ADOPTION DETERMINANTS OF ORGANIC FERTILIZER USE ON BORO RICE PRODUCTION IN SOME SELECTED AREAS OF PABNA DISTRICT IN BANGLADESH

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DEDICATED TO MY BELOVED PARENTS

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ABSTRACT

Now a days organic farming is an important and most demandable method in agriculture. Rice plays a pivotal role in all sphere of life and when it comes to food security of the rural farmers. It is the most important commodity in terms of livelihood and food. It is not only staple food but also center of the entire Bengali life. Among various types of rice, Boro rice is grown all over the Bangladesh for export as well as domestic market. The present study was designed to analyze the socio-economic profile of the respondent, find out the determinants of organic fertilizer use on Boro rice production and identify the problems of organic fertilizer use on Boro rice production. Three villages were selected under Sujanagar Upazila and others two villages from Bera Upazila. Farmers are mainly using cowdung and compost as the organic fertilizer in the Boro rice production. Primary data were collected through purposively random sampling from 120 farmers. About 60 farmers use organic fertilizer in Boro rice production, whereas others 60 farmers who did not use organic fertilizer. Descriptive Statistics, Binary Logistic Regression model used in the study. Majority of the farmers who used organic fertilizer was medium aged farmers with medium family size, and they had completed their secondary level of schooling with medium income. In the contrary, who did not use organic fertilizer, had medium family size with medium income, and they had no formal education. Most of the organic fertilizer user did not use of credit facility, whereas inorganic fertilizer user use credit facility, although organic fertilizer user more engaged on various organizational membership than inorganic fertilizer user. Organic fertilizer user having livestock, but most of the inorganic fertilizer user have no livestock. The Logistic Regression Model reveals that education, training, extension service, information access, livestock, market distance, bicycle/van ownership were significant and positive, on the other hand age, family size, credit facility were significant and negative. Among various problems of using organic fertilizer on Boro rice production, lack of credit facility ranked first, high price of inputs ranked second, and lack of training ranked third position in the study area. This scenery will be changed with adequate use of credit facility, provision of organic fertilizer to the farmers. Government should give more emphasis on training and raising awareness on organic fertilizer use on Boro rice production.

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ABBREVIATIONS AND ACRONYMS

BER	: Bangladesh Economic Review
GDP	: Gross Domestic Product
BBS	: Bangladesh Bureau of Statistic
FY	: Fiscal Year
BRKB	: Bangladesh Rice knowledge Bank
MoA	: Ministry of Agriculture
DAE	: Department of Agricultural Extension
USDA	: United States Department of Agriculture
DFID	: Department for International Development
MT	: Metric Tonne
FAO	: Food and Agriculture Organization
gm	: Gram
FYM	: Farm Yard Manure
BRRI	: Bangladesh Rice Research Institute
DAP	: Diamonium Phosphate
et al.	: and others (at elli)
ha	: Hectare
HIES	: Household Income and Expenditure Survey
HSC	: Higher Secondary Certificate
Ln	: Natural Logarithm
NGO	: Non-Government Organization
No.	: Number
Tk.	: Taka
IRRI	: International Rice Research Institute
%	: Percentage
Min	: Minimum
Max	: Maximum
km	: Kilometer

CHAPTER 01
INTRODUCTION

1.1 Background to the Study

Bangladesh is primarily an agricultural country. Agricultural sector enhances the economic growth of Bangladesh. Profitable, sustainable and environment friendly farming is therefore crucial to ensuring food security. The broad agricultural sector is given top priority to build Bangladesh abundant with food and nutritional security. Agricultural sector plays a pivotal role in the economic growth of Bangladesh. Broad agricultural area contributes 11.50% to GDP and 40.60% of the people involve in this sector. Most of the population about 70% earns their livelihood from agricultural area (BER, 2022). Economy of Bangladesh has been able to regain from the negative impact of corona epidemic. Before epidemic the GDP growth rate was 7.88% in fiscal year 2018-19 but it reduces to 3.45% in fiscal year 2019-20. GDP growth rate has been recovered and rise at 6.94% in fiscal year 2020- 21. It is estimated that GDP growth is probable to 7.25% in fiscal year 2021-22 accordance to BBS (BER, 2022). It is said that, Bangladesh is a land of rice cultivators, also known as rice consumers. Rice is principal food for Bangladeshi peoples. Finally, rice is the main food crop in terms of area, production which add value to the national income and economicprogress. Bangladesh is primarily characterized by a rice monoculture in the area of agricultural crop. There are three major rice crops such as Aus, Aman ,Boro and these main crops comprise 100% of total rice production. Rabi, Kharif-1, Kharif-2 are three main seasons in Bangladesh for agricultural cultivation in addition to Aus is being cultivated in March-April and harvested in June-July on the otherhand Aman rice sown in June-July and it also harvested in November- December.

Boro rice grown at low-lying lands otherwise moderately waterlogged soils. It is irrigated crops so it is therefore need for irrigation from November to May. Boro rice is usually grown at the bank of the river sides deltas of Bangladesh as well as East of India. These areas accumulate water during the monsoon season which may not be depleted during the period of winter season. That system has also spread to conventional areas of crop production wherever irrigation is accessible. Boro paddy uses the remaining moisture after harvesting of Kharif-1 and Kharif-2 paddy. The regions of excessive humidity holding capability are low-lying dumps. In wherever,

water is retained otherwise amassed and regions adjacent towaterways as well as paths, char-areas etc. In assist of spreading of irrigation methods, Boro rice is being reaped at present in areas of its conventional borders. The latest cultivation technique aredeveloping for Boro rice production. The irrigated Boro rice is a kharif season crop which harvest between May to June month. In the previous, it was cultivated to lowlands with the help ofremaining water. During rainy period Boro rice is watered with physically by means of shallow water during periods of scarcity (Fujita, 2010). Many varieties of Boro paddy for example: BR1, BR2, BR3, BR7, BR8, BR12 (BRKB, 2023). With 49.52 million hectares and yield of 209.77 million tons, Boro rice cultivation at the highest altitude in Boro is a major step towards a resistant rice cultivars in Bangladesh (BER, 2022). Boro rice was in full bloom when the first nationwide lockdown was imposed in march 2020. However, Bangladeshi farmers have had satisfactory production during epidemics, lock-down, as well as disaster (DAE, 2020). In the rice production all over the world after China and India Bangladesh ranked as third in 2020 (USDA, 2020). Habiganj, Moulavibazar, Sunamganj, Netrokona, Sujanagar, Sylhet are the main production area of Boro rice in Bangladesh.

Organic farming is practiced in 191 countries. However, 3.7 million cultivators cultivate 76 million hectares agricultural lands with the help of organic fertilizer (FiBL & IFOAM, 2023). Organic fertilizers are naturally available sources of mineral that contain moderate amounts of essential plant nutrients. They can alleviate problems associated with synthetic fertilizers. Application of organic manure is a necessary source of nutrients for sustainable agriculture and ensures high quality food production. Moreover, the cost of rice production in conventional inorganic agriculture is increasing due to rising input costs such as: Chemical fertilizers, herbicides, pesticides, labor (Sapkota et al., 2018). Furthermore, inorganic farming practices contribute to greenhouse gas emission that cause global warming and ultimately contribute to climate change (DFID, 2004). People use various inorganic fertilizers which negatively affect ground water and environment. It reduces soil productivity and affects rice production in the long run. In this case, using organic fertilizer will help restore the soil health. Many studies (Khan et al., 2013; Hoque et al., 2018; Sharada et al., 2018) have examined the determinants of Boro rice production in various aspects. Since, the determinants of Boro rice of many agricultural farm largely depends on fertilizer. It is indeed necessary to find the differences between organic and inorganic fertilizer on productivity of rice farms. Therefore, the present

study find out the adoption determinants of organic fertilizer use on Boro rice production and help to take decision of farmers to use organic fertilizer.

1.2 Agriculture in Bangladesh

Agriculture is a source of various markets for agricultural products demanded by consumers, especially in rural areas. Government should take necessary steps to develop the agriculture in Bangladesh. This includes expanding small scale irrigation system, besides reducing of water logging, and producing high yielding seed cultivars, and its preserving and disseminating. A special priority is given to agricultural research for growth as well as increasing of the draught but salt tolerant cultivars. The cultivars which are cope up with the meteriological condition or ecology in a specific regions as well as short lived crops which made crops appropriate to specific soil types. Bangladesh holds 165.16 million population all over the world. The density of this high population is 1119 whereas yearly growth percentage is 1.22 (BBS, 2022). This country has a long past of production of rice. The sothern part of the country do not considere for producing rice. However, it produces all over the Bangladesh specillay in northen part of the country. For the year- round rice production, the agro ecological conditions is being considered. It is our basic food and about 135 million of people take it as a main foodstuff in their day to day life in this country (BRKB, 2022). Almost 48% of rural people of our country directly or indirecetly engage in rice cultivation. So, the provision of the calory for a person is average two thirds of the toal calory all over the Bangladesh and peple intake protein half of the protein he or she needs (BRKB, 2022). The agricultual GDP and national income in Bangladesh mainly depends on rice production which nearly reach about one sixth of the national income. About 13 million of farmers produce rice in the country and cultivated it almost 10.5 million of hectares. Rice cultivation takes under 75% of the total cultivated land as welll as more than 80% of irrigated land in Bangladesh (BRKB, 2022). Therefore, its keep a significant impact on Bangladeshi people and their livelihood. Population growth percentage is about 2 million annualy. If population growth expands at this rate, the total population will reach 238 million in 2050 in Bangladesh (BRKB, 2022). To feed this growing population, rice cultivation must have to increase. But in the mean time, the inductry, highway, factories, houses and road construction decreases the arable area which is more than 1% per annum (Shelley et al., 2016).

Aus, Aman, Boro are the three major rice producing time in Bangladesh. Among three rice production time aus paddy is pre-monsoon crops and it is growing under rainfed conditions. After pre-monsoon Aus is broadcasted in the period of March-April. Lastly it is harvested during July-August. Due to large sacle of high yielding of Boro rice many areas of Aus rice production changed to irrigated Boro rice. Aman is the monsoon rain rice and it is widely distributed comprising in coastline land. There are two forms of Aman rice cultivation such as direct sowing along with Aus rice during March-April. This varieties of rice transplanting in July-August. Agricultural sector support to our total GDP which is slowly reducing but still it plays a pivotal role of economy in Banglladesh. Therefore, it is said that, rice is the crucial sector in the development of Bangladesh. Moreover, the share of agricultural sector, industrial sector as well as service sector raise at 11.50%, 37.07% and 51.44% respectively in year 2021-2022 (Figure 1.1).

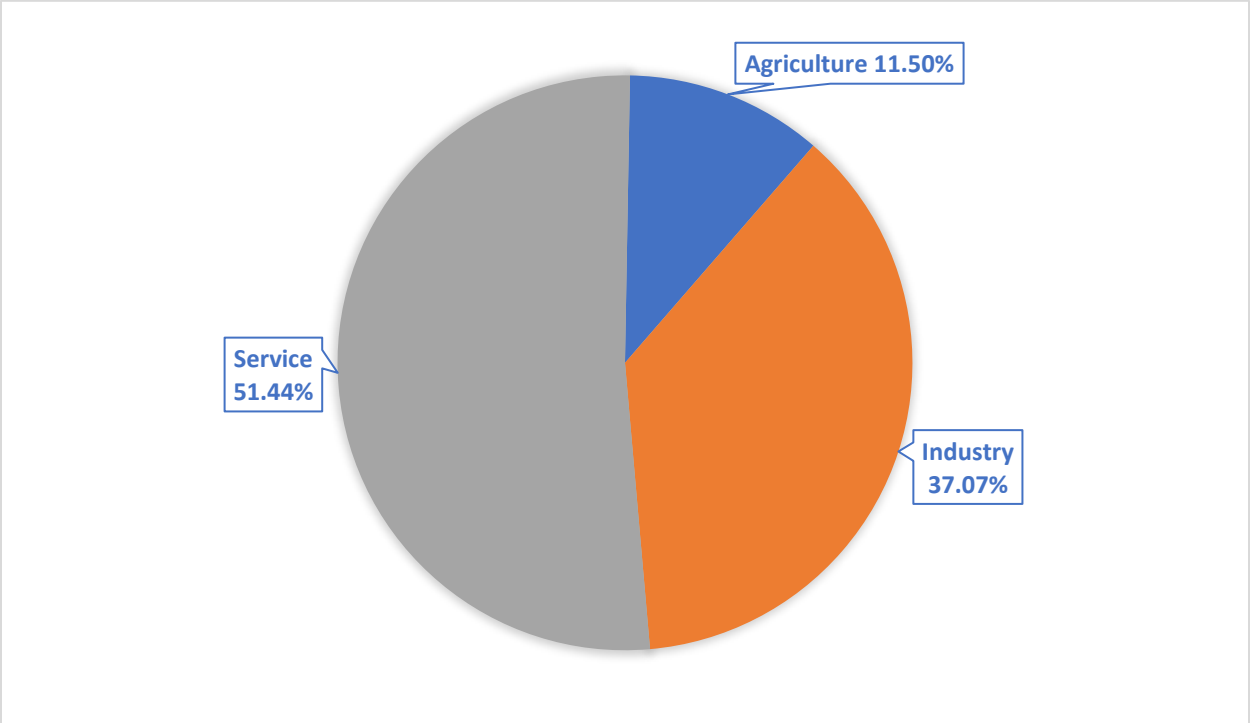

Figure 1.1 Sector Wise GDP Share in Bangladesh, 2022

Source: BER, 2022

In fiscal year 2020-21, food grain production was 443.56 million metric ton. Aus rice is 32.85 million metric ton and 144.38 million metric ton Aman, also Boro rice is 198.85 million metric ton including wheat is 10.85 million metric ton. The total food grain production target for fiscal year 2020-21 is 465.83 million metric in which about 34.84 million metric ton is Aus, 150.47 million metric ton Aman, 209.51 million metric ton is Boro together with wheat is 12.26 million metric ton probably (BER, 2022).

Table 1.1 Food Grains Production (in millin metric ton)

Food grains	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
Aus	23.28	22.89	21.34	27.07	27.20	30.12	32.85	34.84
Aman	131.90	134.83	136.56	139.94	140.55	155.02	144.38	150.47
Boro	191.92	189.38	180.16	195.76	203.89	201.81	198.85	209.51
Total Rice	**347.10**	**347.10**	**338.06**	**362.79**	**373.63**	**386.95**	**376.08**	**394.81**
Wheat	13.48	13.48	13.12	10.99	11.48	12.46	10.85	12.36
Maize	23.61	27.59	35.78	38.93	46.99	54.02	56.63	58.75
Total	**384.19**	**388.17**	**386.96**	**412.71**	**432.11**	**453.44**	**443.56**	**465.83**

Source: BER, 2022

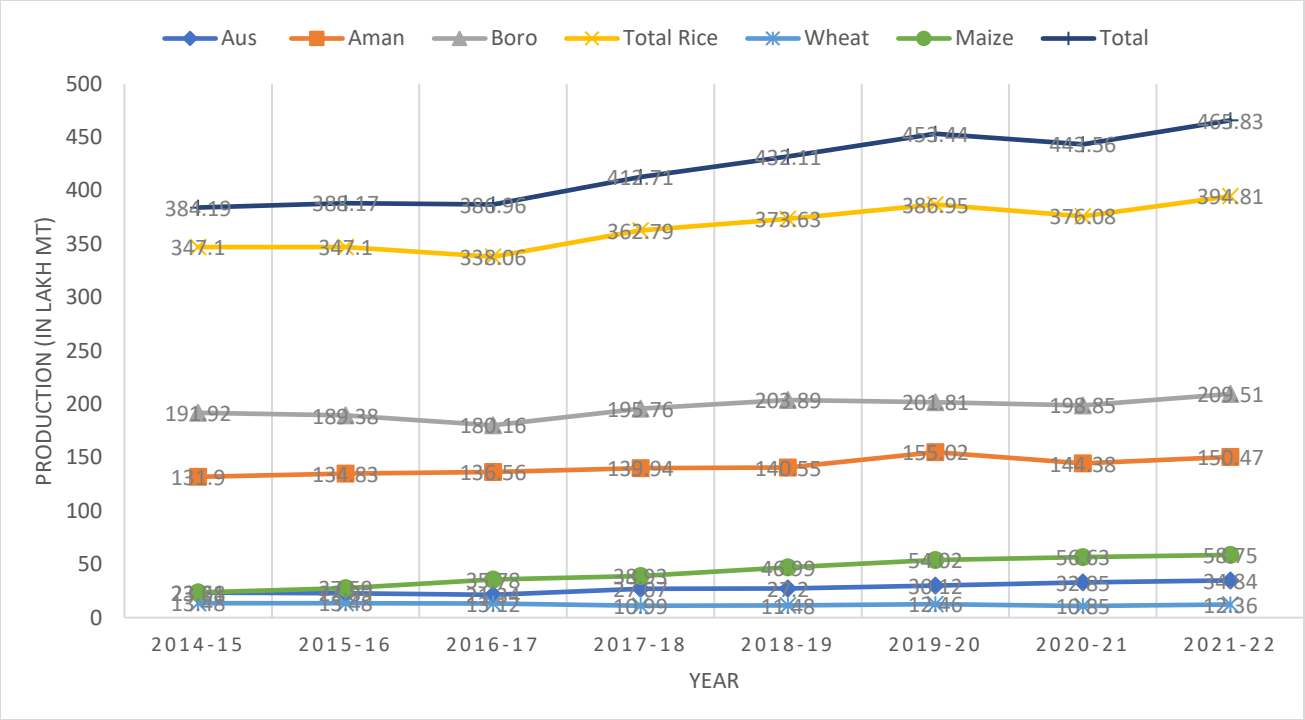

Figure 1.2 Food Grains Production of Aus, Aman, Boro, Wheat and Maize

Source: BER, 2022

Table 1.2 Global Rice Production and Leading Producers Countries

Serial No	Countries	2020 (million tonnes)	2021 (million tonnes)	2022 (million tonnes)	Change: 2022 over 2021
1	China	145.1	145.8	146.1	0.21%
2	India	124.4	126.2	127.4	0.9%
3	Bangladesh	37.4	37.8	38.4	1.4%
4	indonesia	35.0	34.8	35.2	0.9%
5	Vietnam	27.8	28.5	28.4	-0.5%
6	Thiland	21.0	22.0	21.7	-1.1%
7	Mayanmer	15.2	15.0	14.5	-3.3%
8	Philipines	12.9	13.1	13.2	0.7%

Source: FAO, 2022

Bangladesh's rice production is estimated at 38.4 million tons, ranking third in the world for four consecutive years. FAO forecasts that Bangladesh's rice production will increase by 1.4% in 2022. China leads with projected output of 146.1 milloin tonnes, followed by India with 127.4 million tonnes. Indonesia ranked fourth with 35.2 milion tonnes. China's rice production increased by 0.21% while India's growth rate is increased by 0.9 %, 1.4% in Bangladesh and 0.9% in Indonesia.

