed value of 'r'	Table value of 'r' of 98 degrees of freedom 0.05	0.01
Adoption of Modern rice varieties	Age	0.237*	0.196	0.256
	Level of education	0.364**		
	Family Size	0.122^{NS}		
	Farm Size	-0.182^{NS}		

Source: Field Survey, 2019

NS=Not significant * = Significant at 0.05 level of probability ** = Significant at 0.01 level of probability

4.6.1. Relationship between age of the farmers and their adoption of selected MV rice

The relationship between age of the farmers and their adoption of selected MV rice was examined by testing the following null hypothesis:

"There is no relationship between age of the farmers and their adoption of selected MV rice."

The findings imply that the age of the farmers had significant relationship with their adoption of selected MV rice.

As show in the Table 4.6 the co-efficient of correlation between the concerned variables was computed and found to be 'r' = 0.237 which led to the following observation.

- Firstly, the relationship showed a positive trend.
- Secondly, a low relationship was found to exist between two variables.

 The computed value of ‘r’ (0.237) was greater than the table value (r = 0.196) with 98 degrees of freedom at 0.05 level of probability.
 Hence, the concerned null hypothesis was rejected.

It might be concluded that the age of the farmers was a vital factor for adoption of selected MV rice the modern technology has enough likely to increase farm productivity but it should be properly used in the farm. The age of the farmers is a factor for making favorable decision towards the adoption of MV rice. Usually the middle aged farmers are more interested to adopt MV rice because they have more risk taking ability than the old aged farmers. The present result although indicated a significant relationship between age and adoption of selected MV rice but in real situation the middle aged farmers are more receptive of MV rice than those of the old farmers.

4.6.2. Relationship between the education of the farmers and their adoption of Selected MV rice

The relationship between the education of the farmers and their adoption of selected MV rice was examined by testing the following null hypothesis:

“There is no relationship between education of the farmers and their adoption of selected MV rice.”

The co-efficient of correlation between the concerned variables was found to be ‘r’ = 0.364 as shown in Table 4.6. This led to the following observations regarding the relationship between the two variables under consideration:

 The relationship showed a tendency in the positive direction between the concern variables.
 The relationship between the concerned variables was low.
 The computed value of ‘r’ (0.364) was greater than the table value (r = 0.256) with 98 degrees of freedom at 0.01 level of probability.

 The concerned null hypothesis was rejected.

The findings indicate that the education of the farmers had a significant and positive relationship with their adoption of selected MV rice.

Education enables individuals to gain knowledge and thus increases their power of understandings. As a result, their outlook is broadened and perspective of knowledge is expanded. Thus adoption of selected MV rice may be higher among those farmers who had higher education.

4.6.3. Relationship between family size of the farmer's and their adoption selected MV rice

The relationship between family size of the farmer's size of the farmers and their adoption of MV rice was examined by testing the following null hypothesis.

"There is no relationship between the family size of the farmers and their adoption of selected MV rice."

The co-efficient of correlation between the concerned variables was found to be 'r'= (0.122) as shown in Table 4.6. This led to the following observations regarding the relationship between the two variables under consideration:

 The relationship showed a positive trend.

 A very low relationship was found between the two variables.

 The computer value of 'r' (0.122) was smaller than the tabulated value (r=0.196) with 98 degrees of freedom even at 0.05 level of probability.

On the basis of above findings, the null hypothesis could not be rejected. Hence, the researcher concluded that family size of the farmers had insignificant relationship with their adoption MV rice. Thus, it can be said that family size of the farmers was an important factor in gaining knowledge.

4.6.4. Relationship between farm size of the farmers and their adoption of selected MV rice

The relationship between farm size of the farmers and their adoption of selected MV rice was examined by testing the following null hypothesis:

"There is no relationship between farm size of the farmers and their adoption of selected MV rice."

Computed value of the co-efficient of correlation between farm size of the farmers and their adoption of selected MV rice was found to be 'r' = -0.182 as shown in Table 4.6.

The following observation were recorded regarding the relationship between the two variables on the basis of the co-efficient of correlation.

