COMPARATIVE PROFITABILITY OF COMBINE HARVESTER USER AND NON-USER RICE FARMER IN RAJBARI DISTRICT OF BANGLADESH

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CERTIFICATE

This is to certify that the thesis entitled '**COMPARATIVE PROFITABILITY OF COMBINE HARVESTER USER AND NON-USER RICE FARMER IN RAJBARI DISTRICT OF BANGLADESH**' submitted to the Faculty of Agribusiness Management, Sher-E- Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **Master of Science in Department of DEVELOPMEMT AND POVERTY STUDIES,** embodies the result of a piece of bonafide research work carried out by **MD. ANIK HASAN DURJOY**, Registration Number: **15-06841** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

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

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DEDICATED TO MY BELOVED PARENTS

ABSTRACT

The main purpose of the study was to assess the comparative profitability of combine harvester user and non-user rice farmers in the selected district of Bangladesh. The study was undertaken purposively in Rajbari sadar upazila under Rajbari district. Validated and well-structured interview schedule (questionnaire) was used to collect data from 80 rice cultivators during 1st January 2022 to 30 January, 2022. Per hectare gross return of rice cultivators was Tk. 165128 for combine harvester users and Tk. 159998 for combine harvester non-users, respectively. Per hectare gross margin were found to be Tk. 66807 for combine harvester users and Tk. 41508 for combine harvester non-users, respectively. Total net returns were estimated as Tk. 39661 and Tk. 13353 for combine harvester users and non-users per hectare, respectively. Benefit Cost Ratio (BCR) were found to be 1.32 and 1.09 for combine harvester users and non-users. Lack of credit facilities was ranked lst problem and transport/communication facilities were ranked the last.

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ABBREVIATIONS

BARI	Bangladesh Agricultural Research Institute
BB	Bangladesh Bank
BBS	Bangladesh Bureau of Statistics
BCR	Benefit Cost Ratio
DTW	Deep Tube-Well
GDP	Gross Domestic Product
HYV	High Yielding Variety
LUC	Land Used Cost
MP	Murate of Potash
NGOs	Non-Governmental Organization
NR	Net Return
SPSS	Statistical Package for Social Science
STW	Shallow Tube Well
TPS	True Potato Seed
TSP	Triple Super Phosphate
TVC	Total Variable Cost

CHAPTER I
INTRODUCTION

1.1 Background of the Study

Bangladesh is an agricultural country with the geographical area of 147570 square kilometers and population of about 163 millions. The population density per km^2 is 1109 people (BBS, 2020). Agriculture is the major dominating sector of the country. Out of total land area of 14.84 million hectares, the net cropped area of the country is 8.29 million hectares and its cropping intensity is 203 per cent (BER, 2021). About 80 % of its population lives in rural areas, where agriculture is the major occupation and 45.1% (BBS, 2020) labor force are engaged in agriculture. At present the contribution of agriculture to the total GDP (Gross Domestic Product) is 13.6% in which 10.05% comes from crops, 1.19% from forestry, 2.41% from livestock and 3.56% from fisheries (BBS, 2020). In the year (2009-10), Bangladesh earned $687.53 million by exporting agricultural products which is 4.24 % of total export earnings (BBS, 2020). So agriculture plays vital roles for poverty alleviation and food security by increasing income level of rural population. The population growth rate is 1.36 % per annum (BBS, 2020) which causes the decreases of farm size in a horrid manner. The extra population is a threat to the total production.

Rice is a prime supply of subsistence of rural populations in maximum Asian nations. There are approximately four billion humans eating over ninety % of the sector's rice production. Rice changed into selected as the subject within the gift examine due to its outstanding function within the country wide financial system of Bangladesh. The proportion of agricultural GDP in Bangladesh is 13.6 % (BER, 2021). About 80 % of total cultivable land is diverted to rice production (BBS, 2020). Since 1999-2000, boro rice has contributed to more than half of the total rice production in Bangladesh. From 1980's to 2018's, the production of Boro has

increased from 19 to 48 % while the production of Aus and Aman is decreased from 25 to 7 % and from 56 to 45 %, respectively (Ahmed, 2004)). Currently Boro occupies about 41 % of total rice area and contributes to some 56 % share of total rice production in Bangladesh. On the other hand, Aman occupies 50 % of total rice land and contributes to some 38 % of total production and while Aus taking about 9 % of total rice area, contributing by 6 % to rice production (Dev et al., 2009).

A rate of per hectare of low technical efficiency in the production of Modern Variety (MV) rice was observed in Bangladesh (Sharif and Dar, 1996). Given the importance of rice production, yet it is surprising that there have been only a few studies carried out on the efficiency of rice production in Bangladesh. Have farmers promoted their production efficiently along with the progress in available technologies? How have the policies undertaken by governments impacted rice production and a farmer's technical efficiency? These are some of the questions the present study partly sought to answer. Efficiency measures are important because of their vital role in productivity promotion. The efficiency of rice production has been of longstanding interest to the economists and policymakers in Asia because of the strong relationship between rice production and food security in the region (Richard et al., 2007). A number of studies have examined the productive efficiency in its domain of agricultural production (Travers and Ma, 1994; Fan et al., 1994; Wang et al., 1996a, 1996b; Xu and Jeffrey, 1998; Fan, 1999; Tian and Wan, 2000). Some impacts of the advanced techniques in rice production efficiency in developing countries have been touched upon (Bordey, 2004; Chengappa et al., 2003; and Khuda, 2005). In this context Stochastic Frontier approach has found its wide acceptance within the agricultural economics context (Battese and Coelli, 1992, 1995). Some literatures have focused on the Stochastic Frontier model with distributional assumptions by which efficiency effects can be separated from stochastic elements in the model and for this reason

a distributional assumption has to be made (Bauer, 1990). Stochastic Frontier analysis employs a composed error model in which inefficiencies are assumed to follow an asymmetric distribution, usually the half-normal, while random errors are assumed to follow a symmetric distribution, usually the standard normal (Aigner et al., 1977).

Table 1.1 Bangladesh: Boro, Aus and Aman Rice Area and Production Forecast

Variety	MY 2016/17		MY 2017/18		MY 2018/19	
	(Forecast)		(Forecast)		(Forecast)	
	Area	Production	Area	Production	Area	Production
	1,000 HA	1,000 MT	1,000 HA	1,000 MT	1,000 HA	1,000 MT
Boro	4,750	18,890	4,472	17,800	4,800	19,100
Aus	1,098	2,338	1,100	2,350	1,120	2,400
Aman	5,900	13,350	5,700	12,500	5,850	13,200
Total	11,748	34,578	11,272	32,650	11,770	34,700

Source: BBS, 2020

1.2 Area, Production and Yield of Rice in Bangladesh

Rice is grown throughout the country except in the southeastern hilly areas. The agro climatic conditions of the country are suitable for growing rice year-round. Bangladesh ranks fourth among the rice producing countries in the world after China, India and Indonesia (FAO, 2021). Bangladesh agriculture is dominated by production of rice. There are three rice growing seasons in Bangladesh and these are Aus, Aman and Boro season. Aus are generally cultivated in July-August, Aman in December-January and Boro in March-May cropping season. About 75.0% of the total cropped area is devoted to rice cultivation. There are three rice crops grown in Bangladesh, namely Aus, Aman and Boro.