1.3 Importance of Boro Rice and Organic Fertilizer

The dominance of agriculture in Bangladesh is reflected in its contribution to economic development and job creation. Rice is our main food and it is centered of Bengali life including culture, politics, and economy. Bengali life has changed over time, but rice still shines. Rice accounts for 2/3 of the total need of populations calory requirements. It is the source of half of the country's protein intake, while crops and horticulture account for about 10% of the gross domestic product, half of which comes from rice (BBS, 2022). It also accounts for 48% of total rural employment. Unsurprisingly, rice remains at the center of many stakeholder debates. According to the Bangladesh Rice Research Institute, the country's annual demand for rice is 35 million tons. Production forecast for 2021 exceeds 37 million tons. Bangladesh would produce 19 million tons during current Boro season, accounting for 55% of the country's total rice production (USDA, 2020). But the Ministry of Agriculture wants a harvest of 20.5 million tons. Rice plays the most important role in ensuring the food security in Bangladesh. Therefore, it must be approached with the utmost seriousness appropriate policies, comprehensive planning and intense focus to protect the interests of farmers and consumers. In Bangladesh, Boro rice accounted for 49.66 million hectares of the total rice in 2021-2022, with a yield rate of 2 million tons (BBS, 2022). However, the use of organic fertilizers is a necessary supplement for longlasting agriculture and assure of food security. Moreover, the cost of rice production with inorganic practices is increasing day by day (Sapkota et al., 2018). People use various inorganic fertilizers which affect groundwater and reduce the productivity in the long run.

Table 1.3 Area Production and Yield of Boro Rice

Year	Area (M ha)	Production (MT)	Yield (T/ha)
2001-02	3.77	11.77	3.12
2002-03	3.85	12.22	3.17
2003-04	3.95	12.84	3.25
2004-05	4.06	13.84	3.41
2005-06	4.07	13.98	3.43
2006-07	4.25	14.97	3.52
2007-08	4.61	17.76	3.85
2008-09	4.72	17.81	3.77
2009-10	4.78	18.34	3.84
2010-11	4.77	18.62	3.90
2011-12	4.81	18.76	3.63
2012-13	5.17	18.78	3.97
2013-14	4.79	19.01	3.96
2014-15	4.84	19.19	3.97
2015-16	4.77	18.94	4.01
2016-17	4.48	18.01	4.02
2017-18	4.86	19.58	4.03
2018-19	4.85	19.50	4.02
2019-20	4.90	20.00	4.08
2020-21	4.85	20.80	4.29
2021-22	4.96	20.95	4.22

Source: BBS, 2021-2022

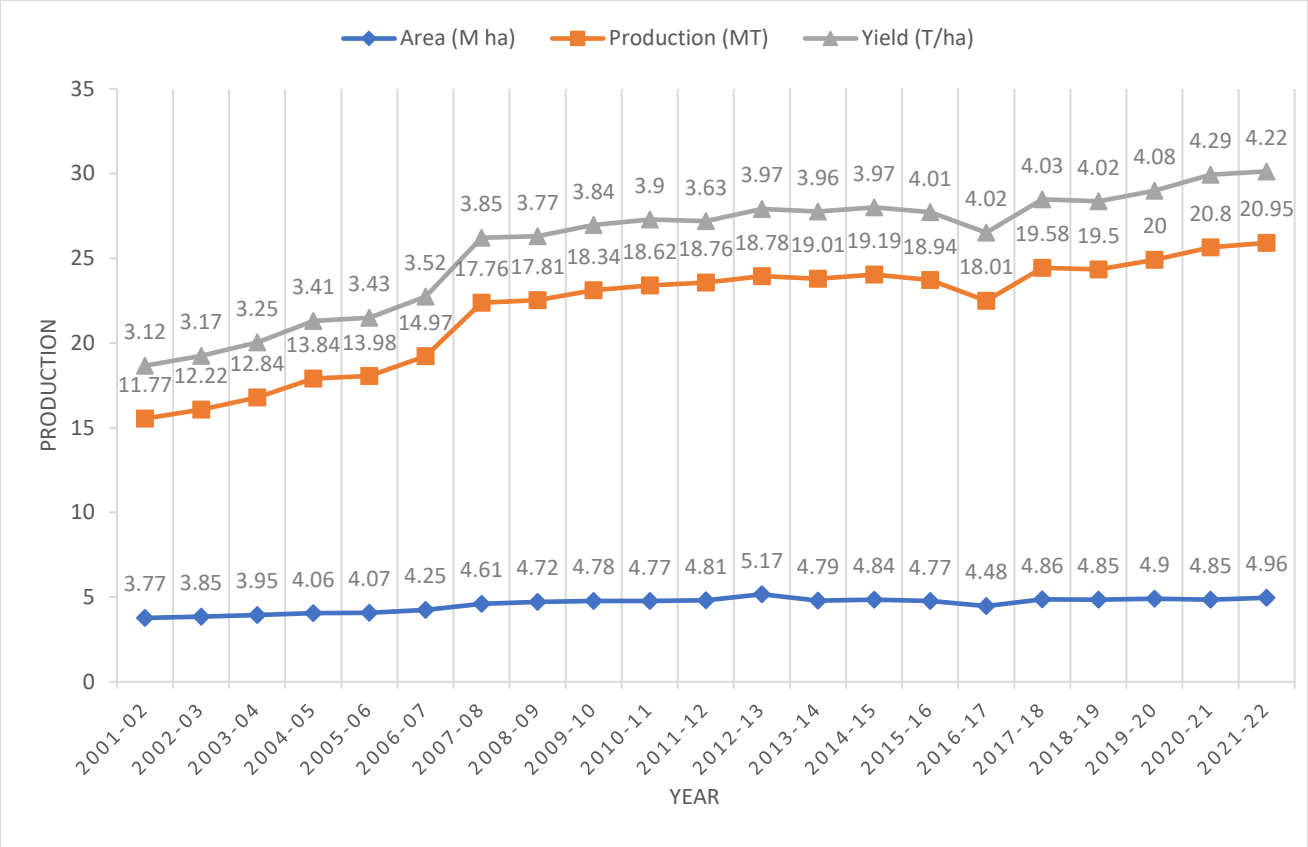

Figure 1.3 Area Production and Yield of Boro Rice

Source: BBS, 2021-2022

1.4 Advantages of Organic Fertilizer

Kitchen waste, cowdung, compost and animal, plant waste are used for making Organic fertilizer. It may be a greate treated manure and fertilizer based product.

1 **Soil texture:** Organic fertilizers improves land texture, thereby increasing the soils water and nutrient storage capacity.

2 **Microbes thrive:** Artificial fertilizers consist of chemical molecules that do not contain carbon. That particles may cause disruption and inaccessible to microorganisms. On the contrary, organic manure enriched in organic matter, which helps growth of microorganisms.

3 **Sustainable as well as environment friendly:** chemical fertilizer entering cannals, and stream of rivers which is detrimental to our marine ecosystem. It has negative impact on

water attribute. Compare to chemical fertilizer organic fertilizer enhances bio-diversity by 30% in accordance with the organic trade association.

4 **Reduction of fertilizer and pesticides:** Organic fertilizers is expensive than chemical fertilizers but it help to decrease exigency of pesticide like as nitrogen, phosphorus and potassium. Organic fertilizer always a cost savings method due to reduction using of pesticide.

5 **Risk of plant:** Chemical fertilizers may cause plant destruction especially for roots and lefs of plant.

6 There are many disadvantages of exercising organic fertilizer such as: it may not hold up primary nutrients like as nitrogen, phosphorous or potassium.

1.5 Nutritive and Medicinal Value of Rice

Rice is the core of any kind of foods. Even if, it is the principal food-stuff to more than 1billion of individual among various countries. Rice is needed for feeding the ½ of the population all over the world. We can not think our daily life instead of rice. In this era, nations would go hungry if rice is not produced enough. Rice is taken under consideration for balance diet. It is a major source of nutritious energy in 17 countries in Asia pacific, 9 countries to the Americans and 8 countries of Africa. Rice delivers 20% of the world's nutrional vitality while wheat supports 19% and maize provides 5% (Wahed and Anjan, 2008). The aasessment of the nutritional value of rice disclose the nutritional value of rice. The value of rice different fron one to another reliant on manyissues. It varies by rice variety also which includes white, brown, red, and black or purple rice. These cultivars are produced in various parts of the world. Additionally, it is reliant on the nutritional content of the soil.

Table 1.4 Nutrients from Per (100 gm) Rice

Composition	Amount (gm)
Calories (k. calorie)	325
Moisture content (percent)	13.3
Carbohydrate (percent)	79
Protein (gm)	6.4
Fat (gm)	0.4
B-carotine (µg)	0
Vitamin B (mg)	0
Thiamin	0.21
Riboflavine (mg)	0.09
Vitamin C (mg)	0
Calcium Ca (mg)	9
Iron Fe (mg)	1

Source: Bose and Som1986; Wahed and Anjan, 2008

1.6 Uses of Rice

1. **Basic food:** Its about 60% of the worlds populstion rice is taken as a main food. Cooking rice is a way to eat rice.
2. **Starch:** Starch contains in rice normally which has significance on ice creams, custard powders, desserts, cream, concentration of beverage.
3. **Rice bran:** Bread, appetizers, cookies and biscuits uses rice bran in confectionary. It is also used for animal feeding, compost, medical purposesalso in wax production.
4. **Rice bran oil:** it is used in the manufacture soaps and fatty acids and also used in aesthetics, artificial fibers, cleansing then controlling acidification. It is a good product moreover it protects heart in the best way.
5. **Flaked rice:** this rice comes from boiled rice then conduct in lots of dishes.
6. **Puffed rice:** Rice can be consumed as puffed rice.
7. **Parched rice:** People taken this type of rice which is simply digestable.

8. **Husk of rice:** Husk practice in carboard as a fuel. Moreover, in paper industry, packaging as well as making fabrics this sort of item is used. Besides above of them production of compost and chemical derivatives depends on it.
9. **Broken rice:** Babies food, breakfast items, rice flour, noodles, poultry feeding take it for main ingredients.
10. **By product:** Straw is used for animal beding, fuel, mushroom beds, covering for agricultural crops, preparation of paper lastly in composting.
11. **Sorces of seed:** Farmers store paddy for seedling.

1.7 Justification of the Study

Bangladesh is land of agriculture. Economic progression of Bangladesh largely reliant on whole improvement of agricultural sector. The environmental stipulation is favorable to the farming of various types of crops. Its about 75% of the total crop land zones are now enagage with rice production. As a result of population growing, the need for Boro rice is augmented drastically. Despite of having immense importance of producing Boro rice to ensure food and nutritional security, many researchers executed many experiments. With the assitance of those researches they find out overall scenerioes, possibilities of Boro rice in Bangladesh. In general, organic fertilizers alone do not increase the yields of Boro paddy. Whereas both of organic and chemical fertilizers using in production gives large scale yielding. People know that chemical fertilizer just provide primary elements to the soil but organic fertilizers supply nutrients to the soil as well as enhances quality.

The effects of inorganic fertilizer on soil and nature is detrimental in long run. Lackings of balance nutrients on soils causing negative influence on land and can make soil unproductive. It is true that sustainable production of crops cannot be maintained by using only chemical fertilizers. In addition to it is not possible to gain higher yielding by using organic fertilizer solely (Bair, 1990). The prerequisite for increasing grain cultivations are properly addressing, managing land productiveness. Ultimately, farmers obtain a good harvest over the long time. Therefore, combination using of organic fertilizers and inorganic fertilizers are too significant to rise land quality and crop prolific. Cowdung and mustard oil is enriched in Nitrogen content. In Bangladesh cowdung is as usual practiced on organic fertilizer for crop farming all over the

Bangladesh. Organic manure is a crucial origin of provision for nutrients in crop production however it is recognized that organic fertilizer is substitute to inorganic fertilizers (Sharma and Mitra, 1991). Therefore, the present study will help to identify adoption determinants of organic fertilizer use on Boro rice production and help to take decision of farmers to use organic fertilizers.

1.8 Objectives of the Study

Broad purposes of that research was to find out the adoption determinants of organic fertilizer use on Boro rice cultivation in Bangladesh. Be that as it may, another definite purposes were also added while studying these major crops production and export-import in Bangladesh. The specific objectives of the study were given belows-

1. To delineate the socio-economic profile of the respondents.
2. To find out the determinants of organic fertilizer use on Boro rice production.
3. To identify the problems of organic fertilizers use on Boro rice production.

1.9 Limitations of the Study

There are many shortcomings of the research analysis some are given below:

1. Data was gathered through face to face interviews from rural areas farmer. The transportation system was unfavorable.
2. Occsssionally the farmers did not cooperate with the interviewer.
3. Farmers are reluctant to expose their personal information.
4. Most of the informations was inaccurate because of farmers forgetness. As primary data was accumulate based on memories.
5. Owing to resource constraints, times constraints the large scale analysis is hampered in some points.

1.10 Organization of the Study

The thesis paper is contained of seven chapters of which have been arranged in the subsequent steps. Chapter 1 included Introduction. Chapter 2 Review of literature. Chapter 3 Methodology of the study. Chapter 4 Socio-economic characteristics of sample farmers of the Boro rice producing farmers. Chapter 5 Adoption determinants of organic fertilizer use on Boro rice production. Chapter 6 Identify the problems of organic fertilizer use on Boro rice production. Finally, Chapter 7 represents the Summary, conclusion and policy recommendations to use organic fertilizer on Boro rice production.

1.11 Concluding Remarks

From the above discussion it is clear that here we describe the background to the research, agriculture in Bangladesh, introduction to Boro rice and its importance, about organic fertilizer and so on. Various charts, Table, graph is shown in this chapter also. In the next chapter we describe some literature review about Boro rice cultivation.

CHAPTER 02
REVIEW OF LITERATURE

The principal aims of this chapter is to evaluate some iterrrelated research which linked to the research analysis. In Bangladesh socio-economic analysis have been executed on Boro rice production in limitation. Adoption determinants is the main aims of many research. Bangladesh made a outstanding improvement of achieving crop production also its nutritional security. Bangladesh is independent in 1971, from this period the food production is increasing. In this era, population is also increasing at increasing rate and the consumption of food haveaugmented considerably over the time period. Many studies are correlated to the current studys. Their shortcomings, analytical methods, valuable recommendations have a great effect on this study. Review of some literature research works pertinent to the studies which have been shown in the recent past are explained below:

Alam et al. (2021) In this research, we found that organic fertilizers when applied together with inorganic fertilizers exposed a good performance in terms of yield combined with yield-promoting properties. The research work existed in the research field of Hajee Mohammad Danesh Science and Technology University, Dinajpur. Duncans New Multiple Range Test (DMRT) used for the treatment. From the result we can see the highest yield Boro was (26.00 t ha-1). Among organic fertilizers poultry manure was superior to cow dung and vermicompost and increased rate also had positive effect in it. The result clearly showed that organic source of nutrients resulted in significantly higher grain yields.

Salam et al. (2021) Organic fertilizer is the key elements of an endurable agricultural progress. The researcher draw a result of the study which bring out the effect of organic fertilizers of the yield of rice in our country. In this study Stochastic Production Frontier (SPF) methods was applied. The sample size is 2652 rice plot. Probit model and propensity score matching (PSM) were also used in this study. The farmers who use organic fertilizer produce 16.67% higher yield. The circumstances showed the household education has a good and significant impact on the rice production. It also reveals the using of organic fertilizer among farmers draw a calculation that

educated farmers are more likely to use of organic fertilizer than who did not use it. Farm size has a negative and significant effect which decrease the 12.7% possinilities of using organic fertilizer. Government and NGOs should inspired farmers to use organic fertilizers for better production. It also improve soil health, development and lessen the pressure to bring chemical fertilizers from others country.