 The relationship showed a tendency in the negative direction between the concerned variables.

 A very low relationship was found between the two variables.

 The computed value of 'r' (-0.182) was found to be smaller than the table value (r = 0.196) with 98 degrees of freedom at 0.05 level of probability.

 The concerned null hypothesis could not be rejected.

The findings imply that the farm size of the farmers had a insignificant relationship with their adoption of selected `MV rice. The findings are quite rational because adoption of selected MV rice is relatively costly. Hence, large farmers get more scope than the small farmers because they can invest more money.

4.7 Reasons for adopting MV Rice

Though the improved varieties were seen to be gaining a strong traction in all the goers, the use of local varieties is going to continue for some time. However, going by the current level of crop promotion program and supply of seeds made to the farmers, the adoption rate for modern varieties is only going to increase. In the current project impact study, farmers' views on the modern varieties were sought and it was found that the reasons for adopting improved varieties were many. From the generalized perspective, the following were the major reasons provided by the farmers:

Table 4.7: Reasons for adopting MV Rice

Serial no	Reasons for adoption	Number of farmers N=60	percentage
1.	The local varieties are low yielding and they wanted to cultivate modern Varieties.	20	33.33%
2.	The local varieties are highly susceptible to diseases and pests and interested to cultivate both local and modern varieties.	16	26.67%
3.	The seeds of the modern varieties were made more freely than the local varieties, and	10	16.67%
4.	Technical advice from the extension agents to grow more of modern varieties citing many advantages over the local ones.	14	23.33%

Source: Field Survey, 2019

From table 4.7 the findings is 33.33 percent farmers are adopted MV rice because the local varieties are low yielding and they wanted to cultivate modern varieties, 26.67 percent farmers are adopted MV rice due to The local varieties are highly susceptible to diseases and pests and interested to cultivate both local and modern varieties, 16.67 percent farmers are adopted MV rice for The seeds of the modern varieties were made more freely than the local varieties, and 23.33 percent are adopted MV rice for Technical advice from the extension agents to grow more of modern varieties citing many advantages over the local ones.

4.8 Problem faced by the farmers in producing MV Rice

The MV rice growers were found to face different problem in producing rice. The main problems were high price of MV seeds, non-availability of MV seed in the market, lack of technical information, inadequate knowledge about MV rice cultivation, lack of government loan for MV rice cultivation, requires of high amount of fertilizer in HYV rice crops , high price of fertilizer, scarcity of fertilizer supply in time , inadequate irrigation in dry season , high price of irrigation cost .The nature and extent of these problems are discussed below (Table 4.8).

Table 4.8. Ranked order of the problems faced by the farmers in adopting selected MV rice

SI No	Problem	Farmers N=60			Rank
		High	Medium	Low	
1	High price of MV seeds	46	14	0	2
2	Non-availability of MV seed in the market	15	38	7	14
3	Lack of technical information	32	15	13	8
4	Inadequate knowledge about MV rice cultivation	36	17	7	7
5	Lack of government loan for MV rice cultivation	28	15	17	13
6	Requires of high amount of fertilizer in MV rice crops	48	8	4	3
7	High price of fertilizer	55	5	0	1
8	Scarcity of fertilizer supply in time	34	20	6	6
9	Lack of Integrated Pest Management (IPM) knowledge	40	15	5	5
10	Inadequate irrigation in dry season	26	31	3	9
11	High price of irrigation cost	42	16	2	4
12	Arsenic problem due to deep tube well irrigation	8	22	30	15
13	Lack of agricultural machineries and tools for MV rice cultivation	24	20	16	12
14	Lack of training in adoption of MV rice cultivation	30	20	10	10
15	Non-availability of printed materials about the cultivation of MV rice	30	15	15	11

Source: Field Survey, 2019

Data contained in (Table 4.8) indicate that ranked “High price of fertilizer” 1st. It is the crucial problem of the farmers. During MV rice cultivation in the field the market price of fertilizer is usually increased rapidly. This has become a usually

and typical event of fertilizer distribution and management programme of the country. Perhaps that is why farmers perceived this problem as topmost one.