1.2.1 Area of Boro crop

Total area under Boro crop has been estimated at 1.18,32,309 acres (47, 88, 276 hectares) in this year (2020-21) as compared to 120, 07, 983 acres (48, 59, 367 hectares) of the last year (2019-20). The harvested area has decreased by 1.46 % this year. Comparative area estimates are shown below (Table 1.2).

Table 1.2. Estimates of total area by type of Boro crop

Variety	**2019-2020**		**2020-2021**		Changes over previous year (%)
	Area		**Area**		
	(in acres)	(in hectares)	(in acres)	(in hectares)	
Local Boro	80,262	32,480	1,12,021	45,332	(+) 39.57%
HYV Boro	99,92,250	40,89,542	99,91,968	40,43,531	(-) 3.80%
Hybrid Boro	19,35,471	7,83,242	21,07,983	8,53,055	(+) 8.91%
Total Boro	1,20,07,993	48,59,367	1,18,32,309	47,88,276	(-) 1.46%

Source: BBS, 2022

1.2.2 Yield rate of Boro rice

Average yield rate of Boro in Financial Year 2020-21 has been estimated 4.085 metric tons rice per hectare which was 4.028 metric tons per hectare in 2019-20. Comparison of estimated yield rates of Boro is shown below (Table 1.3).

Table 1.3. Estimates of yield rate by type of Boro crop

Variety	**2019-2020**		**2020-2021**		Changes over previous year (%)
	Area		**Area**		
	(in acres)	(in hectares)	(in acres)	(in hectares)	
Local Boro	20.81	1.919	20.28	1.870	(-) 2.565%
HYV Boro	42.46	3.916	42.82	3.950	(+) 0.862%
Hybrid Boro	50.91	4.696	52.25	4.820	(+) 2.626%
Total Boro	43.67	4.028	44.29	4.085	(+) 1.406%

Source: BBS, 2022

1.2.3 Production area of Boro rice

Total boro production of Financial Year 2019-20 has been estimated at 195,60,546 metric tons compared to 195,75,819 metric tons of Financial Year 2020-21 which is 0.078 % lower. Comparative estimates of Boro production are shown below (Table 1.4):

Table 1.4. Estimates of production by type of Boro (Husked) crop

Variety	2019-2020	2020-2021	Changes over previous year (%)
	Production (M. Tons)	Production (M. Tons)	
Local Boro	62,343	84,779	(+) 35.989 %
HYV Boro	158,35,103	153,64,347	(-) 2.973 %
Hybrid Boro	36,78,373	32,38,915	(+) 11 .773 %
Total Boro	195,75,819	195,60,546	(-) 0.078 %

Source: BBS, 2022

1.2.4 Year wise Growth Rate of Rice Production in Bangladesh

Table 1.5 showed that total rice production in Bangladesh 2005-06 was 2,65,30,300 ton and growth rate was 5.46 and total production 2019-20 was 3,86,95,330 and growth rate was 3.56. In 2019-20 growth rate was positive but growth rate negative in 2016-17.

Table 1.5. Year wise growth rate of rice production (ton) in Bangladesh

Year	Production	Growth rate
2005-06	2,65,30,300	5.46
2006-07	2,73,18,000	2.97
2007-08	2,89,31,000	5.9
2008-09	3,13,17,000	8.25
2009-10	3,19,75,000	2.1
2010-11	3,35,40,320	4.9
2011-12	3,39,14,000	1.11
2012-13	3,38,33,000	-0.24
2013-14	3,43,56,300	1.55
2014-15	3,48,61,200	1.47
2015-16	3,50,60,500	0.57
2016-17	3,42,01,500	-2.45
2017-18	3,62,79,300	6.08
2018-19	3,73,63,600	2.99
2019-20	3,86,95,330	3.56

Source: BBS, 2021

1.3 Importance of Agricultural mechanization in rice farming

Farm mechanization is the main plank of modern agriculture' Many developed countries revolutionized by using farm mechanization, which resulted in tremendous production and productivity gains. However, the conditions under which it was introduced in those countries differ greatly from Bangladesh context. Two of the most important conditions were the shortage of labour and large size of farm. But as the pressure of population on land is increasing steadily, the solution lies in mechanizing agriculture, which would realize the goal of achieving targeted food gains production in Bangladesh. The main driving force of the economy of Rajbari district is agriculture and hence the expansion of agricultural production which is concentrated in rice, wheat, sugar cane, jute and vegetables production. Nevertheless, the potential of agricultural production lies in crop diversification. The crop diversification can be enhanced by farm mechanization in this region. Moreover, the shortage of draught power encourages farmers to use the mechanized system. Farm mechanization helps increase the cropping intensity by providing temporal and partial adjustment in crop production activities so that least time is lost between the two cropping seasons and farmers can raise more number of crops in a given time. The inherency of lobour shortage in agriculture during important field operations like transplanting, weeding, fertilizer application, etc. can be minimized by economic and efficient use of machines. Further, certain activities like deep ploughing in wetland demands the use machinery to improve the quality of operations. The post-harvest operations like threshing, if undertaken, using machines not only reduce the losses but also improve the quality of the product in some cases. The main question to be answered in this study is whether mechanization would help in achieving the objectives of increasing the farm income, inter-alia taking into consideration the more use of farm machineries. A study of resource productivity on mechanized, non-mechanized and pooled farms may explain the marginal value productivity of inputs among the three categories of farms and justify the investment demands.

The measurement of profitability involves the comparison of profit margin among mechanized, non-mechanized and pooled farms. Further, there is a need to study the changes in the composition and use of the farm machinery in the farms over the years to find out the changes in technology and its adoption by farmers.

1.4 Agricultural Farm Mechanization in Bangladesh

Mechanization may be defined as the process of injecting power and machinery between man and materials in a production system (Khalequzzaman and Karim, 2007). Agricultural mechanization is an art and scientific application of agricultural machinery, tool and implement for increasing farm production and cropping intensity. The irrigation policy in Bangladesh in the 20th century originally focused on large-scale canal systems and Deep Tube Wells (DTW) (Biggs and Justice, 2015). Agricultural mechanization in Bangladesh there by started with DTW for irrigation (Pingali, 2007).