Chakraborty et al. (2020) This outcome gives a clear message that the yield of Boro paddy was affected extensively who are using combination of organic and inorganic fertilizers. The students of Bangladesh Agricultural University done this thesis. The researcher use Duncan's Multiple Range Test (DMRT). The highest yields obtained from Boro rice by using poultry manure. Boro rice provides the highest yield (5.46 t ha-1).

Nayak et al. (2020) The study reveals the most demanding cereal crop is rice and it is our chief food. It is recognized, organic fertilizer used in aromatic rice. People given supreme importance on it to achieve high economic yields. Sustainability in production of rice and total economic returns with better attributes of rice depends on organic manure. Manure from poultry waste is considered to be one of the best organic fertilizer sources. Others sources of organic fertilizer like as farm yard manure and its concentration of manure is better. For sustaining crop productivity, preserving soil health and lessining the environmental dirt organic fertilizer id better than any other kinds of chemical fertilizer.

Kamruzzaman and Taj Uddin (2020) This study was conducted for assessment of the economies of Boro cultivation in the haor ecology of the Kishoreganj district. Almost 175 farmers taken for sample size were chosen from Mithamoin upazila. Random sampling method was used to farm size category. Primary data is investigated with the help of combination of descriptive statistics, mathematical and statistics. Descriptive studies disclose that average farm size of the respondent was 0.54 hectare. Almost of the farm owner was small farmergroup. The Varietal Dversity Index (VDI) showed most farmers in the study area had low varietal diversity

of Boro rice. The study found that Boro production was lucrative and its productivity index was very high.

Saeri and Rahman (2020) This study Brought out a conclusion on output of rice which affects very much for using of organic manure. It helps to farmer to take decision to use organic manure in their crop production. However, study was completed in regency in Ngai of east Java region. Researcher had taken the sample size is 88 who cultivated paddy in their field. Researcher used the Binary logistic regression model and Propensity score matching which also known as PSM method. These two methods were used to find out the determinants of rice production also evaluate the impact of organic manure on productivity of rice. Every farmer average rice production was 7071 kg. The outcome of this thesis was significant and positive to rice production. Schooling, age of farmers, education level, farmers participation impact on farmers decisions how to use organic fertilizer. Result of the propensity score matching presented that farmers who use organic fertilizer get higher production than farmers who are inadvertant to apply organic fertilizer in their field. From above discussion it is clear that using organic fertilizer give higher yield of rice.

Barmon and Tarafder (2019) This study estimates the impact of vermicompost fertilizer on latest cultivars of rice production in Bangladesh. Primary data was collected from farmers by face to face interview. Manoharpur village at Monirampur Upazilla in Jessore district was selected to evaluate the effect of vermicompost on Boro production. About 200 farmers were randomly selected as a sample. This thesis paper used the Cobb Douglas Production Function. The yield of Boro per production was 7,028.1 kg/ha, who use vermicompost and the yield using vermicompost was about 6,401 kg/ha.

Abebe and Debebe (2019) The main goal of the research was revealed the elements that influence marginal cultivator to use organic fertilizer. There were 155 sample considered for the research and primary data were collected from this large sample. Not only Simple random but also Stratified sampling method were used in the study. For analyzing data Econometric

specification was deployed. To deleneate the socioeconomic status Descriptive statistics was used. The result of Logitic regression model showed educational category, slope of land, extension service, availability of composting materials, productiveness of farmland, gender, household health status influenced application of natural manures. Depend on the outcome of the thesis, this study suggested for upcoming interference scheme should be taken to encourage the farmers. Use of organic fertilizer that enhancing production then productivity of crops in the study area.

Rahman and Barmon (2019) That research analyzed the power of vermi-composting on efficiency of recent rice cultivation. There were 340 farmers selected for sampling at the Monirampur upazila at Zessore district. The Cobb–Douglas Stochastic Production Frontier model was employed in the study. Results of the study indicated that the farmers who apllied organic fertilizer their yield was higher. But who used chemical fertilizer got compararatively less. Use of vermicompost significantly increases production and yield was 6869 kg per hectare.

Hoque at al. (2018) This dissertation was done in two sites in Bangladesh at Bangladesh Agricultural University and Maymansingh Sadar. New Duncans Multiple Range Test (DMRT) is applied to the study. There has been a positive impact on grain for using poultry manure, then Kazi Jaibo shar as organic fertilizer. Per hectare yield production was 3.67-6.47 ton. So, yield of BRRI dhan28 was greatly affected by the application of Kazi Jaibo Shar.

Sumon et al. (2018) The study showed thatjoined apply of organic and inorganic fertilizers improve crop productivity. It is maintained soil physical condition and fecundity in a better way. Sher-e-Bangla Agricultural University ia a place where the study was executed. In this study researcher analyzed data by Analysis of Variance methods (ANOVA) where mean differences was compared by Least Significant Difference (LSD) test using MSTAT. The yield was 9.05 t ha-1 of Boro rice.

Mahmood et al. (2017) Organic and inorganic fertilizer are important for crop productivity and soil health. In this study, main goal was to examined the impacts of chemical fertilizer thn organic manure on maize production. Sheep manure, poultry manure, and farmyard manure were applied as organic fertilizer while urea, DAP and sulphate of potash at different concentrations were used as inorganic fertilizers. As a result, the development and grain percentage of maize was significantly enhanced by chemical fertilizer application alongside organic manures. Various descriptive analysis were used in the study.

Islam et al. (2013) In this study we found that application of artificial fertilizer and natural fertilizer had a great influenced on grain production. Duncan's Multiple Range Test (DMRT) method was used at 5% level of propensity for statistical investigation. The complete doses of chemical fertilizer along with organic manure like poultry manure, vermicompost and cowdung were practiced in the field. Finally, a good result was obtained from it. Different treatments of inorganic fertilizer and organic fertilizer displayed a noteworthy differences in terms of effectivene grain per panicle, grain, straw, yields of rice. Maximum ouput was 6.5 ton per hectare.

Hossaen et al. (2011) The joined application of chemical anf natural fertilizer put a severe dominance on tillers, panicle initiation and grain of rice production. Here poultry manure was being used. The maximum weight of rice was 1000-grain. The output of yield was 7.64 ton per hectare with by product was 7.30 ton per hectare. For that reason, it may be suggested 70% nitrogen, potassium, phosphorous mixture with 2.4t poultry manure should be used in per hectare.

Ali et al. (2010) The nonstop nutrient supply from inorganic and organic fertilizer have been discovered to make the integrated plant nutrient system (IPNS) cost effectively and agronomically feasible. The Integrated plant nutrient system method appears to be further advantageous for managing fertilizer which may sustain soil texture. Thus, under the Boro-T aman cropping patern, IPNS may be suggest for the development of Boro and T.aman crops.

Solaiman et al. (2010) The purpose of this study to determine magnitude to environmental impact of using Grameen shakti organic manure on Boro rice production. The sample size was 90. In the investigation correlation matrix was utilized. The findings demonstrated a significant positive relationship between the farmers age, education, farm size, farming experience. In Boro cultivation area farmers used Grameen sakti manure on their production. There was no discernable correlation between the respondent yearly income and the output of Boro rice.

Ali et al. (2009) A field experiment was carried out at Bangladesh Agricultural University in Mymensingh on a farm. To evaluate which organic material sources are suitable for using in conjunction with chemical fertilizers in the boro uncultivated T. aman rice cropping pattern. Chemical fertilizer alone cannot useful for producing crop. Crop production and maintaining soil fertility required a combination of chemical and organic fertilizers. The findings of the experiment showed that higher output was achieved with the use of chemical fertilizer and poultry manure per hectare. Therefore, it is cost effective for cultivators to supplement 30% of chemical fertilizer with organic fertilizer.

Banerjee et al. (2006) Productivity under Boro crop sequence greatest system productivity 9.26 ton/hectare/year was obtained. Maximum 50% suggested quantities of nitrogrn, ptassium, phosphorous by means of fertilizer in mixture with 50% proposed doses of nutrients through green leaf manure and l00% recommended doses through chemical fertilizer during Boro rice season, which result 48.16% increase over control.

Concluding Remarks

From the conversation and analysis over indicated majority of the studies addressed adoption determinants of organic fertilizer use on Boro rice production, as well as social and economic status of the farmers. Some studies showed the current scenario of organic fertilizer adoption and other examines the adoption determinants of organic fertilizer on Boro rice or others crops. Several studies used the Binary logistic Regression model to identify adoption determinants. We shall talk about the studys research methods in the upcoming chapter.

CHAPTER 03

MEDTHODOLOGY

3.1 Introduction

Research methodologies are adopted through various stages to select the most suitable and optimal method to achieve the set research goals. A vital component of any research project is methodology. Consistency of any particular research result is highly dependent on the proper approach applied in the report. Over-all research plan is methodology that describes how to conduct research and specify the techniques applied during the process. A method, described in a methodology, defines a means or mode of data collection or, in some cases, a method of calculating a particular result. It is the responsibility of the authors to clearly describe the methods and process must be taken in choosing in the research domain, origin of data, analyzes in addition to interpretation to reach significant conclusions. This research was carried out with the help of survey method. In the Pabna district of Bangladesh, among various Boro grower in particular region find out the adoption determinants of organic fertilizer utilizing on Boro rice production. Furthermore, they find out the problems of uses of organic fertilizer in the cultivation of Boro rice. The survey method was utilized in this study primarily for two reasons:

1. Overviews allow rapid investigation of large numbers of cases.

2. The result has greater pertinency.

One of the main disadvantages of the survey method is that the surveyor has to trust on the farmers memory. In order to getting solution to the problems, more than once visit was done in the research area for data collection. If there is any inconsistency or omission of data, researcher go back to the farmers to get the omitted or accurate facts.

3.2 Selection of the Study Area

Choosing a research field is an important step in conducting research. The areas selected correspondent both to the specific objectives the research and to the potential for cooperation with

farmers. In Bangladesh Boro is growing everywhere. Boro rice cultivated in Pabna district at a large scale. Considering high concentration of Boro cultivation researcher selected this area. The sample size is 120 farmers of which 60 farmers using organic fertilizer and remaing 60 without using organic fertilizer. Five villages were selected purposively name as Gobindapur, Boruria, Ramkantopur, Khanpura, Aminpur under Sujanagar and Bera Upazila at Pabna district. The farmers within the sample cultivate a variety of Boro rice including BRRI hybrid Dhan28, BRRI Dhan29, BRRI hybrid Dhan3, BRRI hybrid Dhan5 etc. However, we combinedly analyze all the varieties for simplicity.

The following factors primarily influenced the selection of study area:

1. The abundance of Boro rice cultivators within the research region.
2. The agroecological traits of the region.
3. Certain physical characteristics of these villages were same. Some of them were geography, soil and weather patterns for Boro rice production.
4. Ease of access and improved communication facilities in these villages.
5. A high level of cooperation was expected from respondents in order to obtain reliable data.

Certain physical characteristics of these villages were the same.

3.3 Location of the Study Area

In the centre of Bangladesh Pabna district is situated. Pabna district occupies 2371.50 sqaure kilometer. It is located 23°48' latitude and 24°21'N and longitude 89°00' and 89°44'E. Pabna is economically significant district. Pabna town is the administrative capital in the distric. Pabna is loacted in southeast part of the Rajshahi division. Sirajgonj district situated in northeast part of the district and the Padma river divides it from Rajbari district along with Kushtia district to the south. The Jamuna river flows alongside in east of the boundary with the Manikgonj district and shares its boundary with the Natore district to the northwest. The lowest teperature is 9.6 degree celcius and regular temperature is 36.8 degree celcius. Per year precipitation is 1872 mm. the Flood plains of the Ganges, Karatya, Jamuna, and Barind rivers divide the district floor into four parts. The major waterways are Ganges, Ichamati, Gumani, Baral as well as Harasagor. The pabna district in Aminpur thana where the Padma and Jamuna rivers meet in southeast part.

There are nine upazila at Pabna district. Map of Pabna district displays the main regions of Bangladesh where Boro rice is grown specially in figure 3.1.

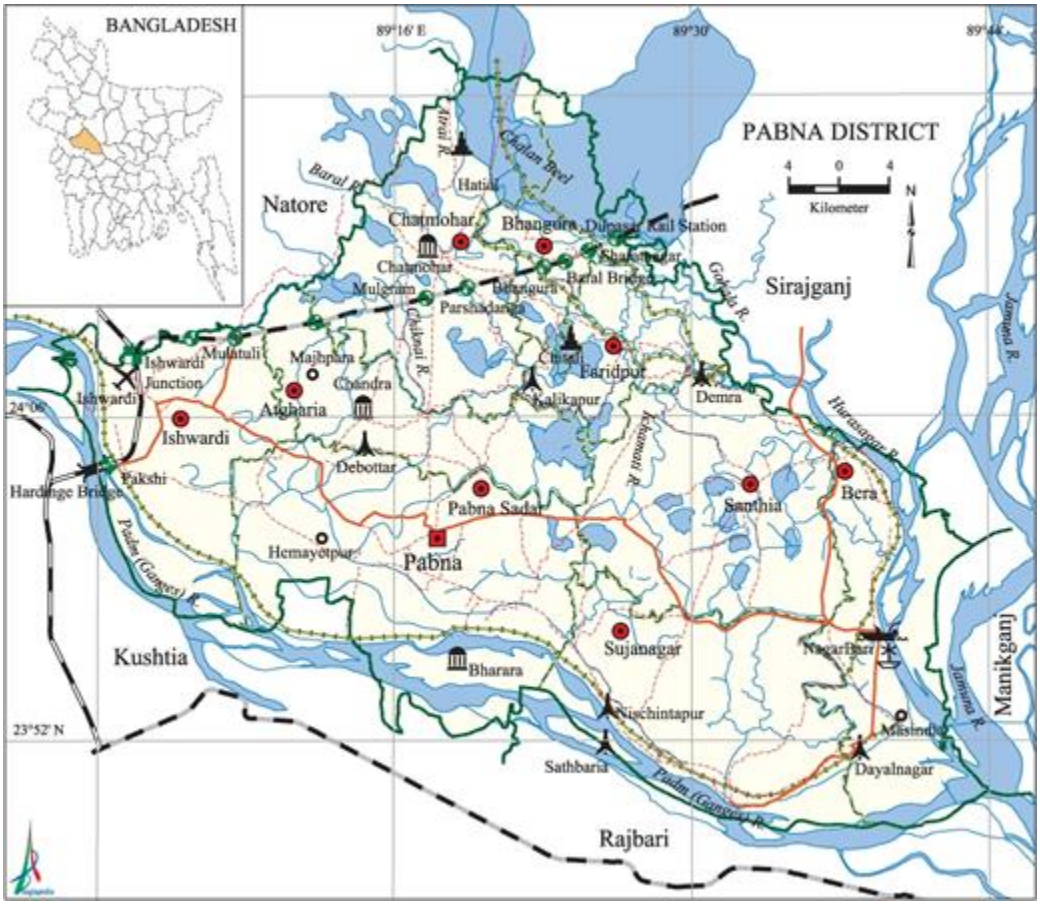

Figure: 3.1 Map of Pabna District

Source: Banglapedia

3.4 Description of the Study Area

Sujanagar Upazila at Pabna district and its area is 334.40 square kilometer. Sujanagar is located in 23°48'-24°00' northern latitude and 89°23'-89°38' eastern longitude. It is surrounded by Sathia Upazila to north, Rajbari Upazila and Pangsha Upazila to southern part. Pabna and Pabna sadar

Upazila are to the western to Bera Upazila. Total population at Sujanagar Upazila is 251192. The principal water bodies including atrai, padma notable gajnar beel, mahishkholer beel and zider beel. In Sujanagar, the average literacy rate is 36.7%. The primary sources of revenue is 61.17% which comes from agronomy. The workers who do not engage in agriculture about 2.89%. Among various sectors the industry sector is 5.95%, commerce is 12.73%, 2.71% is transport and communication, 5.72% under the service sector, 0.95% construction, religious service 0.17%, 0.41% is rent and remittance and others 7.30%. About 53.50% of landowners occupies agricultultural land owners, 46.50% is landless people. In town areas 44.85% and in rustic 54.59% people are land owners. Primary crops of the study area are paddy, wheat, jute, sugarcane, peanuts, onions, garlic, vegetables and extinct or nearly extinct crops kaun, tobacco, maize.

Figure 3.2 Map of Sujanagar Upazila

Source: Banglapedia

Bera Upazila in Pabna district with a total of 248.60 km square located at latitudes 23°48'-24°06' north and longitudes between 89°35'-89°44' eastern area. Bera upazila is eclosed by Shahjadhpur and Chauhali Upazila in north, Goalanda and Rajbari sadar Upazila in south, Chauhali, Daulatpur, Sibalaya Upazila in the east and Sujanagar and Santhia Upazila in the west. Total population of Bera is 231430.