The 2 ndcited problem of the farmers was “High price of MV seeds”. Now a days the MV seed are costly, the farmers due to the economic adversity can not effort MV seeds of all crops. They usually used to produce seed by their own capacity. Use of local varieties of seeds led to the low production. Probably due to this reason farmers faced problem in this respect.

The 3 rd problem of the farmers was “High amount of fertilizer requires in MV rice crops”. Farmers usually cultivate traditional variety, requires low amount of the fertilizer but whenever adopting modern variety requires high amount of fertilizers. Probably due to the reason farmers found problem in this respect.

The 4th problem of the farmers was “High price of irrigation water”. The irrigation cost is high because the fuel oil cost is high. In addition management of DTW (Deep Tube Well) and STW (Shallow Tube Well) is also high. So, it is a problem for the farmers hindering the adoption of MV rice cultivation. In addition the farmers in selling their goods do not get reasonable price. Probably due to this reason farmers faced problem in this respect.

The 5th of the farmers was “Lack of Integrated Pest Management (IPM) knowledge”. Farmers did not understand and realize IPM benefit cultivation. Probably due to this reason farmers faced problem in this respect.

The 6th problem was “Scarcity of fertilizers supply in time”. The farmers do not get fertilizer in time when they go for cultivation of MV rice. Fertilizer was not available at the village market due to lack of transport facilities. Probably due to the reason farmers faced problem in this respect.

The 7th problem of the farmers was “Inadequate knowledge about MV rice cultivation”. This problem arise due to their lack of illiteracy and unavailable training facilities.

The 8th problem of the farmers was “Lack of technical information”. Extension worker and development workers do not provide technical support or advice to the farmers.

The 9th Problem of the farmers was “inadequate irrigation in dry season”. Cultivation at MV rice requires adequate water supply specially in dry season. For scarcity at irrigation, farmers could not produce better yield. There were also not sufficient deep tube wells and available water in the river during dry season in the study area for supply of irrigation water to the field. Probably due to this reason farmers faced problem in this respect.

The 10th problem of the farmers was “Lack of training in adoption of MV rice cultivation”. There were no facilities for training and they could not know how to cultivate MV rice through modern method. Probably due to this reason rural farmers faced problem in this respect.

The 11th problem of the farmers was “non availability of printed materials about the cultivation of rice”. Farmers did not understand the technique of MV rice

cultivation due to lack of available printed materials. Probably due to this reason farmers faced problem in this respect.

The 12th problem of the farmers was "Lack of agricultural machineries and tools for MV rice cultivation". The farmers of the study area did not get agricultural machineries and tool timely. Probably due to this reason faced problem in this respect.

The 13th problem of the farmers was "Lack of Government loan for MV rice cultivation" by using modern rice cultivation technologies. The socio-economic conditions of the rice farmers were not good. They require incentives in adopting MV rice cultivation. In absence of government loan, the farmers face difficulties in adopting such cultivation.

The 14th problem of the farmers was "Non-availability of MV seed in the market". The farmers of the study area do not get MV seed during peak period of MV rice season. Probably due to this reason farmers faced problem in this respect.

The 15th problem of the farmers was "Arsenic problem due to deep tube-well irrigation". Water table of the study area was deeper that is why farmers faced Arsenic problem to the irrigation. Probably due to lack of sufficient water from other sources created this problem.

In order to have an overall understanding of the problems faced by the farmers, problem facing score was computed for each individual. The scores assigned to different responses of the respondents were 3 for "high problem", 2 for "medium problem" 1 for "low problem". Score obtained by an individual for their responses to all the 15 problem aspects were added together to obtained his problem facing score.

CHAPTER V
SUMMARY, CONCLUSION AND RECOMMENDATIONS

This chapter presents the summary of findings, conclusion and recommendations of the study.

The population of Bangladesh is 168 million with a growing rate of 1.37 percent per I annum and 76.61 percent of the population live in the rural areas and its population density is 1093 per sq. kilometres (BBS, 2019). It is Asia's 5th and world's 7lh most populous country. The per capita income is about S 1903 and its people have a life expectancy of 72 years (BBS, 2019).