Irrigation system development and a cooperative-model were associated with the government promotion of four-wheel tractors (4 wt) since 1960s. However, small land holding coupled with further fragmentation of land impeded the wide-scale adoption of 4 wt (Hossain et al., 2007). After independence, irrigation policy in Bangladesh increasingly focused on the use of shallow tube wells (STWs) and less energy requiring Low Lift Pumps (LLPs) for irrigation (Biggs and Justice, 2015). Several institutional models were under taken to promote small-scale mechanization. The Bangladesh Agriculture Development Corporation (BADC) started renting STWs to farmer organizations in 1972 as well as investing in DTWs and LLPs (Hossain, 2009).Consequently, by mid 70sthe number of LLPs in Bangladesh reached 35,000 unit. Since the 1960s locally manufactured mechanical threshers are extensively used as economical options to overcome labor shortages. In1960, a pedal thresher was reproduced in Bangladesh by “Comilla Cooperative Karkhana” using the Japanese model.

At present, almost each district in Bangladesh has a local thresher manufacturer. In some districts such as Jessore and Khulna, there are more than 100 thresher manufacturers (Anon, 2012w). Before 1988, the import of agricultural equipment was restricted. The Standardized Committee of Bangladesh' was responsible for controlling the quality of imported machinery including agricultural equipment and only a list of standardized machines required for agricultural operations could be imported. In 1988, the Ershad Government started liberalizing markets, lowered the tariffs on machine imports, and dissolved the Standardized Committee. This policy change resulted in an import surge of low-cost small engines and engine powered machinery such as power tillers (two-wheel tractors, 2WTs),diesel pumps and other equipment into Bangladesh, primarily from China (Gisselquist et al., 2002; Kienzle et al., 2013; Mottaleb et al., 2016 and Pingali, 2007).

After the trade liberalization in 1988, cost of these machines especially power tillers and minor irrigation pumps fell by 50% resulting in increases of 400% in sales of diesel engines and more than 1000% in power tillers compared to sales three years before the liberalization (Gisselquist et. al., 2002). At present, 80% land is prepared by power tiller and 18% by tractor or 2 WTs and/or 4WTs (Islam, 2018 and Kienzle et al., 2013). However, mechanization of other agricultural field operations is still very low in Bangladesh and thus, adoption of other agricultural equipment such as bed makers, seeders, weeders, harvesters and winnowers is not common (Islam, 2009). From the onset mechanization in Bangladesh spurred farm machinery hiring services. In the 1960s, BADC established a rental operation system of LLP at a 75% subsidy scheme to farmers. Due to the prevailing small landholdings, many farmers who own agricultural machines opt for hiring out these machines in addition to operating ton their own land (Biggs and Justice, 2015; Kienzle et al., 2013).

This, on the one hand, optimizes the use of machines and on the other hand, increases farmers' access to these machines. Through custom hiring services, even the poor can afford to mechanize farming (Alam et al., 2004). This has been reported across South Asia and for different implements – including 4 wt drawn zero-till seed drills (Erenstein and Farooq, 2009), laser-land leveling (Aryal et al., 2015) and 2wt (Mottaleb et al., 2017). Hence the existence of rental markets can facilitate rapid adoption of lumpy technology and make technology accessible to even poor and marginal farmers who otherwise could not invest in or access it. Bangladesh agriculture is now one of the most mechanized agricultural economies in south Asia (Baudron et al., 2015 and Islam, 2009). This was facilitated by a focus on small-scale machinery more adapted to its socio-economic context -be it through cheap imports or local production and manufacturing.

1.5 Significance of the Study

Agriculture is the single leading producing sector of the economy and it contributes about 13.35% to the total Gross Domestic Product (GDP) of Bangladesh. Agriculture is the main income source of most of the people who are living in rural areas. The total export value of agricultural product is 7.01% of total export of Bangladesh (Bangladesh Economic Review, 2021). The general price levels of other food and non-food commodities are related to rice price. Income of farmers and their food security depends on rice price, so changes in price of rice are highly sensitive to the lower and middle classes of consumers those who live below or on the poverty level. Rice price fluctuates and changes throughout the year due to various reasons. From the beginning of production process, there are a large number of value adding steps associated with rice production and marketing. The marketing of rice and also its bi-products i.e. broken rice, husk, bran etc. increases due to adding values at each steps of its marketing.

1.6 Justification of the Study

Rice is the maximum essential cereal crop in phrases of place of production contribution to the countrywide profits and countrywide financial development good sized place is dedicated to rice manufacturing and tens of millions of farmers had been growing rice in this country. Despite the reality that rice is cultivated substantially in Bangladesh, consistent with hectare yield is tons lower in assessment with that of different rice developing countries of the world. In order to satisfy this deficit, yield according to unit place of rice have to be increased. The range of landless laborers, disguised and unemployed population is growing progressively. Therefore, it is vital to produce food grain to meet meals necessities for the increased population.

Bangladesh is the ninth most populous country in the world. The Government of Bangladesh has given an excessive amount of emphasis on paddy production. Then each year Bangladesh imports rice. In 2016 Bangladesh has imported 50 lots of rice. Bangladesh soil is suitable for producing rice. In the beyond a few studies were made on the profitability of rice in Bangladesh. But there is no exclusive study on the profitability of rice particularly in the Rajbari district. As such it was felt that a study on the rice in the area Rajbari district would be of much importance. This is obviously due to the fact that development basically means larger size productive activities in the economy. But we cannot have more of production unless the goods produced are actually sold out and selling depends on the proper marketing conditions. Besides, the results also would serve as a reference for researchers to embark upon similar or related work in other parts of the country. The study would provide useful information to the producers, traders, consumers, future researcher and planners of this rice. This study has been conducted on profitability analysis which has important policy implications for farmer, and the policy makers in Bangladesh.

1.7 Objectives of the Study

The broad objective of the study is the Profitability of rice in Rajbari district in Bangladesh. The specific objectives of the study are as follows:

a) To identify the socio-economic characteristics of rice farmers;
b) To assess the comparative profitability of combine harvester user and non-user rice farmers;
c) To identify constraints faced by the farmers in rice production.

1.8 Organization of the Study

The study has been organized into six chapters. Chapter I indicates the introduction of the research along with the objectives and justification. In Chapter II review of literature is presented and methodology is described in Chapter III. Socio-economic characteristics of the rice farmers described in Chapter IV, Profitability of rice cultivation are presented in Chapter V, problems and solutions of farmers are presented are presented in Chapter VI and finally Chapter VII present the summary of the major findings of the study and concluding remarks.