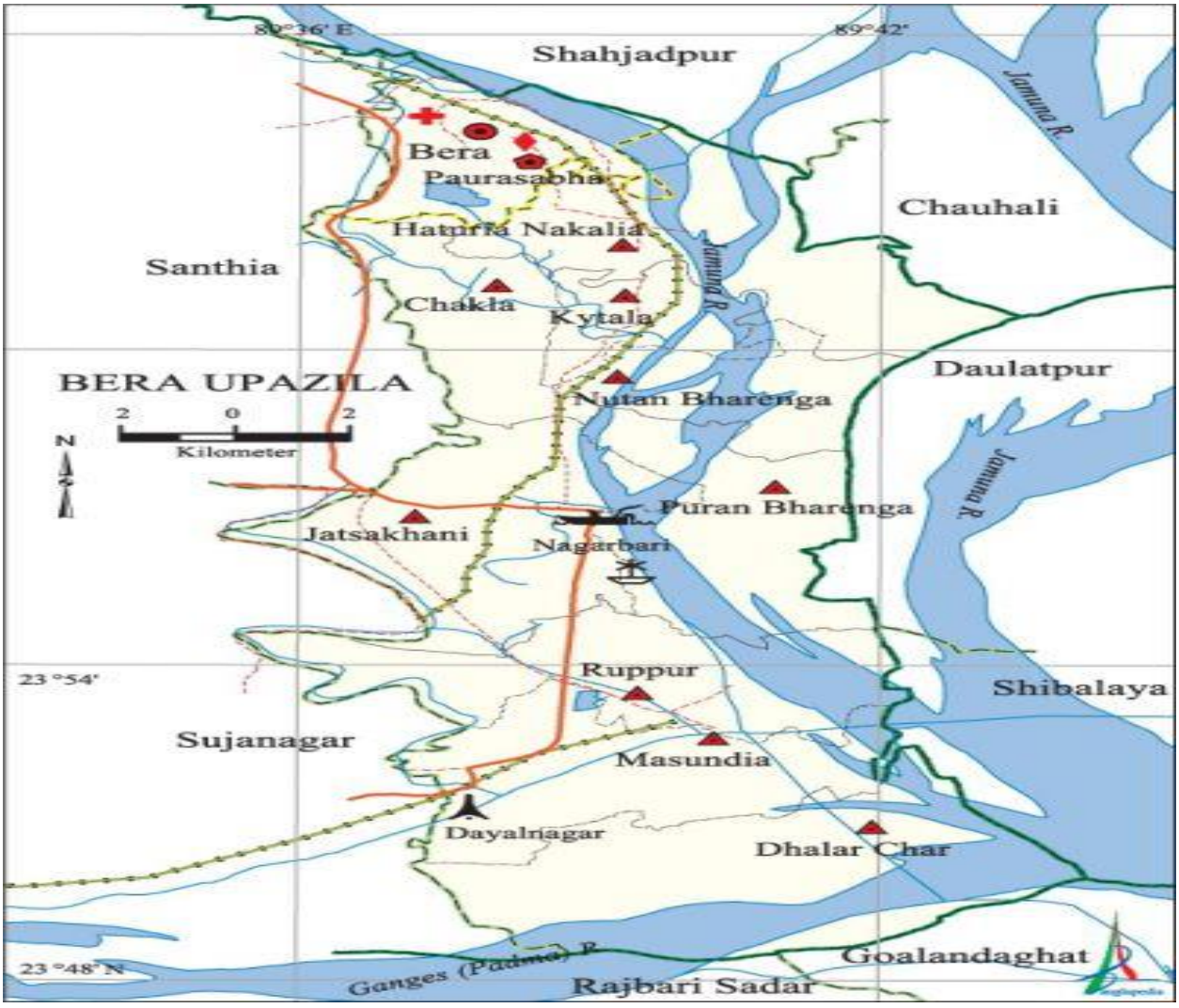

Figure 3.3 Map of Bera Upazila

Source: Banglapedia

Padma, Jamuna, Ichamati, Frasagar. Dhalai Beel, Ichar Beel and Nandiar Beel are famous water bodies of the Bera Upazila. Average literacy rate of 34.59% of which 38.1% male, 28.6%

female. The main crops of Bera Upazila are Paddy, wheat, sugar cane, mustard seeds, onions, garlic, potatoes, vegetables.

3.5 Sampling Technique and Sample Size

When choosing a study sample, there are two things take into account. First of all, to guarantee there are adequate degrees of freedom for statistical analysis, the sample size should be suffiently greater. Second of all field study management, processing and analyzing data must manageable among material, human, and monetary resources (Mannan, 2001). Nevertheless, because of technical and human constraints, it necessary to sampling several numbers prior to drawing conclusion can be drawn. Due to limitation of time, economic and human reasons all of the farmers in the research area could not be included. Hence a total of 120 farmers were purposively random selected of which 60 from organic manure using farmer and 60 farmers who do not use organic manure. A purposively random sampling technique used to this current thesis to reducing expenses and time to accomplish the studys final goals.

Table: 3.1 Sample of the Study

Crops name	District	Upazila	Village	Sample size
Boro rice	Pabna	Sujanagar (of which 30 farmers apply organic manure and remaining 30 practice inorganic fertilizer)	Sagarkandi	30
			Boruria	12
			Ramkantopur	18
		Bera (in which 30 farmers use organic manure and remaining 30 farmers use inorganic fertilizer)	Khanpura	30
			Aminpur	30
Total				120

Source: Field survey, 2022

The sample was chossen using a multistage purposive technique. For instance, at first stage two Upazila namely Sujanagar and Bera Upazila have been selected purposively considering the convenience of data collection of the researcher. In the second step researcher selected five villages namely Sagarkandi, Boruria, Ramkantopur from Sujanagar Upazila and Khanpura, Aminpur from Bera Upazila. Then the researcher herself also communicate with Upazila Krishi Officer Mohammad Rafiul Islam and Block Supervisor Mohammad Mijanoor Rahman with a view to collecting data.

3.6 Selection of Variables

When choosing variables the investigator took a special care. The author choose variables after consulting to other pertinent specialist while taking into account many factors such as resources and money availability, barriers in rural people, socioeconomic and emotional aspects. Author pick various attributes such as age, educational qualifications, gender, size of family, income, expenditure, farm size, human labor, machinery inputs, seedling, manure, fertilizer, irrigation, pesticide, farm experience, credit facility, extension service, training, and so on.

3.7 Data Collection Procedure

Data collection is treated as an important part of the study. The quality of the survey result is significantly impacted by it. When making the questionnare data collection tool was used and following steps were taken:

3.7.1 Interview Schedule

Lacking of specific targets and goals, interview schedule tends to miss all vital information. It is wasting of interviewees time also asking pointless quieries consume time. In order to construct the survey questionnaire, all of the issues were addressed as much as feasible.

3.7.2 Pre-testing the Interview Schedule

To determine how much time was needed and reliability of study, the interview schedule was pretested. In doing so, the investigator was able to obtain the needed data and looked into the

acccuracy of it. To ensure finest work output, the interview schedule in terms of collecting data, processing and analyzing, and pre-testing of the interview schedule was carried out from July-August, 2022 at rural areas of Sujanagar upazila, Pabna district. Researcher herself randomly selected some farmers as respondent.

3.7.3 Finalization of the Interview Schedule and Method of Data Collection

The interview schedule was sent to my supervisor after modifications accordance to the pre tested suggestions. My co-supervisor contributed significantly to the interview schedule too. Finally, interview schedule was closed with approval of my supervisor. The interview schedule had completed in face to face interviewing.

3.8 Data Collection Technique

To finish a relevant study, several kinds of data and information are needed. Because of it, primary data was gathered from field survey and secondary data through rigorous searching.

3.8.1 Primary Data Collection

The term primary data describes the information which obtained directly from the sources by researcher. Primary data sources including surveys, observations, questionnaires, and interviews etc. The researcher personally performed the interviews. Interviews were conducted at the convenient place of the respondent.

3.8.2 Secondary Data Collection

In order to conduct the meaningful research a broad study is needed. It is needed for clarity of information information. A variety of Agricultural Universities, research organization, libearies, conferences, journals and reportshave been the sources of secondary data to evaluate the quality and depth of study.

1 Journal of agricultural statistics yearbook
2 Economic review of Bangladesh
3 Statistical Yearbook of Bangladesh
4 National and international journals, articles and publications

5 Thesis papers of Masters and PhD
6 Online, web browsing
7 Books, Journals, Publications etc.
8 Libraries of -Sher-e-Bangla Agricultural University (SAU)

3.9 Data Editing and Coding

Other crucial stages of the survey is data management such as coding and editing. It is connected to data processing. It needs to finish before data processing. In the survey, coding was completed in connection with the questionnaire to enable the researcher to easily and precisely identify the right response. When we talk about data editing, we are talking about the process of valididting data which previously collected from field.

3.10 Data Processing

Data processing involved a number of very important steps that influenced the the findings according to the relevant procedures. The following steps were performed throughout data processing.

1 Input data
2 Adding files and combine them
3 Verification of data (further computer checking, editing and imputation)
4 Final judgement on mistakes
5 Finishing data proccessing and create data file
6 Complete records
7 Transforming data file
8 All files stored

3.11 Processing, Tabulation and Analysis of Data

Data that were gathered were manually edited and coded. Gathered data then precise and cautiously checked. Data were also entered into a computer and analyzed using the associated Microsoft Excel and STATA software. At this point it is noted, the information was collected from the regional areas firstly. Taking necessary review data changed to standard international units.

3.12 Analytical Technique

Fulfilling the objectives of the study data were scrutinized. For this study, the following methods were studied: Descriptive Statistics and Econometric Analysis

3.12.1 Descriptive Statistics

Tabular methods, bar charts, pie chart are commonly used to examined the respondent socio-demographic status, living standard, demographic profile, perceptions of organic fertilizers and barriers to adoption.

3.12.2 Econometric Analysis

3.12.2.1 Logit Model

This studys second goal was to find out adoption determinants of organic fertilizer practices of Boro rice producers. Here, the adoption of organic fertilizer is a binary dependent variable and many affecting components are the explanatory variables. The adoption of organic fertilizer is a binary dependent variable which has the option of either ‘adoption’ or ‘non-adoption’. The Binary logistic regression model is the most suitable tool for examining how each independent variables affects the possibilities of adoption (Raut et al. 2011; Thapa et al. 2011).

$$Z_i = \beta_0 + \beta_k X_i + U_i \qquad (3.1)$$

where,

Z_i= Latent variable which takes value 1= if farmers use organic fertilizer and, 0 otherwise (Organic fertilizer = Cowdung, Vermi compost, Kitchen waste etc.)

β_0= Intercept

β_k= Parameter, k= Number of parameters

X_i= Input (Age, Education, Family size, Farm size, Farming experience, Credit facility, Training, Extension service, Information access, Livestock, Participation in group, Market distance, Bi-cycle/van)

i= 1,2,3…..n

U_i= Error term

The above logistic function can be expressed as follow:

$$\log\left[\frac{P}{1-P}\right] = \beta_0 + \sum \beta_k \mathbf{X}_i + U_i \qquad (3.2)$$

Where, p= Probability of outcome

β_0= Intercept

β_k is the parameter of estimates, k= (1,2,3…..13)

X_i is the vector of independent variables which includes age, education, family size, farm size, farming experience, credit facility, training, extension service, information access, livestock, participation in group, market distance, bi-cycle/van

U_i= Error term

3.13 Definition of Different Variables

Table 3.2 Definition of Different Variables

Variable	Definitions	Expected sign
Age	Age of the respondent in complete year.	(+)ve, (-)ve
Education	Education level of the respondent in year.	(+)ve, (-)ve
Family member	Total no. of family member of the respondent.	(-)ve, (+)ve
Farm size	Total farm size of the respondent in hectors.	(+)ve, (-)ve
Farming experience	Farming experience of the respondent in year.	(+)ve, (-)ve
Credit facility	A dummy variable that takes a value 1 if farmers have credit facility, and 0 otherwise.	(+)ve, (-)ve
Training	A dummy variable that takes a value 1 if farmers received any training on agricultural crops, and 0 otherwise.	(+)ve, (-)ve
Extension service	A dummy variable that takes a value 1 if farmers received extension service, and 0 otherwise.	(+)ve, (-)ve
Information access	A dummy variable that takes a value 1 if farmers have any information access and 0 otherwise.	(+)ve, (-)ve
Livestock	A dummy variable that takes a value 1 if farmers have any livestock, and 0 otherwise.	(+)ve, (-)ve
Participation in group	A dummy variable that takes a value 1 if farmers have membership to any organization, and 0 otherwise.	(+)ve, (-)ve
Bi-cycle/van	A dummy variable that takes a value 1 if farmers have any bi-cycle/van, and 0 otherwise.	(+)ve, (-)ve

3.14 Concluding Remarks

In this chapter we discussed about the study area, methodology of the study area, and various econometric model such as Logistic Regression. In the next chapter we will describe the social and economic feature of the respondents

CHAPTER 04

SOCIO-ECONOMIC CHARACTERISTICS OF SAMPLE FARMERS

4.1 Introduction

The primary aim of this part is to ascertain the socioeconomic features of Boro rice farmers which stipulate fundamental data for observed area. Socioeconomic features is major word used by social scientist to encompass a variety of topics. The social and demographic conditions are related to social factors such as age, educational profile, gender etc. Economic factors are related to the monetary status such as income, expenditure etc. Decision making behavior of a person largely controlled by his socio-economic features. Due to time and resource constraints, farmers unable to collect all information on socioeconomic characteristics. For this study, a total of 120 sample farmers of which 60 farmers were selected from Upazila Sujanagar and other 60 farmers were selected from Bera Upazila respectively. The reason is that, there are many interrelated attributes and characterizes of individual were almost the same socioeconomic quality is considered in this thesis paper which includes age, educational status, experience, size of family, availability of credit, extension, training facilities and so forth. In the following section different social and economic traits of the selected farmers has been described.

The social and demographic conditions are related to social factors.

4.2 Distribution of Respondents Based on Age

Average age of the Boro farmer was 48.41 years. Table 4.1 showed that the minimum and maximum age of the Boro rice farmer were 25 years and 80 years respectively.

Table 4.1 Age of Household Head in the Study Area

Criteria	Mean	Min	Max
Age	48.41	25	80

Source: Field Survey, 2022

Every group of Boro rice respondents in the study area were divided into various age group shown in Table 4.2

Table 4.2 No. of Boro Rice Farmers and Percentage Based on Organic Fertilizer Use

Age group	Organic fertilizer user		Inorganic fertilizer user	
	No. of farmers	Percentage	No. of farmers	Percentage
17-35	17	28.33	6	10.00
36-50	33	55.00	16	26.67
Above 50	10	16.67	38	63.33
Total	60	100	60	100

Source: Field Survey, 2022

Age was classified according to the guidelines delivered by the Peoples Republic of Bangladesh, Ministry of youth and sports. Figure 4.1 displays distribution of age among Boro farmers. Three categories were created out of the farmers: Young (17-35 years old), Middle (36-50 years old), old (above 50 years old). Age of Boro rice farmer were categorized as 17-35 years ,36-50 years, and above 50 years respectively. Among the sample 120 of Boro rice farmer, of which 60 farmer used organic fertilizer and remaining 60 farmer used inorganic fertilizer. Only within 60 farmer who used organic fertilizer about 17 farmers (28.33%), and remaining 60 farmers who used inorganic fertilizer about 6 farmers (10%) within the age group 17-35 years. Between the age group 36-50 the organic fertilizer user holds 33 farmers (55%), and inorganic fertilizer user holds 16 farmers (26.67%). The age group above 50 organic fertilizer user holds 10 famers (16.67%) and inorganic fertilizer user holds 38 farmers (63.33%) only (Table 4.2). According to study area 55% of organic fertilizer user which is majority in percentage of organic fertilizer user between age group 36-50. About 63.33% is majority farmers who used inorganic fertilizer above age 50 years. Figure 4.1 showed age-based distribution of Boro rice farmers.