Rice plays an important role in the economy of Bangladesh. The country is approaching near to the self-support in rice production still there is some shortage of food. The country imports 22.59 lakh tonnes of food almost every year (BBS, 2018). At least for food security purpose the rice production should be increased continuously. About 80% of the total cultivable land is covered with rice which is about 10.5 million hectare (BRRI Report, 2018).

Quoted from (World atlas.com, 2017) stated that Bangladesh is the fourth largest rice producing country in the world, following China, India and Indonesia. Per capita consumption of rice is also higher in Bangladesh. In Bangladesh a person on an average uptake 150 kilo of milled rice annually. People obtain 75% calorie from rice alone. This ratio is the highest in the world.

5.1 Summary of Findings

The major findings of the study are summarized below:

5.1.1.1 Age

The age scores of the farmers ranged from 27 to 67 years. The average age score was 45.9. The findings indicates that the highest proportion (48.33 percent) of the respondents fell in the middle aged category compared to 18.33 percent young and 33.33 percent old aged category.

5.1.1.2 Education

Education scores of the farmers ranged from 2 to 16. The average score was 8.47. The finding shows that a large proportion (48.33 percent) of the respondents fell under category of secondary education compared to 25 percent having primary education and 26.67 percent having above secondary education. As education can enlighten a family, it may contribute to the adoption of selected MV rice.

5.1.1.3. Family size

The family size of the farmers ranged from 3 to 9 in numbers with an average 5.47. The result shows that the highest proportion (41.67percent) of the farmers under number the medium family categories compared to 31.67 percent and 26.66 percent having small and medium family categories respectively. These findings indicate that more than 67 percent of the respondents had medium family size.

5.1.1.4. Farm size

The study farm size varied from 0.12 to 0.81 hectares. The average farm size was 0.41 hectares. The findings indicates that the highest proportion (100 percent) of the farmers had small farm compared to 0 percent had medium farm and 0 percent having large farm.

5.1.2. Adoption of MV rice

The researcher researched with two MV rice varieties i. e BRRI Dhan-28and BRRI Dhan-29. In case of varieties BRRI Dhan-28 it was found that 36.67% farmers cultivated this variety. In case of BRRI Dhan-29 we found that 63.33% farmers cultivated this variety.

5.1.3Relationships between the Selected Characteristics of the Farmers and their Adoption of Selected MV rice

To explore the relationship of the four selected characteristics of the farmers with their adoption of selected MV rice. Pearson's product moment co-efficient of correlation (r) was computed.

Correlation analysis indicates that age and level of education were found to have positive and significant relationship with their adoption of selected MV rice. Family size and farm size were found to have insignificant relationship with their adoption of selected MV rice.

5.2. CONCLUSION

Bangladesh is predominantly an agriculture based country. At present agricultural sector are largely dominated by the rice production. Rice is the staple food of Bangladesh and basically rice cultivation is the major source of livelihood of the people of Bangladesh. An attempt has been made in the study to examine the profitability and resource use efficiency of Boro rice producing farms. It may be concluded that Boro rice production is profitable. If modern inputs and production technology can be made available to farmers in time, yield and production will be increased which can help farmers to increase income and improve livelihood standards. It can help in improving the nutritional status of rural people.

Among the costs items for producing MV Boro paddy, human labour was the vital one. Cost of irrigation was the second highest which is essential for MV Boro paddy production. The yield of MV Boro paddy was quite satisfactory in the study areas. Farmers earned a significant profit from MV Boro paddy. Specialized, experienced and educated farmers earned comparatively higher profit than those of other diversified, less experienced and lower educated farmers. Specialized farming, knowledge sharing and education of the farmers could be the ways of increased farm profit. In such way, the farmers earn a handsome amount which contributed around 29 per cent of total household income. Boro rice contributed 55 per cent of total rice production. So, increase of Boro rice production would be a significant possible way to remove food deficiency in the country. Irrigation is the vital input for crop cultivation in Rabi season in Bangladesh. So, developments of irrigation facilities are the crucial issue to increase and sustain MV Boro production. Only one fourth of the young farmers were engaged in Boro production, so impressive extension works could involve more number of youths which would create a seasonal employment in the country.