CHAPTER II
REVIEW OF LITERATURE

The main purpose of this chapter is to review some related studies in connection with the present study. Although a lot of studies have been done on costs and returns of rice production in Bangladesh, only a few studies have so far conducted related to economic analysis of rice production under different area. This study highlights only a few of the studies, which are considered recent and very relevant for this research. Again, some of these studies may not entirely relevant to the present study, but their findings, methodology of analysis and suggestions have a great influence on the present study and all of these study have been conducted on Bangladesh, so it have great influence on the present study. Therefore, some of the literatures related to the present study are briefly discussed below:

2.1 Profitability on rice farming

Akter et al. (2019) conducted a study on factors determining the profitability of rice farming in Bangladesh. The finding of cost-benefit analysis reveals that rice farming is a profitable activity in Bangladesh as the estimated cost of production was lower than the return in the selected study areas. However, the profitability differs among different farmers' group and large farmers are more profitable in rice cultivation than small and medium farmers. In addition, the functional analysis identifies three inputs such as the cost of power tiller, fertilizer and hired labor as the significant determinants of profitability for all farmers in the study regions. Moreover, these factors also differ across the farmer's groups except the cost of fertilizer.

Chowdhury et al. (2013) investigated the "efficiency of rice farms during boro period in Bangladesh: an econometric approach". They were focusing to achieve the target by improving the efficiency of the farmers. Modern econometric tools,

like Stochastic Frontier Approach (SFA) were used for measuring the efficiencies of the farmers. Empirical results of this study shows that average technical, allocative and economic efficiency of the farmers during Boro period were 86 per cent, 75 per cent and 64 per cent respectively.

Devi and Singh (2014) analyze resource use and technical efficiency of rice production in Manipur. Rice is regarded as the first cultivated crop in Asia as well as important food crop of India. The cost and return structure and technical efficiency in rice production has been reported in different regions as well as in the state of Manipur to show different regions have adopted the latest technology. Primary data have been collected from the sample rice farms with the help of pre-tested scheduled through personal interview with respondent farmers. Technical efficiency of individual farms has been estimated through stochastic production function analysis. The total cost of cultivation on small farms was much higher than the large farms. Imputed rental value for owned land was the major cost items for all the farms. On an average majority (40%) of the rice growing farmers were operating at the technical efficiency level of (99-100) % in relation to frontier output level. Gross return as well as net return per hectare have been observed to be highest for category I followed by category II. Most of the farms have been observed to be potential to expand production and productivity, increasing technical efficiency as majority has been performing with increasing returns to scale.

Islam et al. (2017) conducted a study on profitability and productivity of rice production in selected coastal area of Satkhira district in Bangladesh. The study found that the small farmers (Tk. 10292.89) got higher net returns than the medium (Tk. 6894.39) and large (Tk. 4798.70) farmers per hectare, respectively. The undiscounted BCR was 1.38, 1.23 and 1.15 for small, medium and large

farmers respectively. It is found that the coefficient of seed, fertilizer, power tiller, irrigation cost and human labor have significantly impact on gross return.

Long (2015) conducted a study on "Comparative analysis of resource use efficiency between organic rice and conventional rice production in Mekong Delta of Vietnam. The efficiency with which farmers use available resources is very important in agricultural production. The study was conducted to measure and compare resource use efficiency and relative productivity of farming under Organic rice and Conventional rice production in Mekong Delta of Vietnam. One hundred twenty randomly selected farms, 60 from each system, were surveyed. The study explored differences in efficiency and productivity between production systems. Cobb-Douglas production function analysis was used to calibrate resource use efficiency. The results showed that the regression coefficients of expenditure on seed, organic manure and bio-fertilizers in Organic rice cultivation, and expenditure on herbicide and machine labor in Conventional rice cultivation were significant. The efficiency was greater than one for seed, organic manure, machine labor and bio-fertilizer for Organic rice production. In conventional rice production, herbicide and machine labor were underutilized resources. The results suggested that the quantity of these resources was used less than optimum and there exists further scope for increased use of these resources. Other resources were over utilized, such as human labor and bio-pesticide in organic rice production, and seed, chemical fertilizer, pesticide and human labor in conventional rice production.

Nasrin et al. (2011) conducted a study on "land tenure system and agricultural productivity in a selected area of Bangladesh". They examine relative efficiency of farming under tenancy systems in some selected areas of Mymensingh district. They were found that share tenant farmers earned significantly lower net return (Tk. 19,252.18) than the cash tenant farmers (Tk. 22,815.89) from Boro rice

production and Boro rice production was profitable from the viewpoint of both tenant operators. They also showed that all the explanatory variables (key production inputs) included in the Cobb- Douglas revenue type production function model were important for explaining the variations in gross returns under both tenancy arrangements.

Parasar et al. (2016) conducted a study on "resource use efficiency in rice production under SRI and conventional method in Assam, India." To meet the rising demand for rice, the staple food in Assam, the production of rice has to be increased by many folds. Considering the shrinkage of agricultural lands, productivity increase is the only way out to increase the production. System of Rice Intensification (SRI) is reported to enhance rice yield to considerable extent. However, the acceptability of the method by the tradition rice growers of the state is a matter of concern. Further, the resource use status of SRI is yet to be studied systematically in Assam. The present study on resource use in SRI has shown that the resources used in SRI need to be increased for enhanced rice production the state.

Sujan et al. (2017) conducted a study on financial profitability and resource use efficiency of boro rice cultivation in some selected area of Bangladesh. Result based on Farm Budgeting model showed that per hectare variable cost and total cost of production was BDT (Bangladeshi Taka) 57,583 and BDT 71,208, respectively. Average yield was found 4.112 ton which was more than the previous year's national average yield of 3.965 ton. The average gross return, gross margin, and net return were BDT 86,548, BDT 28,965 and BDT 15,340, respectively. Benefit-Cost ratio (BCR) was found 1.22 and 1.50 on full cost and variable cost basis. Cobb-Douglas production function analysis showed that the key production factors, that is, human labour, irrigation, insecticide, seed and fertilizer had statistically significant effect on yield. MVP and MFC ratio analysis

showed that growers allocated most of their resources in the rational stage of production.

Toma et al. (2015) conducted a study on financial profitability of aromatic rice production in some selected areas of Bangladesh. Total costs for aromatic rice was estimated at Tk. 64446.51 per hectare and per hectare gross return of aromatic rice was Tk. 114243.71. Gross margin for aromatic rice was estimated at Tk. 59999.29 per hectare. Thus, the net return was estimated at Tk. 49797.20 for aromatic rice production. The undiscounted Benefit Cost Ratio on the basis of total cost was 1.77 implying that the aromatic rice production was highly profitable.

Wadud et al. (2011) conducted a study on profit efficiency and farm characteristics evidence from the rice farmers in Bangladesh. They examine profit efficiency of rice farmers in some selected district of Bangladesh. From the study they found that estimated profit frontier revealed negative elasticity of price of fertilizers and positive elasticity of wage rates, price of seeds and area of land cultivated. The mean profit efficiency was 69%.