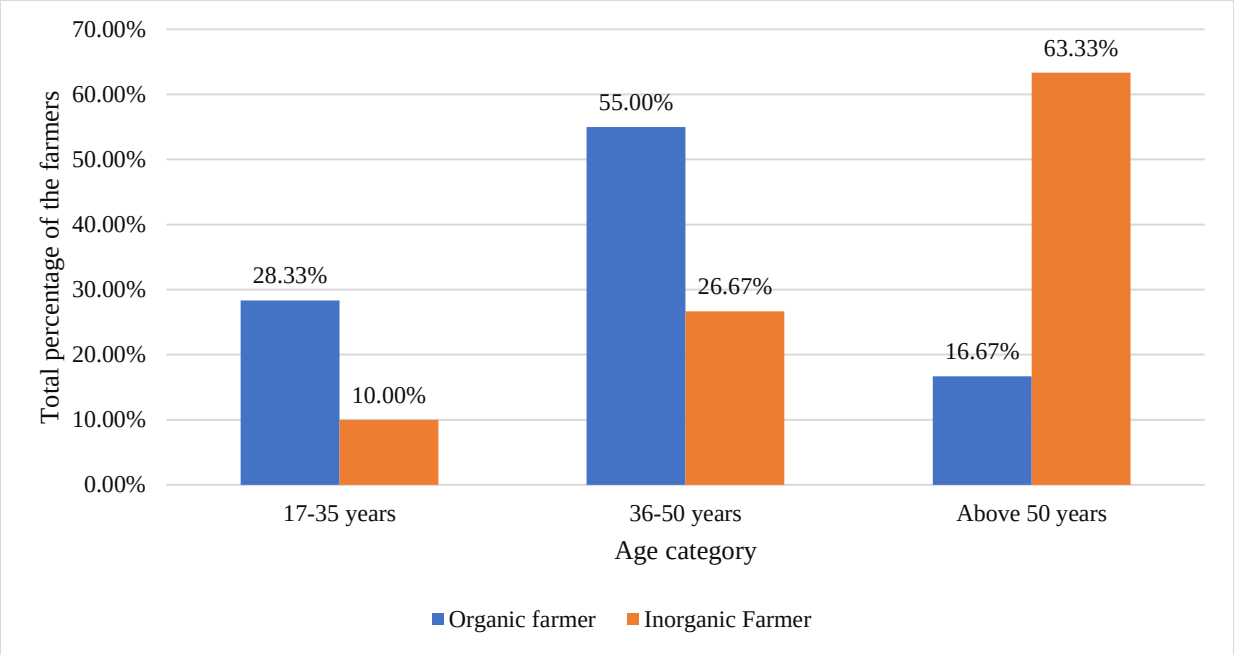

Figure 4.1 Age of the Farmers in Study Area

Source: Field survey, 2022

4.3 Distribution of Respondents Based on Education

Education is a sign of a community's socioeconomic progress. Education is essential to decrease poverty anddisparity, improve wellness and enable application ofwisdom. People with more education have more useful information about the food and livelihood systems. Higher incomes, which are again dependent on higher levels of earnings, are also associated with higher levels of education. According to Bangladesh Bureau of Statistics, 2016 education classified as Primary (class 1-5), Secondary (class 6-10), Higher secondary (class 11-12), and Higher level (13-17).

From Figure 4.2, 5.00% of farmer who use organic fertilizer, 41.67% of farmer who use inorganic fertilizer are illiterate. 33.33% among organic fertilizer user, and 38.33% of inorganic fertilizer user had completed their primary education, within organic fertilizer user 58.34% and 18.33% within inorganic fertilizer user had completed their secondary school, and only 3.33% of organic fertilizer user and 1.67% who do not use organic fertilizer had completed their higher secondary and above schooling. The study conclusion shown the most of the sample farmers

who use organic fertilizer only had a secondary level of education and within inorganic farmer majority had no formal education.

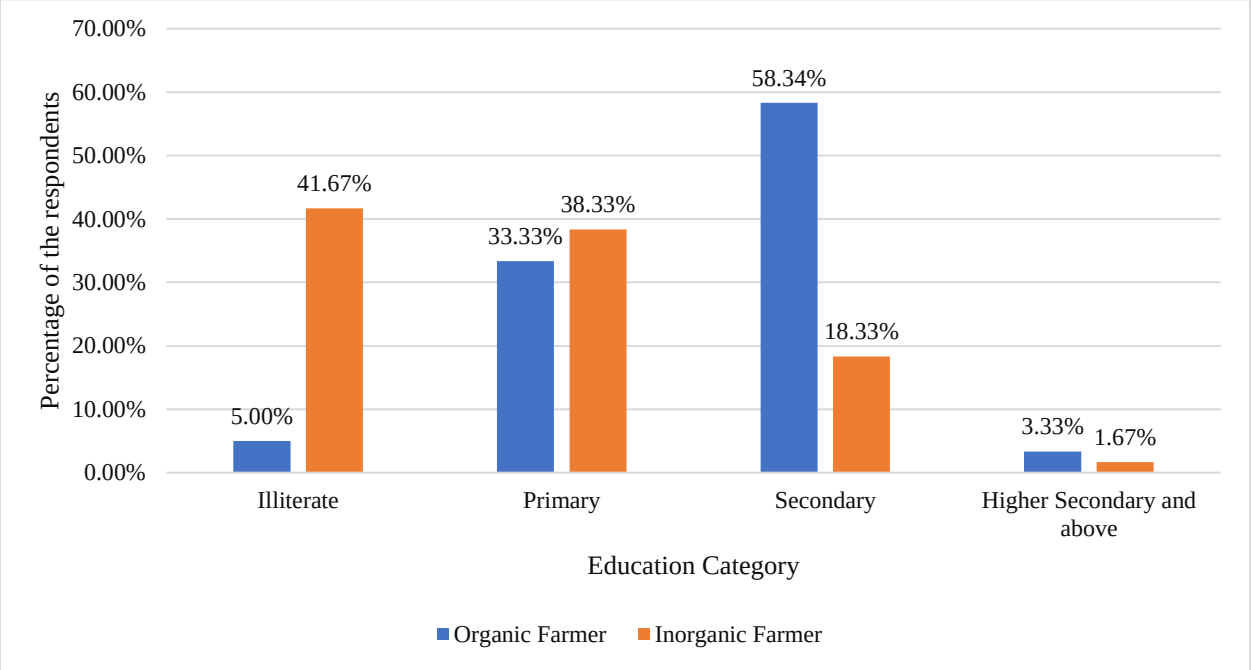

Figure 4.2 Education of the Farmers in Study Area

Source: Field survey, 2022.

4.4 Distribution of Respondents Based on Family Size

To the study area, family size is stated as total number of population living in the same roof as the family's head. The average number of families in the study area was 4.84, which is greater than the national average of 4.06 (HIES, 2016). According to Table 4.3, households had a minimum of 2 people and a maximum of 10 people in each family.

Table 4.3 Size of Household of Boro Farmers in the Study Area

Criteria	Mean	Min	Max
Family size	4.84	2	10

According to the HIES, 2016 the total population of all families was divided into three groups Figure 4.3 showed the differences in family size among Boro farmers. 120 farmers were sampled, 60 of which use organic farmer, remaining 60 inorganic farmer and 40.00% (organic fertilizer user), 43.33% (inorganic fertilizer user) of them belonged to small families (of up to 4 members), 58.33% (organic fertilizer user), 50.00% (inorganic fertilizer user) hold medium families (of 5–7 members), and 1.67% (organic fertilizer user), 6.67% (inorganic fertilizer user) to large families (7 or more members).

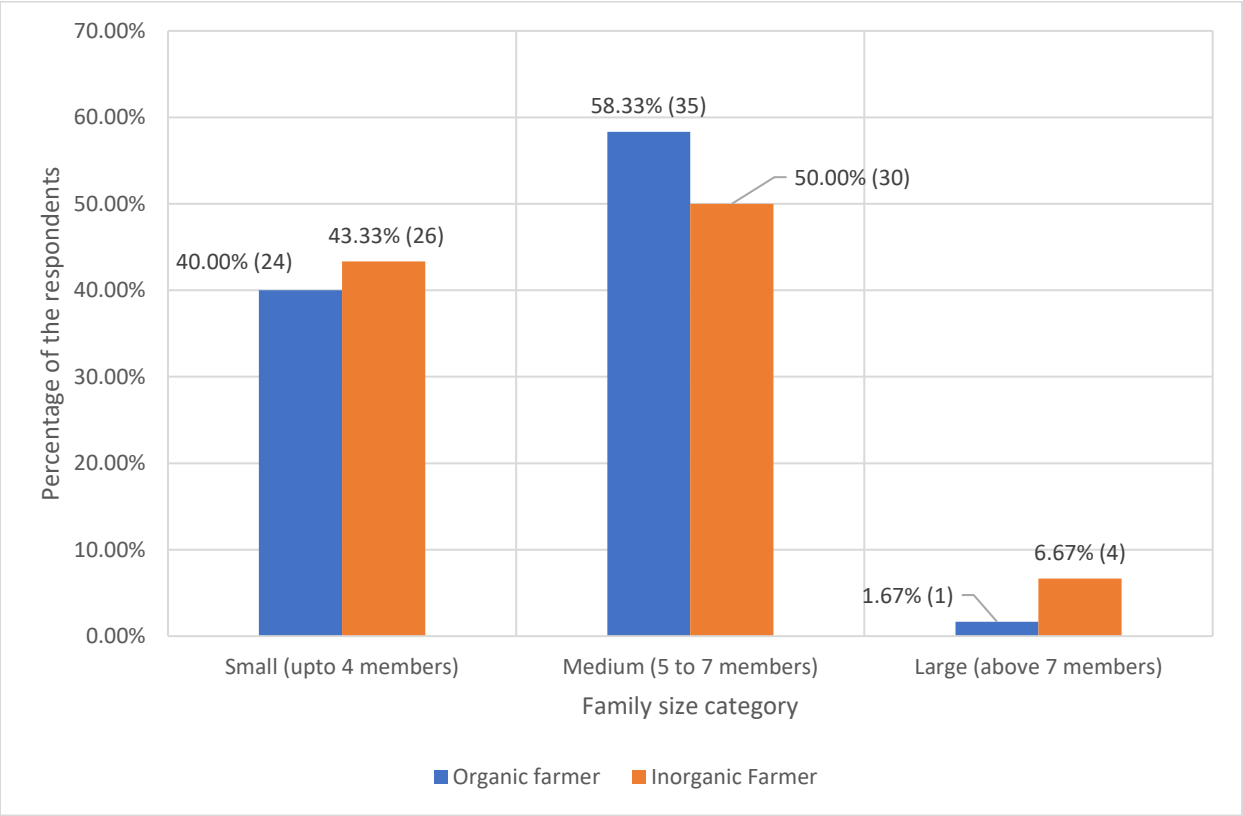

Figure 4.3 Family Size of Farmers in the Study Area

Source: Field Survey, 2022.

Note: Household size has been categorized based on BBS (2016)

4.5 Distribution of Respondents Based on Gender

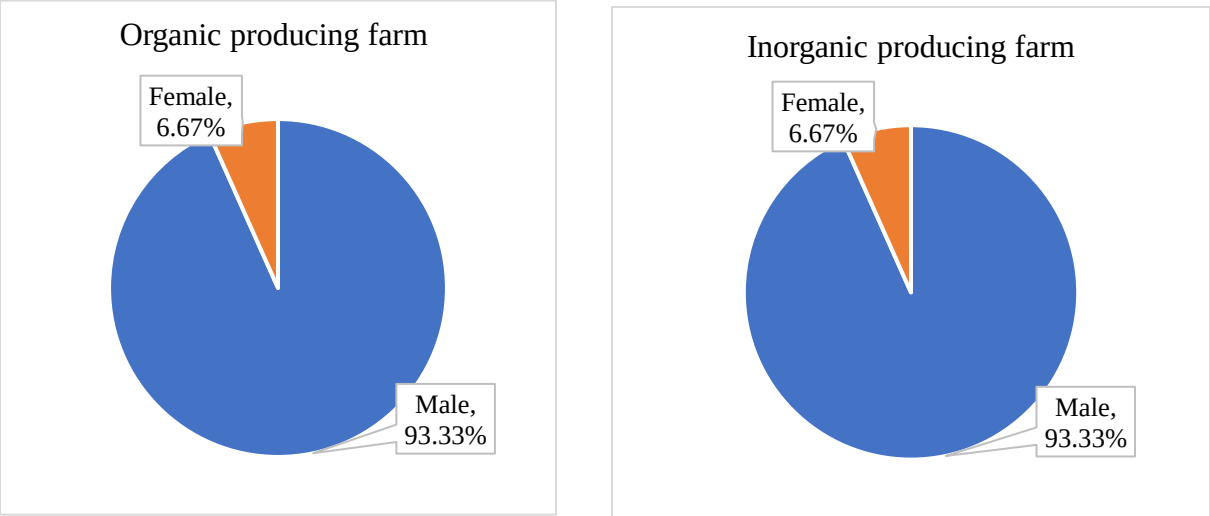

Figure 4.4 Gender distribution of the Farmer in the Study Area

Source: Field Survey, 2022

It can be seen from figure 4.4 about 6.67% of farmer who use organic fertilizer are female which the majority are male. Besides, about 6.67% of female using inorganic fertilizer.

4.6 Distribution of Respondents Based on Annual Household Income

Farmers annual household income comprised all earnings from different sources including day labor, services, business, remittances, livestock rearing, crop farming and fish farming. According to HEIS (2016), boro farmers are categorized having low income (less than 2 lakh), medium income (2-5 lakh), and high income group (more than 5 lakh) based on their household income.

It can be seen from Table 4.4, about 13 farmers (21.66%) who use organic fertilizer, and 4 farmers (6.67%), a total no. of 17 farmers (14.16%) of the respondent under high income group. About 40 farmers (66.67%) of organic farmer and 45 farmer (75%) of inorganic farmer, a total of 85 farmer (70.83%) farmer under the medium income group. Lastly, 7 farmer (11.67%) of organic fertilizer user and 11 farmer (18.33%) of inorganic fertilizer user, a total of 18 farmer (15%) under the lower income group.

Table 4.4 Annual Income of Boro Rice Farmers in the Study Area

Income Category (Thousand Taka)	Organic Fertilizer User		Inorganic Fertilizer User		Total	
	Number	Percentage	Number	Percentage	Number	Percentage
up to 200	7	11.67	11	18.33	18	15.00
201-500	40	66.67	45	75.00	85	70.83
above 500	13	21.66	4	6.67	17	14.16
Total	60	100.00	60	100.00	120	100

Source: Field Survey, 2022.

Note: Household size has been categorized based on BBS (2016)

4.7 Distribution of Farmer Based on Farming Experience

It can be estimated that the average Boro farming experience was 11.49 years. Table 4.5 show that minimum and maximum values of Boro farming experience are observed at 2 years and 30 years respectively (Table 4.5)

4.5 Farming Experience of Farmers

Criteria	Mean	Min	Max
Experience	11.49	2	30

Source: Field Survey, 2022

According to the field survey it shown from Table 4.6 majority of the farmer, 42 farmers (70.00%) of organic farmer, and about 39 farmer (65.00%) farmer of inorganic farmer have up to 10 years experience.

Table 4.6 Farming Experience Category Based on Years

Farm experience category	Organic farmer		Inorganic farmer	
	No. of farmer	Percentage	No. of farmer	Percentage
Up to 10 years	42	70.00	39	65.00
11-20 years	14	23.33	13	21.67
Above 20 years	4	6.67	8	13.33
Total	60	100	60	100

Source: Field Survey, 2022

Figure 4.5 show the Boro farming experience which is divided into farming experience group (up to 10 years), (11-20 years) and (above 20 years) according to field survey.

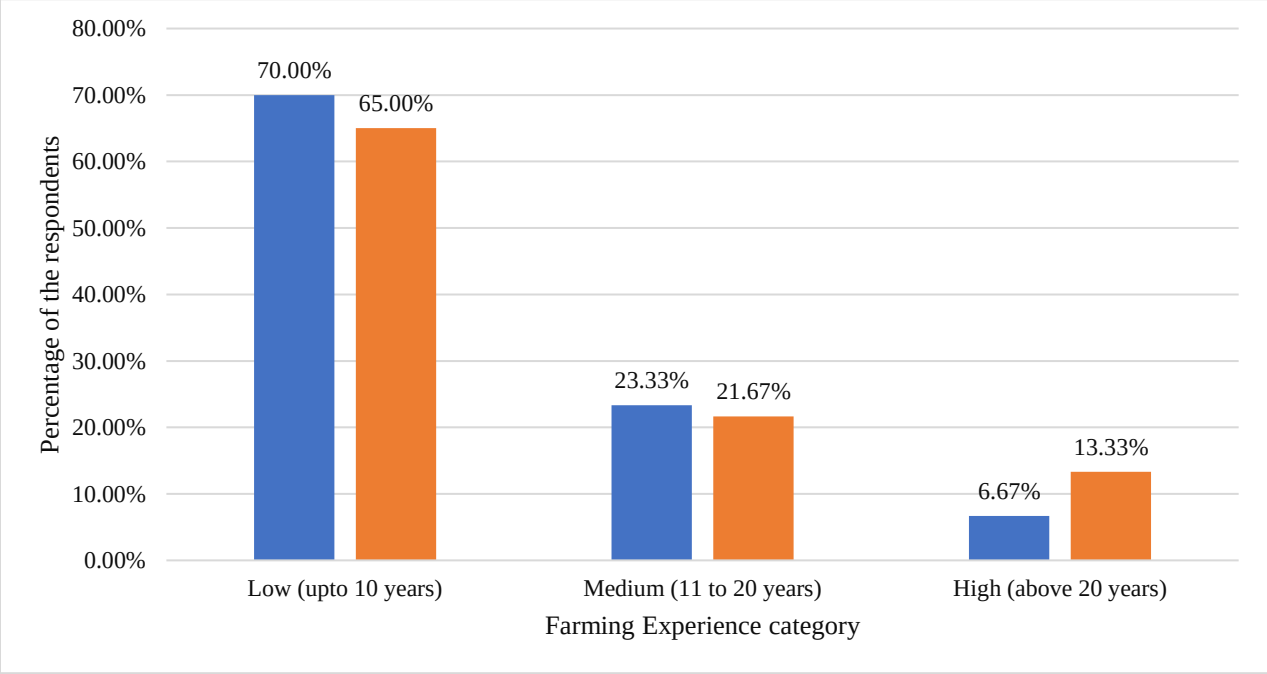

Figure 4.5 Experience of Farmers in the Study Area

Source: Field Survey, 2022.