Findings of the study and the logical interpretations of their meaning considering other relevant facts encouraged the researcher to draw the following conclusions:

- The adoption of selected MV rice of the farmers was moderate, as nearly 75 percent of the farmers had medium to high adoption. However, to meet the ever demand of food, there is a need to further enhance the rate and extent of adoption of selected MV rice among the farmers. Particularly, both the Government Organization (GO) and Non-Government Organization (NGO) workers should provide appropriate technical and management related information to the farmers through continued extension and other support services. It may be concluded that the adoption of selected MV rice was moderate and needs further improvement.

- Most of the MV rice farmers were middle aged. Age of the MV rice farmers showed positive and significant relationship with their adoption. Therefore, it may be concluded that special attention needed to be given on any particular age group.

- Findings of the study showed a significant relationship of education with their adoption of MV rice. Education is a contributory factor of gaining knowledge and skill and has creating positive attitude in an individual. There is a need to enhance the educational level of the farmers. It may, therefore, be concluded that enhancement of formal education among the farmers may contribute positively towards the formation of favorable opinion towards the selected MV rice and consequently their increased adoption by the farmers.

5.3 Recommendation

To enhance the productivity, efficiency and effectiveness of Boro rice production, the following recommendations are made as a part of present study which acts as a formulating strategy for enhancing Boro rice production in Jamalpur district.

- Though the government is already given subsidy on fertilizer like urea and other inputs required for rice cultivation but fair prices of inputs should be ensured so that the farmers can get the inputs at a reasonable price.
- Bank loan and institutional credit should be made available on easy term and conditions to the Boro rice farmers.
- Government procurement program should ensure that farmers will get fair prices of their output by purchasing the output directly from the farmers not from the middlemen or rice stockholders.
- Scientific method of cultivation should be introduced to increase production. The farmers should be provided with training, adequate services, information and necessary facilities to cope with new and changed situation.
- Attention should be given to improve storage and marketing facilities of the study area.
- Bangladesh Power Development board should be given attention on the irrigation season of Boro rice production so that the farmers get available electricity at a reasonable cost.

- It may be recommended that agricultural extension agencies especially the DAE and relevant NGOs should critically review their training programmes and make sound provisions so that the farmers understand the benefits of adoption of modem varieties rice. The DAE and other non-governmental organizations should strengthen their extension services to

the growers and farmers to motivate them for adopting modem varieties rice cultivation practices. The farmers should be encouraged to adopt modem varieties rice.

- Majority of the farmers had medium farms and they could give more attention to their farming operation as they generally work on the farm.

5.3.1 Recommendations for further study

A small piece of study as has been conducted which can not provide all information for the proper understanding of the adoption of modem MV rice varieties. Therefore, the following suggestions are made for further study:

I. The present investigation explored the relationships of the four characteristics of the rice growers with their adoption of modem varieties of rice. Further research may be conducted by taking other characteristics to observe relationships with their adoption of modem varieties rice.

II. The present study was conducted in fifteen villages of Melandaha Upazila under Jamalpur district. So, similar studies may be undertaken in other parts of the country to verify the findings of the present study.

III. A positive trend of relationship was obtained between education of the growers and their adoption of MV rice, the relationship was statistically significant. Generally a positive significant relationship is expected to be observed between

education of the farmers and their adoption of MV rice. Hence, further studies are necessary to verify the relationship between the concerned variables.

IV. The present study has been carried out among the male farmers only. So, a similar study may be conducted with the farm women to examine their views and opinions regarding the adoption of modem varieties rice.

V. The present study was concerned only with the adoption of modem varieties rice. It is therefore, suggested that future studies should include other important MV crop varieties rather than rice only.

5.4. Problem faced by the farmers adopting selected MV rice

The farmers express some problems as for effective dissemination of MV rice cultivation. An attempt was made to identify the problems faced by the farmers in adopting MV rice. As many as 15 problems were mentioned by the farmers. The main problem faced by the farmers are high price of fertilizer and high price of modern variety seeds.

CHAPTER VI

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