1.2 Agricultural mechanization in rice farming

Acharyaa et al. (2021) the study revealed that per hectare average human labor used by traditional farm was significantly higher (141.6 man days/hectare) than mechanized rice farm (72.7 man days/per hectare). Per hectare average machine hour used in mechanized farm was 14.0 hours. Number of bullock labor required in traditional rice farm was more than 4 times higher than in mechanized rice farm and was significant. Per hectare total cost of production in mechanized and traditional farms was NRs 85,434.6 and NRs. 95,993.6, respectively and the mean difference was significant. The mechanized rice farm had significantly higher income (NRs. 112711.1/ha) than traditional rice farm (NRs.102064.9/ha). The benefit cost ratio per hectare was significantly higher in mechanized farm (1.32) as

compared to traditional (1.06). The variable cost saved in mechanized farm in comparison to traditional rice farm was NRs. 20,366.8 per hectare, which was 24.80 % and was significant. The study indicated that the use of farm machines for rice cultivation would significantly save the human labor cost, reduce cost of production, increase the yield thereby removing drudgery; addressing the labor shortage issues and making mechanized rice farm more profitable.

Khatiwada et al. (2021) a study was conducted in Shivasatakshi municipality of Jhapa district to assess the economic impact of agricultural mechanization in rice farming in 2020. Altogether, 40 rice farmers were selected randomly and surveyed using a semi-structured interview schedule. Based on the use of machinery, farmers were categorized into mechanized and non-mechanized farmers. Cost and revenue were calculated among both categories. T-test was used to compare the mean cost and revenue between mechanized and non-mechanized rice farmers. The average cost of production of rice was NRs.87,215.50/ha. The cost of human labor was found higher in both categories (more than 40%). The average total cost of production was lower in mechanized farms (NRs.67,191.74/ha) as compared to non-mechanized farms (NRs. 1, 07,239.27/ha). The contribution of rice grain and straw to the overall revenue was 98.53% and 1.46% respectively. The average revenue from production was calculated to be NRs.1, 21,879.25/ha. The average gross revenue was greater in mechanized farms (NRs.1,26,042.90/ha) than non-mechanized farms (NRs. 1, 22,067.00/ha). The benefitcost ratio was observed higher in the mechanized rice farms (1.898) than non-mechanized farms (1.143). The findings of the study showed that mechanized rice farming reduced the cost of production by lowering down human labor cost and increased the profitability of the enterprise.

Reza and Khan (2013) conducted a study and found that among the three categories of tillage methods such as power operated, animal operated and power

plus animal operated (pooled) tillage, most of the farmers use power tiller/tractor for tilling their land and still some farmers use animal power for tilling. Combine tillage method (power and animal operated) is also found in the study area. It is found from the study that the actual productivity of the inputs is very low compared to the optimal attainable production. Due to lack of modern technologist, high input cost, and low market price, the profit margin is very low of Boro and Aman paddy.

Van den Berg et al. (2007) results show that at the present scale of farming, the dual government objectives of increasing rural incomes and increasing rice production are clearly conflicting. Farmers can generate incomes comparable to non-farm wages, but only when they switch completely to production of more remunerative crops, such as vegetables. At larger farm sizes, however, labour constraints inhibit farmers from specialization in non-rice crops, and rising per capita incomes and increasing rice production go hand in hand. Mechanization is necessary to allow substantial increases in farm size.

2.3 Conclusion of the Study

From the summary of the above studies it is clear that few of the previous studies conducted in Bangladesh focused on profitability, but no studies were accomplished in this study area. A number of researchers explained their opinions on their own viewpoint. It should be noted here that such a study like comparative profitability of combine harvester user and non-user rice farmer in Rajbari district is a new and important study and no systematic research has yet been carried out in this manner. As a result, no exact literature on similar study could be found. The present study is designed to measure the profitability of combine harvester user and non-user rice farmer in Rajbari district in Bangladesh.

CHAPTER III
METHODOLOGY

There are various methods of data collection in farm management research. Selection of particular method depends on many considerations, such as nature of research, sufficient literature and primary information, availability of funds and time etc. A farm management research involves collection of information from individual farmers. Survey method was used in the present study because it is thought to have some advantages over other methods. The following steps were followed in conducting the present study:

3.1 Selection of the Study Area

The area in which a farm business survey is to be made depends on the particular purpose of the survey and the possible cooperation from the farmers. Generally, owners of the farms hesitate to give information to strangers and outsiders on their own private business and financial transaction.

In consideration of the above-mentioned factors, Rajbari sadar upazila under Rajbari District was purposively selected where a large number of rice cultivars. Apart from these, the area is chosen for the following reasons:

i) No published information is available in the study areas.

ii) Very easy communication facilities from the researcher's residence and hence was less expensive as well as less time consuming to conduct the study in these locations.

iii) The researcher expected better co-operation from the owners of the rice farmer.

iv) The rice fields are located in the same physiographic area and the area is, therefore, more representative to conduct field survey.

Figure 3.1 Map of Rajbari district showing Rajbari sadar upazila

Figure 3.2 Map of Rajbari sadar upazila showing the study area

3.2 Selection of the Samples

A purposive sampling technique was followed for the study. Data were collected from 80 rice cultivators; of which 40 combine harvester user and 40 combine harvester non-users Rajbari sadar upazila.

3.3 Period of the Study

The present study covered period from 1st January 2022 to 30 January, 2022. Data were collected by the researcher himself.

3.4 Preparation of the Survey Schedule

Preparation of survey schedules is of crucial importance in this study. A comprehensive survey schedule was prepared to collect necessary information from the concerned respondent in such a way that all relevant information needed for rice cultivation could be easily obtained within the shortest possible time. The interview schedule was pretested for judging their suitability. After pre testing, the schedule was finalized.

3.5 Collection of Data

To satisfy the objectives of the study, necessary data were collected by visiting each farm personally and by interviewing them with the help of a pretested interview schedule. Usually most of the respondent does not keep records of their activities. Hence it is very difficult to collect actual data and the researcher has to rely on the memory of the respondent. Before going to an actual interview, a brief introduction of the aims and objectives of the study was given to each respondent. The question was asked systematically in a very simple manner and the information was recorded on the interview schedule. When each interview was over the interview schedule was checked and verified to be sure that information to each of the items had been properly recorded. In order to minimize errors, data

were collected in local units. These were subsequently converted into appropriate standard unit.

3.6 Editing and Tabulation of Data

After collection of primary data, the filled schedules were edited for analysis. These data were verified to eliminate possible errors and inconsistencies. All the collected data were summarized and scrutinized carefully. For data entry and data analysis, the Microsoft Excel programs and SPSS programs were used. It might be observed here that information was collected initially in local units and after checking the collected data, it was converted into standard units. Finally, a few relevant tables were prepared according to necessity of analysis to meet the objectives of the study.