4.8 Distribution of Farmers Based on Agricultural Training Received

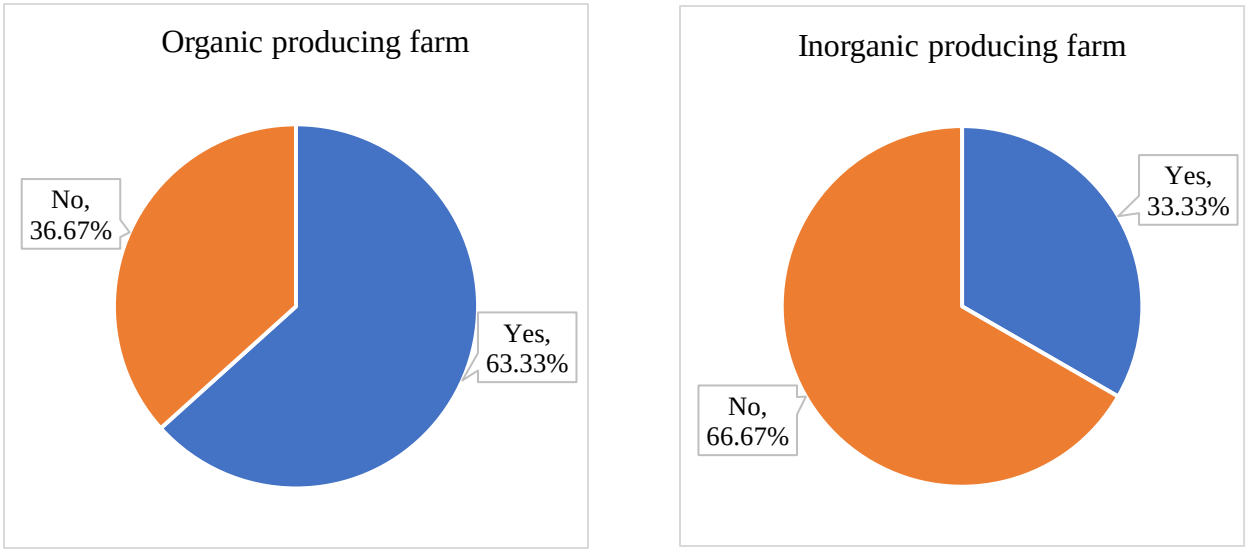

Figure 4.6 Training on Agriculture of Farmers in the Study Area

Source: Field Survey, 2022.

Among the organic farmers 63.33% of 60 respondents got training on production of different agricultural crops whereas, 36.67% of the respondent did not get any training. On the other hand, about 33.33% of inorganic farmer got training where as 66.67% did not get training.

4.9 Distribution of Farmer Based on Extension Service Received

Figure 4.7 showed that among the respondent farmers, 63.33% organic farmers receive extension service that means farmers had direct or indirect contact with the agricultural extension officers and rest of the 36.67% of organic farmers do not receive any extension service. Among inorganic farmers 36.67% got extension service remaining 63.33% did not get extension service.

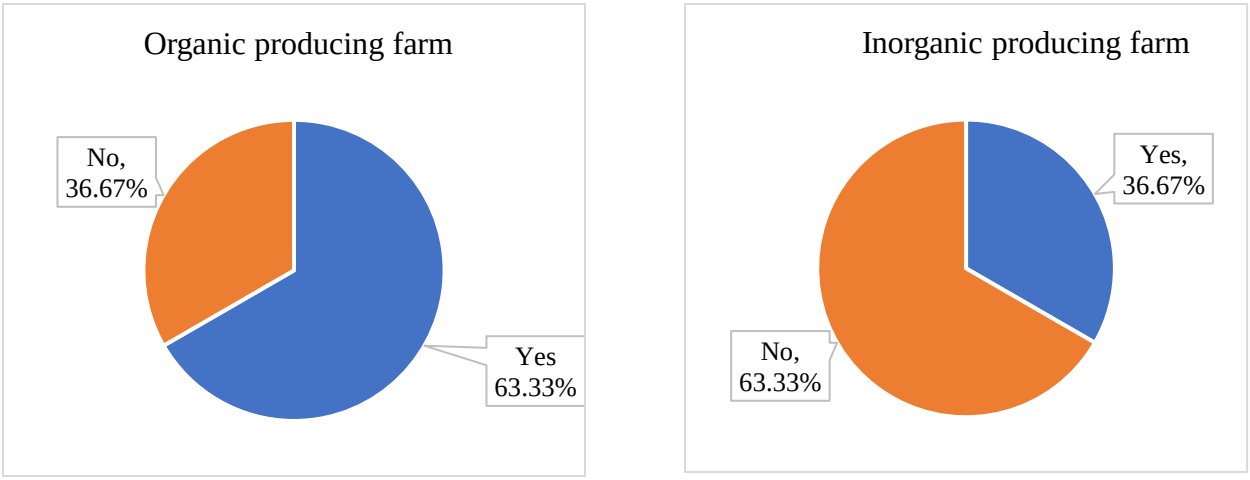

Figure 4.7 Farmers Received Agricultural Extension Service in the Study Area

Source: Field Survey, 2022.

4.10 Distribution of Farmers Based on the Use of Credit

Proper financing is an important component to farming business. About 46.67% of organic farmers received loan from Banks and different NGOs for Boro rice cultivation and 53.33% farmers was used their own funds for Boro cultivation in the study area. Again about 78.33% of inorganic farmer received loan and 21.67% did not receive any loan.

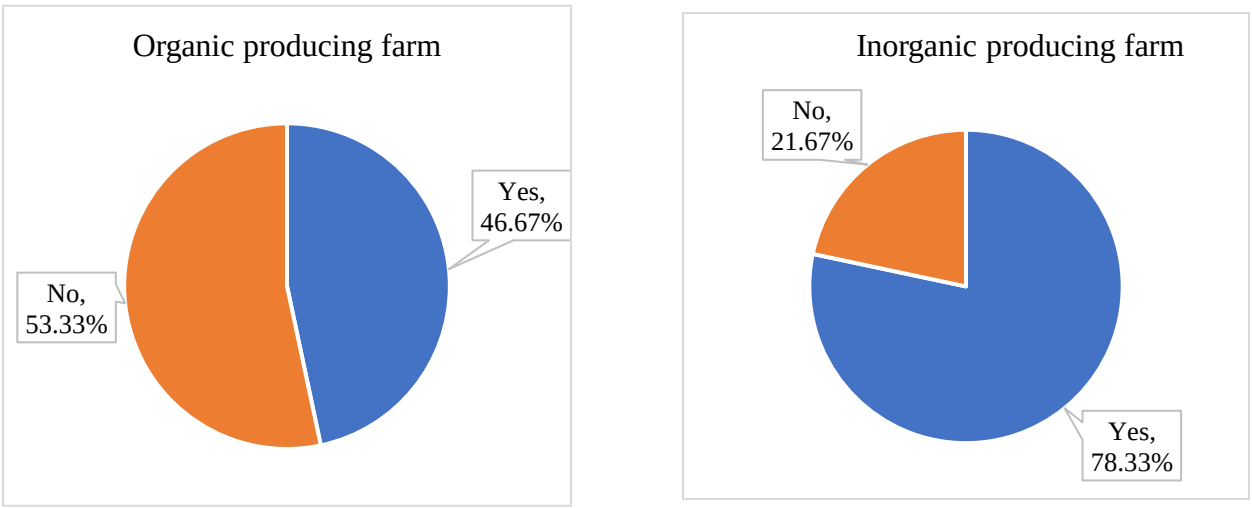

Figure 4.8 Use of Credit by Farmers in the Study Area

Source: Field Survey, 2022

4.11 Distribution of Farmers Based on Livestock Rearing

From the figure 4.9, about 66.67% sample of organic farmers rearing livestock and rest of 33.33% farmers do not parenting livestock. On the other hand 30.00% of inorganic farmers have livestock remaining 70.00% do not have any livestock.

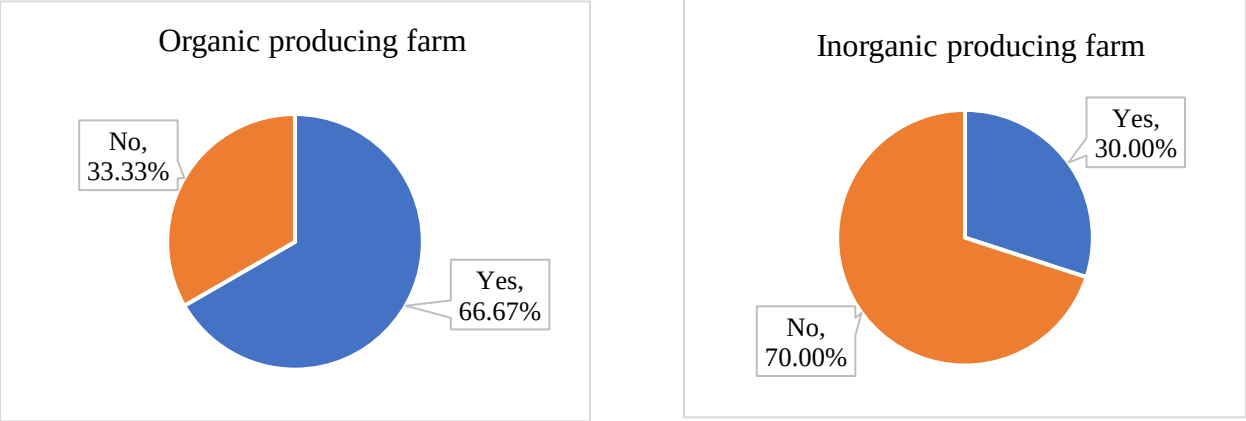

Figure 4.9 Livestock Rearing Percentage in the Study Area

Source: Field Survey, 2022

4.12 Distribution of Farmers Based on Membership in Organization

Among the organic farmers, 66.67% of Boro rice farmers were member of various organizations and 33.33% of Boro growers had no participation in any organization. The figure also showed that 33.33% of inorganic farmer received membership and 66.67% did not.

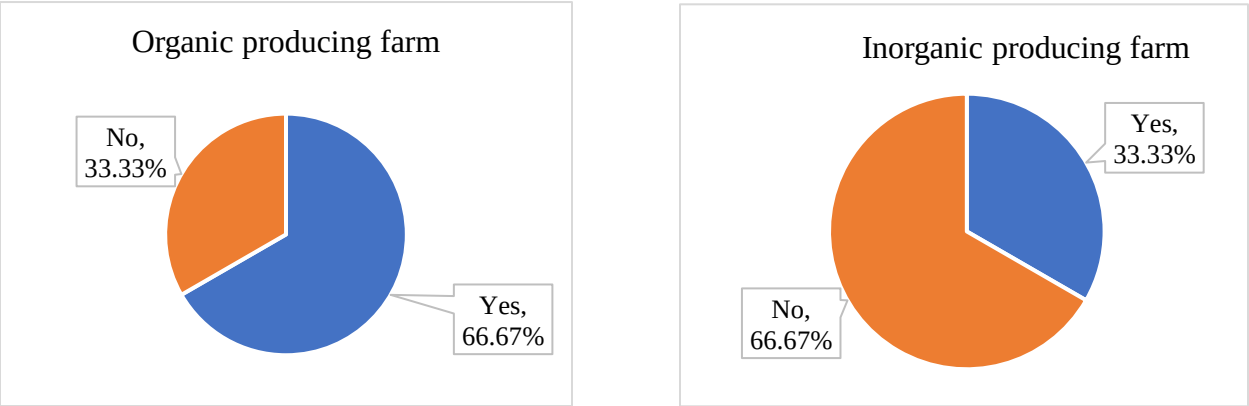

Figure 4.10 Membership in Organization in the Study Area

Source: Field Survey, 2022

4.13 Distribution of Farmers Based on Local Market Distance from Home

According to the study area on the basis of distance of market, it can be estimated that the average distance between home and nearby market is 1.5 km, lowest distance is 0.5 km, and highest

distance from home to local market is 5 km respectively.

Table 4.7 Distance from Home to Local Market

Criteria	Mean	Min	Max
Market Distance (km)	1.546	0.5	5

4.14 Concluding Remarks

The socioeconomic features of sample farmers were covered in this section based on study area. From the above discussion it is evident that certain distinctions exist in socio-economic characteristics among Boro rice farmers in selected area.

CHAPTER 05

ADOPTION DETERMINANTS OF ORGANIC FERTILIZER USE ON BORO RICE PRODUCTION

5.1 Introduction

The primary goal of this section is to to judge the determinants influencing the adoption of organic farming on Boro rice farmers. A binary logistic model was used in the study area. A statistical analytical tool for predict binary outcome is the logistic regression model method, such as true or false, according to previous observation of data. Findings of the research are being discussed in this chapter.

5.2 Adoption Determinants of Organic Fertilizer Use on Boro Rice Production

To run the binary logistic model, use both continuous and dummy variables as independent variable. There may be correlations between the variables selected for analysis. Avoiding correlation between the independent variables is very important for research reliability. Hence, VIF (Variance Inflation Factor) test is applied to detect the multi-collinearity. Test result showed that VIF value ranged between 1.11 to 4.51 which is lower than the cut off value of 10. The VIF value is 4.39. Besides, the correlation matrix also indicate that multicollinearity is not an issue in the study. In addition, link test has also been conducted to find the validity of the logit model specification. Results shows that the hats value is 0.0145204 which is insignificant at 5% level of significant. Hence, the logistic regression model specification is valid and there is no omitted variable issue in the model.

5.3 Interpretation of the Variables Based on Marginal Effect

5.3.1 Age (X_1) of the Respondent

The marginal effect of age was negative and significant at 5% level of significance, which implies that increase in age by 1 year will decrease probability of adoption of organic fertilizer on Boro rice production by 0.7% (Table 5.1). The most likely reason for this might be that aged farmers prefer to practicing traditional farming method than adopting organic farming method.

5.3.2 Education (X_2) of the Respondent

The marginal effect of education was positive and significant at 5% level of significance which implies that increase in education by 1 year will increase probability of adoption of organic fertilizer on Boro rice production by 1.8% (Table 5.1). The most likely reason for this might be that educated person are aware of good quality of foods, sustainable agricultural development and environmental protection.

5.3.3 Family Size (X_3) of the Respondent

The marginal effect of family size was negative and significant at 10% level of significance, which implies that farmers having large family are 3.6% less likely to adopt organic fertilizer on Boro rice production compared to those who have small family (Table 5.1).

5.3.4 Credit Facility (X_6) of the Respondent

The marginal effect of credit facility was negative and significant at 5% level of significance, which implies that farmers who have credit facility are 15.7% less likely to adopt organic farming on Boro rice production compared to those who do not have credit facility (Table 5.1).

5.3.5 Training (X_7) of the Respondent

The marginal effect of training was positive and significant at 5% level of significance, which implies that farmers who have taken training on organic farming are 12.5% more likely to adopt organic fertilizer on Boro rice production compared to those who have not taken training (Table 5.1). The most likely reason for this might be that trained farmers knowledge and perception about organic farming is better than who do not have received training.

Table 5.1 Estimated Determinants of the Adoption of Organic Fertilizer in Boro Rice Production

Variable	Coefficient	Marginal Effects
Age (X_1)	-0.0903**	-0.007**
	(0.021)	(0.013)
Education (X_2)	0.230*	0.018**
	(0.065)	(0.048)
Family Size (X_3)	-0.463	-0.036*
	(0.111)	(0.098)
Farm size (X_4)	0.305	0.023
	(0.692)	(0.692)
Farming Experience (X_5)	-0.031	-0.002
	(0.52)	(0.517)
Credit facility (X_6)	-2.028**	-0.157**
	(0.020)	(0.014)
Training (X_7)	1.613**	0.125**
	(0.046)	(0.031)
Extension Service (X_8)	1.378*	0.107*
	(0.087)	(0.071)
Information Access (X_9)	1.254*	0.097*
	(0.081)	(0.067)
Livestock (X_{10})	1.464**	0.114**
	(0.047)	(0.037)
Participation in Group (X_{11})	1.088	0.084
	(0.155)	(0.138)
Market Distance (X_{12})	0.99	0.077*
	(0.108)	(0.095)
Bicycle/van ownership (X_{13})	1.486**	0.115**
	(0.056)	(0.040)

p values in parentheses

Note: ***, **, and * indicates significant at 1, 5 and 10 percent level, respectively.

Source: Field survey, 2022

5.3.6 Extension Service (X_8) of the Respondent

The marginal effect of extension service was positive and significant at 10% level of significance, which implies that farmers who have got extension service are 10.7% more likely to adopt organic fertilizer on Boro rice production compared to those who have not got (Table 5.1). The most likely reason for this might be that farmers who accessed extension services more frequently and familiar with organic farming achieved higher yield and profit from their cultivation.

5.3.7 Information Access (X_9) of the Respondent

The marginal effect of information access was positive and 10% level of significance, which implies that farmers who have information access are 9.7% more likely to adopt organic fertilizer on Boro rice production compared to those who having no information access (Table 5.1). The most likely reason for this might be that access to information facilitates learning, sharing, and adopting of organic agriculture techniques that will benefit farmers.

5.3.8 Livestock (X_{10}) of the Respondent

The marginal effect of livestock was positive and 5% level of significance, which implies that farmers having livestock are 11.4% more likely to adopt organic fertilizer on Boro rice production compared to those who did not have any livestock (Table 5.1). The most likely reason for this might be that who have livestock organic manure is available to them compare to who do not have livestock.

5.3.9 Market Distance (X_{12}) of the Respondent

The marginal effect of market distance was positive and significant at 10% level of significance which implies that increase in market distance to local market from home by 1 kilometer will increase probability of adoption of organic fertilizer on Boro rice production by 7.7% (Table 5.1).

5.3.10 Bicycle/Van Ownership (X_{13}) of the Respondent

The marginal effect of bicycle or van was positive and significant at 5% level of significance, which implies that farmers having bicycle or van are 11.5% more likely to adopt organic fertilizer on Boro rice production compared to those who did not have any bicycle or van (Table

5.1). The most likely reason for this might be that farmers who have bi-cycle or van can easily carry organic fertilizer without hiring any van. It saves farmers time and cost.

5.4 Concluding Remarks

Among the factors age, education, family size, credit facility, training, extension service, information access, livestock, market distance, and bicycle/van have the greatest impact on the adoption of organic farming on Boro rice production. Therefore, age, family size, credit facility have negatively impact on adoption of organic farming on Boro rice production. With this recognition, more training facilities, credit services, information access to larger farmer groups and increase more awareness on organic farming. However, we will discuss the problems of Boro rice production in next chapter.

CHAPTER 06

IDENTIFY THE PROBLEMS OF ORGANIC FERTILIZER USE ON BORO RICE PRODUCTION

6.1 Introduction

The primary goal of this chapter is to determine the scale of the problem of organic fertilizer facing Boro rice farmers. Farmers faced many problems of using organic fertilizer producing Boro rice. The issues encompassed social, cultural, financial and technical aspects. This chapters goal is to outline some socioeconomic problems and contraints of using organic fertilizer on Boro production. The main issues and limitations associated with Boro cultivation are described below.

6.2 Lack of Credit Facility

Respondents were faced credit limitations to use organic fertilizer on Boro rice production. A big amount of money is required to buy different inputs such as human labor, seedlings, manures, irrigation etc. In the research region approximately 7.5% of Boro farmers complained that their credit was insufficient to purchase the minimum amount of inputs for the production and this is a major problem which ranking 1st in the study area (Table 6.1)

6.3 High Price of Inputs

High price of agricultural input was one of the major bounderies in Boro rice production in the study area. Agricultural inputs perform a crucial part on Boro rice production such as, labor, fertilizers, manure, machinery etc. About 86 farmers or 71.67% among 120 respondent faced by high price of inputs and it is ranked by 2nd position in the study area (Table 6.1)

6.4 Lack of Training

Farmers with agricultural training are aware of the importance of water management, herbicides, resistant cultivars and high quality of seedlings. Contemporary methods of farming in agriculture are used in the study area but many respondents don't have information about proper doses, approaches of how to use latest inputs and technologies. Lackings of proper training is another obstacle to use organic fertilizer. About 57.5% of the respondent reported to the problem and this problem is ranked 3th in the study area (Table 6.1).

Table 6.1 Problems of Organic Fertilizer Use on Boro Rice Production to the Study Area

Problems	No. of farmers	Percent of farmers	Rank
Lack of Credit Facility	93	77.5%	1st
High Price of Inputs	86	71.67%	2nd
Lack of Training	69	57.5%	3rd
Insects, Pest and Disease	42	35%	4th
Labor Shortage	28	23.33%	5th
Irrigation Problem	17	14.17%	6th
Lack of Storage	12	10%	7th

Source: Field Survey, 2022

6.5 Insects, Pest, and Disease

Insects, pest and disease are one of the most serious limitations in using organic fertilizer on Boro rice production. Boro rice producers have been plagued with pest and disease infestations. Pests and diseases spread, reducing crop yields and increasing production costs. About 35% of Boro rice producers stated facing this difficulty and it is ranked 4th in the study area (Table 6.1)

6.6 Labor Shortage

Boro rice production and using organic fertilizer is labor intensive. Magority of the labor used in land preparation, transplantation of seedlings and period of harvesting. The unavailability of labor was noted as various stages of cultivation such as transplanting, intercropping and harvesting. The survey found that 23.33% of Boro rice producers reported for this problem and it is ranked 5th in the study area (Table 6.1

6.7 Irrigation Problem

Water availability is an important input for Boro rice production. The yield of Boro rice differed with the treatment of irrigation water. Most of the farmers in the study area do not have their own shallow or deep tube-wells. However, the availability of irrigation water in the study area is not a serious due to portable irrigation equipment. However, farmers reported this problem, which ranked 6th in the study area (Table 6.1)

6.8 Lack of Storage

Lack of storage facilities is another major problem for Boro production. Storage meets the usability of time requirement and removes the time gap between producer and consumer. As Boro is a high yielding variety and farmers who seeking high price they store rice and when there is a shortage, they sell it at high price. About 10% of the respondents faced this problem which ranked 7th position in the study area (Table 6.1).

6.9 Concluding Remarks

The above discussion indicated that farmers who are using organic fertilizer on Boro rice production in the study area facing some major difficulties. Those are the chief constraints of using organic fertilizer on Boro rice production in the study area. To improve the production and lessen the issues of boro rice some steps should be taken.

CHAPTER 07

SUMMARY, CONCLUSION AND RECOMMENDATIONS

7.1 Introduction

This chapter devoted to summaries in the discussion made in previous chapter. Conclusions are drawn based on empirical results. Policy recommendations will be prepared to improve existing organic farming for Boro rice production in Bangladesh.

7.2 Summary

Economic growth is primarily driven by agriculture in Bangladesh. The performance of the agricultural sector is inextricably linked to economic development. Countrys crop industry makes up the largest portion of agriculture and its GDP which contributes indirectly to overall growth and development of the economy. GDP growth rate reached 7.5% in 2022 (BER, 2022). The broad agricultural sector adds 11.50% to GDP, about 70% of the population earns their living from agriculture (BER, 2022) additionally, agriculture produces a wide range of agricultural commodities marketplaces that highly demanded by rural consumers.

In Bangladesh rice is essential to all aspects of life. In terms of livelihood and food security it is the most crucial commodity for people. In accordance with BBS, food grain production was 443.56 million metric ton in fiscal year 2020-21 in which Aus 32.85 million metric ton, Aman 144.38 million metric ton, Boro 198.85 million metric ton and wheat 10.85 million metric ton. The total food grain production target for fiscal year 2020-21 is 465.83 million metric ton, of which about 34.84 million metric ton is Aus, Aman 150.47 million metric ton, Boro 209.51 million metric ton and wheat 12.26 million metric ton approximately.

Boro rice is grown all over the Bangladesh for export as well as domestic market. Its production contributes significantly to raise farmers living standards specially in marginal and small farmers and meeting the nutritional requirements of the people of Bangladesh. As Boro rice production is labor intensive, so cultivation of this crop can create more employment opportunities for rural

people in Bangladesh. In this regard, organic farming plays an important role on Boro rice production. Organic fertilizers are naturally available sources of minerals that contain moderate amounts of essential plant nutrients. The use of organic fertilizers is a necessary source of nutrients for sustainable agriculture and ensures high quality food production. Farmers using various inorganic fertilizers negatively affect ground water and the environment. It reduces soil productivity and affects rice production in the long run. In this case, use of organic fertilizer restores soil health and increases productivity of Boro rice.

The present study provides answers of several important questions, such as determinants of organic fertilizer use in Boro rice production, problems of using organic fertilizer on Boro rice production. Therefore, a systematic research work is done on this to make available information to the farmers who want to cultivate Boro rice using organic fertilizer. The sampling frame of this study was selected purposively. Five villages of Sujanagar and Bera upazila in Pabna district were selected for the study. In addition to, extensive study on all the secondary sources, 120 farmers (60 farmers from organic fertilizer user and 60 farmers from who do not use organic fertilizer) from two Upazila Sujanagar and Bera were purposive randomly selected for conducting the field level survey to collect primary data.

Typically, farmers cultivate Boro rice in December-January and reaped it after three months. In this study data was gathered in the period of August-September, 2022. Primary data were gathered from producers. Purposive random sampling technique was used for data collection. Farmers direct interviewed using a pre-tested interview schedule. The consistency and completeness of the collected data were ensured by verificationand checking. Prior to entering the data into computer, data editing and coding was completed. All data were summarized and scrutinized carefully to eliminate any possibility of error. Data analysis was done using the Microsoft Excel and STATA.

Descriptive analysis such as socioeconomic condition of sample household considered age, educational status, family size, gender, annual household income, farming experience, agricultural training, extension service, use of credit, livestock involvement, membership on organization, local market distance from home of the sample farmers was completed with the help of SPSS and data were presented in the tabular and graphical form, because these were of simple calculation, widely used and easy to understand.

The socio-economic profile of age of the organic fertilizer user of Boro rice producer reveals that about 28.33% of the populations were under 17-35 years age group, 55% of organic fertilizer user which is majority in percentage of organic fertilizer user between age group 36-50. About 63.33% is majority farmers who used inorganic fertilizer above age 50 years. and only 16.67% were of 50 years or above. On the other-hand within the inorganic fertilizer user 16.67% of the populations were under 17-35 years age group and only 63.33% was of 50 years or above. The average age of the Boro rice farmer was 48.41 years, minimum and maximum age of the Boro rice farmer were 25 years and 80 years respectively. The socio-economic profile of educational status about 5.00% of farmer who use organic fertilizer, 41.67% of farmer who use inorganic fertilizer are illiterate. 33.33% among organic fertilizer user, and 38.33% of inorganic fertilizer user had completed their primary education, within organic fertilizer user 58.34% and 18.33% within inorganic fertilizer user had completed their secondary school, and only 3.33% of organic fertilizer user and 1.67% who do not use organic fertilizer had completed their higher secondary and above schooling. The socio-economic profile of family size reveals that 40.00% (organic fertilizer user), 43.33% (inorganic fertilizer user) of them belonged to small families (of up to 4 members), 58.33% (organic fertilizer user), 50.00% (inorganic fertilizer user) hold medium families (of 5–7 members), and 1.67% (organic fertilizer user), 6.67% (inorganic fertilizer user) to large families (7 or more members).The socio-economic profile of annual income of the 120 respondent is about 15.00% farmer under lower income group. About 70.83% farmers are medium and 14.16% high income group respectively. The socio-economic profile of farming experience reveals that according to the field survey it can be seen majority of the farmer, about 70.00% of organic farmer, and about 65.00% farmer of inorganic farmer have up to 10 years experience. The socio-economic profile of training on agriculture reveals that among the organic farmers 63.33% of 60 respondent got training on production of different agricultural crops whereas, 36.67% of the respondent did not get any training. On the other hand, about 33.33% of inorganic farmer got training where as 66.67% did not get training. The socio-economic profile of extension service reveals that about 63.33% organic farmers receive extension service that means farmers had direct or indirect contact with the agricultural extension officers and rest of the 36.67% of organic farmers do not receive any extension service. Among inorganic farmers 36.67% got extension service remaining 63.33% did not get extension service. The socio-economic profile of used of credit, about 46.67% of organic farmers received loan and 53.33%

farmers was used their own fund, whereas about 78.33% of inorganic farmer received loan and 21.67% did not receive any loan. The socio-economic profile of having livestock about 66.67% sample of organic farmers have livestock and rest of 33.33% farmers do not have livestock. On the other hand 30.00% of inorganic farmers have livestock remaining 70.00% do not have any livestock. The socio-economic profile of membership on organization reveals that among the organic farmers, 66.67% was member of various organizations and 33.33% of farmers had no membership in any organization, whereas 33.33% of inorganic farmer received membership and 66.67% did not.

Binary Logistic Regression model is used to find out adoption determinants of organic fertilizer use on Boro rice production. Thirteen inputs were used in this model. Among the inputs age, family size, credit facility were significant and negative, which implies that increase in inputs by 1 unit will decrease probability of adoption of organic farming on Boro rice production by percent. The marginal coefficient were -0.007, -0.036, -0.157 respectively. On the other hand education, training, extension service, information access, livestock, market distance, bicycle/van ownership were significant and positive. The marginal coefficient 0.018, 0.125, 0.107, 0.097, 0.114, 0.077, 0.115 respectively. The value of VIF was 4.39, in addition link test has been conducted, the value of hats was 0.0145204 and there is no correlation and omitted variable issues in the model.

Farmers faced a lot of problems of using organic fertilizer on Boro rice production. Lack of credit facility, high price of inputs, lack of training, insects, pest and disease, labor shortage, irrigation problem, lack of storage were the major problem faced by farmers. Among these problems lack of credit facility ranked first, high price of inputs ranked second, and lack of training ranked third position in the study area.

7.3 Conclusion

Rice is the first cereal crop which is grown by farmers all over the Bangladesh. Boro rice is cultivated for food and market purpose. The study areas have tremendous potential for Boro rice production. As Boro rice is a crop, it would help to create employment generation. Result from socio-economic profile reveals that, about majority of organic fertilizer user between age group 36-50 holds medium family size, on the other hand among inorganic fertilizer user majority above 50 years with medium family size. Among organic fertilizer user, majority completed their secondary level of schooling with medium income whereas inorganic fertilizer user, majority of them had no formal schooling with medium income. Most of the organic fertilizer user have up to 10 years farming experience who have agricultural training, whereas inorganic fertilizer user have up to 10 years farming experience with no training on agriculture. Most of the organic fertilizer user did not use of credit whereas inorganic fertilizer get it although organic fertilizer user engaged on organizational membership than inorganic fertilizer user. Organic fertilizer user having livestock on the other hand most of the inorganic fertilizer user have no livestock.

Education, training, extension service, information access, livestock, market distance, bicycle/van ownership, age, family size, credit facility had significant effect on determinants of organic fertilizer use on Boro rice production.

Among various problems of using organic fertilizer on Boro rice production, lack of credit facility ranked first to the study area, high price of input ranked as second position, lack of training facility ranked as third position.

7.4 Recommendations

Based on the above analysis, the following recommendations are made as general guidelines for development of Boro rice production with organic fertilizer application in the study area and across the country.

1. High price of input is the main problem of using organic fertilizer. So, price of input should be curtailed.
2. To increase production, farmers should be provided with appropriate training on recommended fertilizer dose of using organic fertilizer.
3. Education improves farm productivity through the use of organic fertilizers in production. This study suggests that farmers schooling program should be implemented in the study area.
4. Organic fertilizer has a positive impact on Boro rice production. Therefore, Government should take necessary measures to supply organic fertilizer.
5. Livestock rearing is the main source of organic fertilizer which has positive impact on adoption determinants of Boro rice production. So, Government should be taken various policy to encourage livestock rearing.
6. Boro rice production with organic fertilizer is a labor intensive crop. Labor should be availed to the farmers.
7. Various awareness program of organic fertilizer on Boro rice should be implemented to increase production of Boro rice.

REFERENCE

Abebe, G., & Debebe, S. (2019). Factors affecting use of organic fertilizer among smallholder farmers in Sekela district of Amhara region, Northwestern Ethiopia. *Cogent Food & Agriculture*, *5*(1), 1669398.

Alam, M. M., Arifunnahar, M., Khatun, M. M., Sumon, M. A. A., Rahman, M. A., & Islam, M. J. (2021). Effect of Different Organic and Inorganic Fertilizers on the Growth and Yield of Boro Rice (BRRI dhan29). *International Journal of Research and Scientific Innovation, volume, VIII*

Ali, M. A., Alam, M. R., Molla, M. S. H., & Islam, F. (2010). Crop productivity as affected by fertilizer management options in Boro-T. aman cropping pattern at farmers' fields. *Bangladesh Journal of Agricultural Research*, *35*(2), 287-296.

Ali, M. E., Islam, M. R., & Jahiruddin, M. (2009). Effect of integrated use of organic manures with chemical fertilizers in the rice-rice cropping system and its impact on soil health. *Bangladesh Journal of Agricultural Research*, *34*(1), 81-90.

Alim, M. A. (2012). Effect of organic and inorganic sources and doses of nitrogen fertilizer on the yield of Boro rice. *Journal of Environmental Science and Natural Resources*, *5*(1), 273-282

Bair, N. (1990). Characterization of the environment for sustainable agriculture in semi-arid tropics. In sustainable agriculture, Issues, perspectives and prospects in semi- arid tropics (Ed. Singh, R.P) Hydaradada, India. Indian Society of Agronomy, 1: 90-128.

Banerjee, H., Pal, S., & Maiti, S. (2006). Integrated effect of organic and inorganic fertilizer on the productivity and profitability of rice grown under rice–rice crop sequences in the Gangetic West Bengal. *Journal of crop and weed*, *2*(1), 40-44.

Barmon, B. K., & Tarafder, S. K. (2019). Impacts of vermicompost manure on MV paddy production in Bangladesh: A case study of Jessore district. *Asia-Pacific journal of rural development*, *29*(1), 52-76.

BBS (2016). Preliminary reports on Household Income and Expenditure Survey-2016, Bangladesh Bureau of Statistics, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka.

BBS (2021). Yearbook of Agricultural Statistics 2021. Bangladesh Bureau of Statistics, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka.