3.7 Procedure for computation of costs

The farmers producing rice had to incur cost for different inputs used in the production process. The input items were valued at the prevailing market price and sometime at government price in the area during survey period, or at the priced at which farmers bought. Sometimes, the farmers purchased hired labor, seed, fertilizer, manure and insecticide from the market and it was easy to pricing these items. But, farmers did not pay cash for some input such as family labor, home supplied seed, manure etc. So it was very difficult to calculate the cost of production of these inputs. In this case opportunity cost principle was used. In calculating the production cost, the following components of cost were considered in this study area:

- Human labor
- Land preparation/Mechanical power cost
- Seed
- Manure

• Fertilizer
• Insecticides
• Weeding
• Irrigation
• Pesticides cost
• Interest on operating capital and
•Land use.

Cost of human labor

Human labor cost was one of the most important and largest cost items of boro rice production in the study area. It is required for different farm operations like land preparation, weeding, application of fertilizer and insecticide, harvesting and carrying etc. Mainly two types of human labor used in the study area; such as family labor and hired labor. Family labor includes the operator himself, the adult male and female as well as children of a farmer's family and the permanently hired labor. To determine the costs of unpaid family labor, the opportunity cost concept was used. In this study the opportunity cost of family labor was assumed to be market wage rate, i.e., the wage rate that the farmers actually paid to the hired labor. The labor that was appointed permanently was considered as a family labor in this study. In computing the cost of hired labor, actual wages were paid and charged in case where the hired labors were provided with meals; the money value of such payment was added to the cash paid. The labor has been measured in a man-day unit, which usually consisted of 8 hours a day.

In producing rice human labor were used for the following operations:

- Land preparation/ploughing/laddering
- Fertilizing, weeding and irrigation
- Pest control
- Harvesting, storing and marketing

Cost of Power Tiller and Laddering

Human labor and mechanical power were jointly used for power tiller and laddering. Power tiller and laddering cost was the summation of hired and home supplied draft power and human labor. Hired power tiller and laddering cost were calculated by the prevailing market prices that were actually paid by the farmers. Home supplied mechanical power and human labor cost was estimated on the basis of opportunity cost principle.

Cost of seeds

Cost of seed was also estimated on the basis of home supplied and purchased seed. Home supplied seed were calculated at the prevailing market rate and the costs of purchased seed were calculated at the actual price.

Cost of cow dung

Cow dung may be used from home supplied or through purchased. The value of home supplied and purchased cow dung was calculated at the prevailing market price.

Cost of fertilizer

It is very important for rice cultivation to use the fertilizer in recommended dose. In the study area, farmers used different types of chemical fertilizer i.e., Urea, TSP (Triple Super Phosphate), MP (Muriate of Potash), Gypsum, Zinc sulphate and boron for growing rice cultivation. Fertilizer cost was calculated according to the actual price paid by the farmers.

Cost of insecticide

Most of the sample farmers used Dithane M-45, Thiovit 80wp and Rovral 50wp for rice cultivation. The cost of these insecticides was calculated by the prices paid by farmers.

Cost of irrigation

The cost of irrigation included the rental charge of machine plus and the costs of fuel. Someone rent/borrow only water from the shallow tube well (STW) owners by paying some charge.

Harvesting cost by combine harvester

The cost of combine harvester included trashing hours, total used fuel, total harvested area, costs of spare parts, filters, fluids, amount of service labour hours, cost of labour, frequency of mechanical, electrical, hydraulic, maintenance interventions/service operations.

Interest on operating capital

Interest cost was compute at the rate of 10% per annum. It was assumed that if farmers would take loans from a bank, they would have to pay interest at the above mentioned rate. Since all expenses were not incurred it the beginning of the production process, rather they were spent throughout the whole production period the cost of operating was, therefore, computed by using the following formula:

$$\textbf{Interest on operating capital} = \frac{\text{Operating Capital} * \text{Rate of interest x Time}}{2}$$

This actually represented the average operating costs over the period because all costs were not incurred at the beginning or at any fixed time. The cost was charged for a period of 6 months at the rate of Tk. 10 per annum.

Land use cost

The price of land was different for different plots depending upon location and topography of the soil. The cost of land used was estimated by the cash rental value of land. In calculating land use cost, average rental value of land per hectare

for a particular year. In computing rental value of land of the land used cost (LUC), it was calculated according to farmer's statement.

3.8 Profitability Analysis

Cost and return analysis is the most common method of determining and comparing the profitability of different farm household. In the present study, the profitability of rice cultivation is calculated by the following way-

3.8.1 Calculation of Gross Return

Per hectare gross return was calculated by multiplying the total amount of product and by-product by their respective per unit prices.

Gross Return= Quantity of the product * Average price of the product + Value of by- product.

3.8.2 Calculation of Gross Margin

Gross margin is defined as the difference between gross return and variable costs. Generally, farmers want maximum return over variable cost of production. The argument for using the gross margin analysis is that the farmers are interested to get returns over variable cost. Gross margin was calculated on TVC basis. Per hectare gross margin was obtained by subtracting variable costs from gross return. That is, Gross margin = Gross return – Variable cost.

3.8.3 Calculation of Net Return

Net return or profit was calculated by deducting the total production cost from the total return or gross return. That is,

Net return = Total return – Total production cost.

The following conventional profit equation was applied to examine farmer's profitability level of rice producing farms in the study areas.

Net profit, $\pi = \Sigma P_m Q_m + \Sigma P_f Q_f - \Sigma(P_{xi} X_i) - TFC$.

Where, π = Net profit/Net return from rice cultivation (Tk. /ha);

P_m = Per unit price of rice (Tk. /kg);

Q_m = Total quantity of the rice cultivation (kg/ha);

P_f = Per unit price of other relevant rice (Tk./kg);

Q_f = Total quantity of other relevant rice (kg/ha);

P_{xi} = Per unit price of i-th inputs (Tk.);

X_i = Quantity of the i-th inputs (kg/ha);

TFC = Total fixed cost (Tk.) and

i = 1, 2, 3,....., n (number of inputs).

3.8.4 Undiscounted Benefit Cost Ratio (BCR)

Average return to each taka spent on production is an important criterion for measuring profitability. Undiscounted BCR was estimated as the ratio of total return to total cost per hectare.

$$\textbf{BCR} = \frac{\text{Total Return}}{\text{Total Cost}}$$

CHAPTER IV

SOCIOECONOMIC CHARACTERISTICS OF THE RICE FARMERS

4.1 Introduction

This chapter provides a brief description of the socioeconomic characteristics of rice farmers in the study area. Decision making behavior of an individual is determined to a large extent by his socioeconomic characteristics. The socioeconomic characteristics considered in the present study were age, education, experience, family size, rice cultivation area, total land size, sources of family income, etc.