BBS (2022). Yearbook of Agricultural Statistics 2022. Bangladesh Bureau of Statistics, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka

Beattie, B.R. & C.R. Taylor. 1985. The Economics of Production. Montana State. University, John Wiley & Sons, New York, USA.

BER (2022). Bangladesh Economic Review (BER) 2022. Ministry of Finance, Government of the People's Republic of Bangladesh, Dhaka.

Bangladesh Rice Knowledge Bank (BRKB). (2023). Boro Rice Varieties (2023). Retrieved from http://knowledgebank-brri.org/brri-rice-varieties/boro-rice-varieties

Bangladesh Rice Knowledge Bank (BRKB). (2022). Rice in Bangladesh (2022). Retrieved from http://www.knowledgebank-brri.org/riceinban.php

Banglapedia (2021). https://en.banglapedia.org/ National Encyclopedia of Bangladesh, Bera Upazila, Pabna, Bangladesh.

Banglapedia (2021). https://en.banglapedia.org/ National Encyclopedia of Bangladesh, Pabna District, Bangladesh.

Banglapedia (2021). https://en.banglapedia.org/ National Encyclopedia of Bangladesh, Sujanagar Upazila, Pabna, Bangladesh.

Bose, T.K. & Som, G.M. (1986) Vegetable Crops in India. Naya Prokash, Calcatta, India, 567-569.

Chakraborty, S., Rahman, A., & Salam, M. A. (2020). Effect of integrated nutrient management on the growth and yield of Boro rice (Oryza sativa L.) cultivars. *Archives of Agriculture and Environmental Science*, *5*(4), 476-481.

Chaudhari, P. R., Tamrakar, N., Singh, L., Tandon, A., & Sharma, D. (2018). Rice nutritional and medicinal properties. A review article. *Journal of Pharmacognosy and Phytochemistry*, *7*(2), 150-156.

DAE (2020). Crop Production Report, June 2020. Department of Agricultural Extension, Government of the People's Republic of Bangladesh, Dhaka.

DFID (2004). Agricultural Sustainability. UK: Department for International Development.

Economics Discussion (2023). The Cobb-Douglas Production Function (2023). Retrieved from https://www.economicsdiscussion.net/production-function/the-cobb-douglas-production-function/18519.

Eyhorn, F. (2007). *Organic farming for sustainable livelihoods in developing countries? the case of cotton in India*. vdf Hochschulverlag AG.

FAO (2022). Food Outlook -June 2022. Food and Agriculture Organization of the United Nations, Rome, Italy.

Felipe, J., & Adams, F. G. (2005). " a theory of production" the estimation of the cobb-douglas function: A retrospective view. *Eastern Economic Journal*, *31*(3), 427-445.

FiBL & IFOAM (2023). The World of Organic Agriculture Statistics and Emerging Trends (2023). Retrieved from https://www.fibl.org/fileadmin/documents/shop/1254-organic-world-2023.pdf

Fujita K. (2010). Re-thinking Economic Development. The Green Revolution, Agrarian Structure and Transfor mation in Bangladesh. Japan: Kyoto University Press.

Heady, E. (2013) & Dillon (1969). Agricultural Production Functions. *Kalyani Publisher Ludhiana*, *134*, 135.

Holganix. (Apr 13, 2021). Advantages and Disadvantages of using organic fertilizer, Kaitlyn Ersek on Apr 13, 2021, from https://www.holganix.com/blog/8-advantages-and-disadvantages-of-using-organic-fertilizer

Hoque, T. S., Jahan, I., Islam, M. R., & Ahmed, M. (2018). Performance of different organic fertilizers in improving growth and yield of boro rice. *SAARC Journal of Agriculture*, *16*(2), 153-166.

Hossaen, M. A., Shamsuddoha, A. T. M., Paul, A. K., Bhuiyan, M. S. I., & Zobaer, A. S. M. (2011). Efficacy of different organic manures and inorganic fertilizer on the yield and yield attributes of boro rice. *The Agriculturists*, *9*(1-2), 117-125.

Hossain, M. A., Hasan, M. K., & Naher, Q. (2008). Assessment of technical efficiency of potato producers in some selected areas of Bangladesh. *Journal of Agriculture & Rural Development*, *6*(1), 113-118.

IRRI. (2022). Boro Rice: An Opportunity for Intensification, International Rice Research Institute. Retrieved from http://www.knowledgebank.irri.org/images/docs/boro-rice-and-opportunity-for-intensification.pdf

Islam, M. A. F., Khan, M. A., Bari, A. F., Hosain, M. T., & Sabikunnaher, M. (2013). Effect of fertilizer and manure on the growth, yield and grain nutrient concentration of boro rice (Oryza sativa L.) under different water management practices. *The Agriculturists*, *11*(2), 44-51.

Shelley, I. J., Takahashi-Nosaka, M., Kano-Nakata, M., Haque, M. S., & Inukai, Y. (2016). Rice cultivation in Bangladesh: present scenario, problems, and prospects. *Journal of International Cooperation for Agricultural Development*, *14*, 20-29.

Kabir, S. (2013). Prospects of Boro rice production in Bangladesh. *Advances in Environmental Biology*, *7*(14), 4542-4549.

Kamruzzaman, M., & Uddin, M. T. (2020). Economic viability of Boro rice production in Haor ecosystem of Kishoreganj district. *Bangladesh Journal of Agricultural Economics*, *41*(454-2021-344), 45-62.

Khan, A., Md, Islam., F, M, M, AL., Bari, F., Hossain, M, T., & Sabikunnaher. (2013). Effect of Fertilizer and Manure on the Growth, Yield and Grain Nutrient Concentration of Boro Rice (Oryza sativa L.) under Different Water Management Practices. *The Agriculturists* 11(2): 44-51

Mahmood, F., Khan, I., Ashraf, U., Shahzad, T., Hussain, S., Shahid, M., & Ullah, S. (2017). Effects of organic and inorganic manures on maize and their residual impact on soil physico-chemical properties. *Journal of soil science and plant nutrition*, *17*(1), 22-32.

Mannan, S. A. (2001). An analysis of agro-economic potentials of jute production in Bangladesh. *An Unpublished Ph. D. Thesis, Department of Agricultural Economics, Bangladesh Agricultural University, Mymensingh*.

Molla, M. A. H. (1706). *Prospects and Challenges of Organic Farming in Bangladesh* (Doctoral dissertation, Bangabondhu Sheikh Mjibur Rahman Agricultural University.

Nayak, B., Rath, B. S., Shahid, M., Jena, S. N., Bagchi, T. B., & Roy, P. S. (2020). Organic Nutrient Management in Aromatic Rice-Rice Sequence: A Critical Review. *International Journal of Chemical Studies*, *8*, 1435-1444.

Rahaman, M. S., Haque, S., Sarkar, M. A. R., Rahman, M. C., Reza, M. S., Islam, M. A., & Siddique, M. A. B. (2021). A cost efficiency analysis of boro rice production in Dinajpur district of Bangladesh. *Fundamental and Applied Agriculture*, *6*(1), 67-77.

Rahman, S., & Barmon, B. K. (2019). Greening modern rice farming using vermicompost and its impact on productivity and efficiency: An empirical analysis from Bangladesh. *Agriculture*, *9*(11), 239.

Raut, N., Sitaula, B. K., Vatn, A., & Paudel, G. S. (2011). Determinants of adoption and extent of agricultural intensification in the central mid-hills of Nepal. *Journal of Sustainable Development*, *4*(4), 47.

Saeri, M., & Rahman, M. S. (2020). Impact of organic fertilizer on productivity of rice farming in Ngawi regency of east Java, Indonesia. *Russian Journal of Agricultural and Socio-Economic Sciences* 108(12):120-126

Salam, M. A., Sarker, M. N. I., & Sharmin, S. (2021). Do organic fertilizer impact on yield and efficiency of rice farms? Empirical evidence from Bangladesh. *Heliyon*, *7*(8), e07731.

Sapkota, B., Dutta, J., Chaulagain, T., & Subedi, S. (2018). Production and marketing of rice in Naghlebhare Rice Block, Kathmandu: an economic analysis. *Nepalese Journal of Agricultural Sciences*, *16*, 138-148.

Sharada, P., & Sujathamma, P. (2018). Effect of organic and inorganic fertilizers on the quantitative and qualitative parameters of rice (Oriza sativa L.). *Current Agriculture Research journal*, *6*(2), 166.

Sharma, A. R., & Mittra, B. N. (1991). Direct and Residual Effect of Organic Materials and Phosphorus-Fertilizer in Rice (Oryza-Sativa)-Based Cropping System. *Indian journal of Agronomy*, *36*(3), 299-303.*Research journal*, *6*(2), 166.

Shelley, I. J., Takahashi-Nosaka, M., Kano-Nakata, M., Haque, M. S., & Inukai, Y. (2016). Rice cultivation in Bangladesh: present scenario, problems, and prospects. *Journal of International Cooperation for Agricultural Development*, *14*, 20-29.

Solaiman, M., M. S. Ali, M. E. Haque, M. A. I. Mozumder, & S. M. M. Rahman. "Environmental impact of using grameen shakti organic manure on boro rice cultivation." *Age* 7: 7-78.

Sumon, M. J. I., Roy, T. S., Haque, M. N., Ahmed, S., & Mondal, K. (2018). Growth, yield and proximate composition of aromatic rice as influenced by inorganic and organic fertilizer management. *Notulae Scientia Biologicae*, *10*(2), 211-219.

Thapa, G. B., & Rattanasuteerakul, K. (2011). Adoption and extent of organic vegetable farming in Mahasarakham province, Thailand. *Applied Geography*, *31*(1), 201-209.

TechTarget (2023). logistic regression, by George Lawton, Ed Burns, Linda Rosenerance (2023). Retrieved from https://www.techtarget.com/searchbusinessanalytics.

United State Department of Agriculture (USDA). (2020). Grain and Feed Annual, Washington, D.C. Retrieved from *https://* apps.fas.usda.gov

Wahed, M. A., & Roy, A. K. (2008). *Food composition data in Bangladesh*. Dhaka: ICDDR, B, 2008.

Willer, H., Trávníček, J., Meier, C., & Schlatter, B. (2021). The world of organic agriculture 2021-statistics and emerging trends.

APPENDICES

Appendix-A: Analysis Result

core age Edu size Farha farepayers credit facility interservice Training livestock participation group info access distance bicycle an

	age	edu	hhsize	farmha	farmex~s	credit~y	extens~e	Traini~g	livves~k	partic~p	infoac~s	distan~m	bicycl~n
age	1.0000												
edu	-0.3801	1.0000											
hhsize	0.1033	-0.1167	1.0000										
farmha	-0.2583	-0.0407	0.2401	1.0000									
farmexpyears	0.0917	-0.1096	0.2419	0.0298	1.0000								
creditfaci~y	0.1301	-0.3102	0.0115	0.0916	0.0529	1.0000							
extenservice	-0.2011	0.1504	0.0318	0.1275	-0.0609	0.0516	1.0000						
Traininng	-0.2029	0.1171	0.0023	0.1001	0.0409	-0.1119	-0.0334	1.0000					
livvestock	-0.1250	0.2792	0.0151	-0.0114	0.0720	-0.2153	0.0667	0.1324	1.0000				
participat~p	-0.1694	0.2153	0.0700	0.0791	0.0631	-0.0861	0.2000	-0.1001	0.0334	1.0000			
infoaccess	-0.1852	0.1875	-0.0318	0.1347	-0.0897	-0.0861	0.1667	0.1334	0.1334	-0.0333	1.0000		
distancekm	-0.2764	0.1749	0.0104	0.5074	-0.1200	-0.1214	0.0644	0.0563	0.1752	0.1832	0.1139	1.0000	
bicyclevan	-0.1794	-0.0131	0.1149	0.1704	0.1529	-0.0560	0.1168	0.1486	0.0818	0.2169	0.0501	0.1861	1.0000

```
. hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of ln_revenue

         chi2(1)      =     0.07
         Prob > chi2  =   0.7880
```

```
. ovtest

Ramsey RESET test using powers of the fitted values of ln_revenue
       Ho:  model has no omitted variables
                  F(3, 108) =     2.47
                   Prob > F =     0.0657
```

. vif

Variable	VIF	1/VIF
ln_chemica~t	7.68	0.130178
ln_manurec~t	7.63	0.131122
ln_machine~t	6.68	0.149641
ln_seedcost	6.27	0.159507
ln_irrigat~t	3.10	0.322358
ln_hiredla~t	1.52	0.655987
ln_pestici~t	1.18	0.847044
ln_familyl~t	1.06	0.944760
Mean VIF	4.39	

. linktest

Source	SS	df	MS	Number of obs	=	120
				F(2, 117)	=	1329.59
Model	36.1277655	2	18.0638827	Prob > F	=	0.0000
Residual	1.58956532	117	.013586028	R-squared	=	0.9579
				Adj R-squared	=	0.9571
Total	37.7173308	119	.31695236	Root MSE	=	.11656

ln_revenue	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
_hat	.6421918	.3030474	2.12	0.036	.0420223	1.242361
_hatsq	.0145204	.0122729	1.18	0.239	-.0097854	.0388261
_cons	2.199886	1.874761	1.17	0.243	-1.51298	5.912753

Appendix-B: Research Questionnaire

An Interview Schedule for the Study Entitled

Adoption Determinants of Organic Fertilizer Use on Boro Rice Production in Some Selected Areas of Pabna District in Bangladesh

Serial number: ☐

Dear Respondent,

All of your information will be kept confidential and will be used for research purpose only. Please provide the following information.

A. General information

Respondents Name:……..

Address: Village: …….. Upazila:……..

District: …….. Mobile: ……..

B. Socio-economic information

1. Household information

Name of respondent	Relation with respondent	Age (Years)	Years of schooling	Sex (F/M)	Sources of income		Yearly income (Tk.)	
Respondent	Self				Main	Subsidiaries	Main	Subsidiaries

(use code: Husband =1, Wife=2, Son=3, Daughter =4, Father =5, Mother =6, Others=7)

(use code: Crop Farming= 1, Livestock rearing=2, Fish farming= 3, Day labour= 4, Service=5, Business= 6, Remittances= 7, Others= 8)

2. Farm size

Types of land	Area (decimal)
Homestead land	
Own cultivated land	
Mortgaged in land	
Mortgaged out land	
Rented in land	
Rented out land	
Leased in land	
Leased out land	
Pond	
Fallow	
Total	

3. Area under Boro rice cultivation and land ownership

Owner cultivation	Tenant cultivation

4. Annual expenditure (Tk)

Purpose	**Unit**	**Expenditure (Tk.)**
a. Consumption expenditure		
i) Food	Weekly	
b. Non-food expenditure		
i) Housing	Yearly	
ii) Cloths	Yearly	
iii) Education	Yearly	
iv) Medical	Yearly	
v) Festivals	Yearly	
vi) Others (If any)	Yearly	

C. Productivity related information

5. Cost of production

a) Human labour use

Activities	Types of labour	Man-days	Wage rate (Tk./day)
1.Land preparation	Family		
	Hired		
2.Seedling	Family		
	Hired		
3.Weeding	Family		
	Hired		
4.Irrigation	Family		
	Hired		
5.Applying fertilizer	Family		
	Hired		
6. Applying pesticide or others	Family		
	Hired		
7. Harvesting	Family		
	Hired		
8. Threshing and winding	Family		
	Hired		
9. Drying and sorting	Family		
	Hired		

b) Machinery inputs

Purpose of use	Types of ownership	Unit	Cost/unit	Total cost (Tk.)
1.Land preparation (power tiller/tractor)	Owned			
	Hired			
2.Harvesting (Harvestor)	Owned			
	Hired			
3.Carrying (power tiller/tractor/van)	Owned			
	Hired			
4.Threshing (Thresher)	Owned			
	Hired			
5.Others (specify)	Owned			
	Hired			

C) Materials inputs

Inputs (unit)	Types	Quantity	Price/unit	Total value
1.Seedling (Kg))	Home supplied			
	Purchased			
2.Transport cost (TK)	Marketing			
	Buying inputs			
3.Manure	Cow dung			
	Vermi compost			
	Poultry manure			
	Kitchen waste			
	Others			
4.Fertilizer (Kg))	Urea			
	TSP			
	Phosphate			
	MoP			
	Gypsum			
5.Irrigation				
6.Pesticide (Litter)				
7.Others (Specify)				
8. How much cost incurred for rental house per month? OR, if it is your own house how much will be the rent if you rent the house?				

6. Return from production

Output (s)	Types	Quantity	Price/unit	Total
Rice (Kg)				
By product	Paddy straw			

7. Boro rice farming experience: ……years

8. Do you receive any agricultural credit facility: Yes/No

9. Access of extension service: Yes/No

10. Do you receive any training on agriculture? Yes/No

11. Do you have livestock? Yes/No

12. Participation in farmer groups: Yes/No

13. Do you have information access? Yes/No

14. Short distance from local market: ……..km

15. Do you have bi-cycle / van……. Yes / No

(Use Yes= 1, No=0)

18. Please mention the problems in Boro rice production with organic fertilizer

1. High price of agricultural inputs
2. Lack of credit facility
3. Irrigation problems
4. Lack of training programmers
5. Lack of labour availability
6. Lack of storage facility
7. Insecticides, pest and disease problems

Thank you for your nice cooperation