4.2 Age Distribution of Rice Farmers

Age distribution of rice farm owners is very important in maintaining profitable operation of a farm business. The selected rice farmers were grouped into three categories according to their ages. The different age groups of the rice farm owners are presented in Table 4.1. The age of the selected rice farmers was observed to be ranging from a minimum of 32 to a maximum of 65 years.

Table 4.1: Age distribution of the rice farmers

Categories (years)	Combine harvester Users		Combine harvester Non-users	
	Number	Percent (%)	Number	Percent (%)
Upto 35 years	2	5.0	1	2.5
36-50 years	22	55.0	20	50.0
Above 50 years	16	40.0	19	47.5
Total	40	100.0	40	100.0

Source: Field survey, 2022

It is clear from the Table 4.1 that combine harvester users age between 36-50 years of accounted for 55.0 % of the total sampled rice farmers while combine harvester non-users farmers middle aged 36-50 years constituted 50.0 %. There

are 40 % sample combine harvester users' farmers whose age was above 50 years. From the Table find that farmers' combine harvester non-users age between upto 35 years of accounted for 2.5 % of the total sampled rice farmers while combine harvester user farmers' upto 35 years constituted 5.0 %. There are only 47.5 % sample combine harvester non-user farmers' whose age was above 50 years.

4.3 Educational level of Rice Farmers

Education plays an important role for rice farmers and helps a farmer to have day-to-day information about the existing modern techniques together with changes in various management practices. It enables a man capable of managing scare resources and hence to earn maximum profit.

Table 4.2: Level of education of the rice farmers

Categories (years of schooling)	Combine harvester Users		Combine harvester Non-users	
	Number	Percent (%)	Number	Percent (%)
Illiterate (0-0.5)	9	22.5	8	20.0
Primary (1-5)	10	25.0	13	32.5
Secondary (6-10)	15	37.5	16	40.0
Higher secondary (>10)	6	15.0	3	7.5
Total	40	100.0	40	100.0

Source: Field survey, 2022

To examine the educational level of the rice farmers, education was classified into four categories such as illiterate, primary, secondary and higher secondary. Table 4.2 displays the educational level of the respondents. The Table reveals that the highest 37.5 % of the combine harvester user farmers attained secondary educational level. Farmers had who higher secondary constituted 15.0 % while 9.0 % of the combine harvester users farmers were in illiterate. The Table also reveals that the highest 40.0 % of the combine harvester non-user farmers attained secondary educational level. Farmers had who higher secondary constituted 7.5 %

while 20.0 % of the combine harvester non-users farmers were in illiterate. Combine harvester user farmers were primary level of education constituted 25.0 % while 32.5 % of the combine harvester non-users farmers were primary level of education.

4.4 Experience in Rice Cultivation

Experience distribution of rice farm owners is very important in maintaining profitable operation of a farm business. The selected rice farmers were grouped into three categories according to their experience. The different experience groups of the rice farm owners are presented in Table 4.3.

Table 4.3 Distribution of the farmers according to their rice farming experience

Categories (years)	Combine harvester users		Combine harvester non-users	
	Number	Percent (%)	Number	Percent (%)
Upto 15 years	9	22.5	6	15.0
16-30 years	19	47.5	20	50.0
Above 30 years	12	30.0	14	35.0
Total	40	100.0	40	100.0

Source: Field survey, 2022

It is clear from the table that farmers between 16-30 years of experience accounted for 47.5 % for combine harvester users and 50.0 % for combine harvester non-user, respectively of the total sampled rice farmers while farmers' upto 15 years constituted 22.5 % and 15.0 %. There are 30.0 % combine harvester users and 35 % combine harvester non-user sample farmers whose experiences were above 30 years.

4.5 Total Farm Size of the Farmers

Based on their farm size, the rice cultivators were classified into four categories namely 'marginal farm', 'small farm', 'medium' and 'large farm'. The distribution of the farmers according to their farm size is presented in Table 4.5. In case of

combine harvester users, Table 4.4 indicates that the medium farm holder constitutes the highest proportion (87.5 %) followed by small farm holder (2.5 %) and (0 %) marginal and 10.0 % of the farmers had large farm size respectively. On the other hand combine harvester non-users, Table 4.4 indicates that the medium farm holder constitutes the highest proportion (77.5 %) followed by small farm holder (15.0 %) and (0 %) marginal and 7.5 % of the farmers had large farm size.

Table 4.4: Total land holding status of the farmers

Categories (ha)	Combine harvester users		Combine harvester non-users	
	Number	Percent (%)	Number	Percent (%)
Marginal land (upto 0.20 ha)	0	0	0	0
Small land (0.21-1.0 ha)	1	2.5	6	15.0
Medium land (1.01-3.0 ha)	35	87.5	31	77.5
Large land (Above 3.0 ha)	4	10.0	3	7.5
Total	40	100.0	40	100.0

Source: Field survey, 2022

4.6 Rice Cultivation Area

Based on their farm size, the rice cultivators were classified into four categories namely ‘marginal farm’, ‘small farm’, ‘medium’ and ‘large farm’. The distribution of the farmers according to their farm size is presented in Table 4.5. Table 4.5 indicates that the small farm holder constitutes the highest proportion (57.5 %) followed by medium farm holder (30.0 %) and (5 %) marginal and 7.5 %of the farmers had large farm size respectively. On the other hand combine harvester non-users, Table 4.5 indicates that the small farm holder constitutes the highest proportion (62.5 %) followed by medium farm holder (32.5 %) and (2.5 %) marginal and 2.5 % of the farmers had large farm size.

Table 4.5: Rice cultivation area of the farmers

Categories (ha)	Combine harvester users		Combine harvester non-users	
	Number	Percent (%)	Number	Percent (%)
Marginal farm (up to 0.2 ha)	2	5.0	1	2.5
Small farm (0.21-1.0 ha)	23	57.5	25	62.5
Medium farm (1.01-3.0 ha)	12	30.0	13	32.5
Large farm (>3.01 ha)	3	7.5	1	2.5
Total	40	100.0	40	100.0

Source: Field survey, 2022

4.7 Household Expenditure

On the basis of expenditure, the respondents were categorized into three groups as shown in Table 4.6. In case of combine harvester users, the highest proportion (77.5 %) of the respondents had 151-250 thousand expenditure that was followed by (12.50 %) and (10.0 %) family expenditure. In case of combine harvester non-users, 85.0 % had 151-250 thousand family expenditure followed by 15.0 % had above 250 thousand expenditure.

Table 4.6: Expenditure of the rice farmers

Categories ('000'tk)	Combine harvester users		Combine harvester non-users	
	Number	Percent (%)	Number	Percent (%)
Upto 150 thousand	5	12.5	0	0
151-250 thousand	31	77.5	34	85.0
Above 250 thousand	4	10.0	6	15.0
Total	40	100.0	40	100.0

Source: Field survey, 2022

4.8 Family Size of the Rice Farmers

The average family sizes were 5.98 and 6.35. In the study area, family size has rice considered as one which has a total number of people living together with the same head of the family. The family member includes wife, sons, unmarried daughter, father, mother and brother. The total numbers of persons of all families were divided into three age categories according to their family size. The different family size of rice farmers is presented in Table 4.7.

Table 4.7: Family size of rice farmers

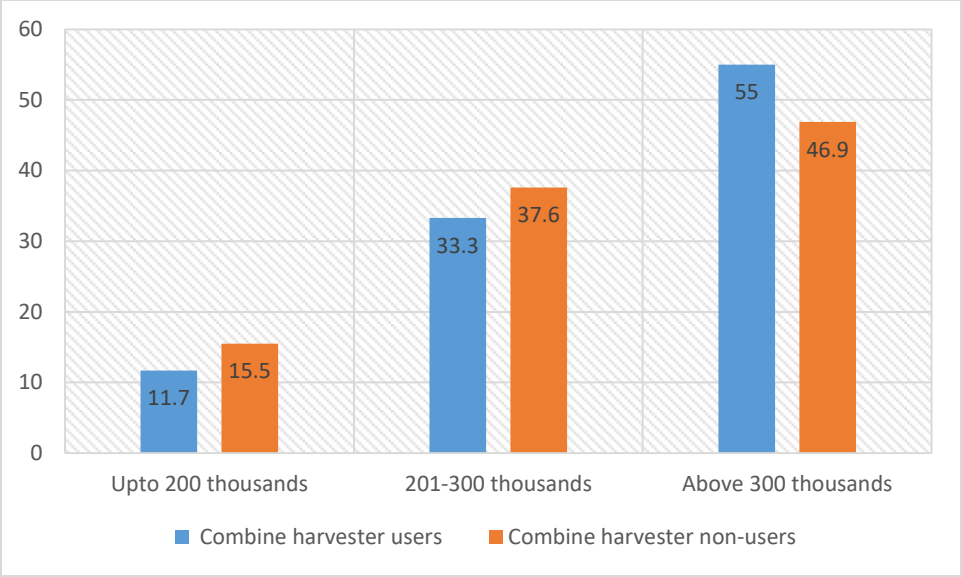
Categories (Members)	Combine harvester users		Combine harvester non-users	
	Number	Percent (%)	Number	Percent (%)
3-4 members	7	17.5	4	10.0
5-6 members	20	50.0	17	42.5
Above 6 members	13	32.5	19	47.5
Total	40	100.0	40	100.0

Source: Field Survey, 2022

Table 4.7 indicates that 17.5 % families of combine harvester user farmers consisted of 3-4 members, 50.0 % families consisted of 5-6 members, 32.5 % families consisted of above 6 members. Table 4.6 also indicates that 10.0 % families of combine harvester non-user farmers consisted of 3-4 members, 42.2 % families consisted of 5-6 members, 47.5 % families consisted of above 6 members.

4.9 Household Income level of the Rice Farmers

Family income of the farmers comprises different sources. Annual family incomes of rice farmers come from rice farming, business, agriculture, service, and others.



Source: Field survey, 2022

Figure 4.1: Income of the rice farmers

The average annual family incomes were Tk. 225.60 thousand and Tk. 238.24 thousand. Annual family incomes of combine harvester user and combine harvester non-user owners are shown in Figure 4.1. Figure 4.1 indicates that 55 % families of combine harvester user farmers consisted of above 300 (Tk. '000'), 33.3 % families consisted of 201-300 (Tk. '000') and 11.7 % families consisted of above upto 200 (Tk. '000'). Figure 4.1 also indicates that 46.9 % families of combine harvester non-user farmers consisted of above 300 (Tk. '000'), 37.6 percent families consisted of 201-300 (Tk. '000') and 15.5 % families consisted of upto 200 (Tk. '000').

4.10 Conclusion of the Chapter

From the above discussion it can be narrated that this study shows the numbers of small farmers are higher than marginal and medium farmers. Marginal farmers are cultivating more land under rice cultivation than small and medium farmers. The study also compared many perspectives of the socio economic characteristics of the sample farmers those were also discussed in this chapter.

CHAPTER V
COMPARATIVE PROFITABILITY OF COMBINE HARVESTER USER AND NON USER OF RICE FARMER

5.1 Introduction

Profitability is a major criterion to make decision for producing rice at farm level. It can be measured based on net return, gross margin and ratio of return to total cost. The costs of all items were calculated to identify the total cost of production. The returns from the crops have rice estimated based on the value of main products and by-products.

5.2 Pattern of Input Use

5.3 Pattern of Input Use for Rice Cultivation

Farmers in the study areas used various inputs for rice cultivation. Farmers used on an average family labor were 19 man-days and hired labor was 61 man-days in combine harvester user. Farmers used on an average family labor were 33 man-days and hired labor was 69 man-days in combine harvester non-user. On an average they used 35 kg seed per hectare for combine harvester user and 36 kg seed per hectare for combine harvester non-user. They applied at the rate of urea 198 kg/ha for combine harvester user and 190 kg/ha urea for combine harvester non-user, TSP 124 kg/ha for combine harvester user and 120 kg/ha for combine harvester non-user and MP 122 kg/ha for combine harvester user and 115 kg/ha for combine harvester non-user. It was observed that among the chemical fertilizer farmers used highest amount urea for combine harvester user. In the study areas, farmers also applied zinc 10 kg/ha for combine harvester user and 11 kg/ha for combine harvester non-user and manure 2000 kg/ha for rice cultivation.

Table 5.1 Level of input use per hectare of rice cultivation

Particulars	Farms			
	Combine harvester user	Price Tk./unit	Combine harvester non-user	Price Tk./unit
Family	19	550	33	550
Hired	61	550	69	550
Seed (kg)	35	92	36	90
Urea (kg)	198	17	190	17
TSP (kg)	124	22	120	22
MP (kg)	122	16	115	16
Manure (kg)	2000	3	2000	3
Zinc (kg)	10	200	11	200

5.4 Profitability of rice production

5.5 Variable Costs

5.6 Human Labor Cost

Labor cost is an important component in rice production and this has implication for income and employment generation. In calculating the cost of farm operation, the services of both hired and family labor were taken into consideration. Family labor includes the operator himself and other working members of the family while the hired labor includes permanent hired labor, and labor employed on daily contract basis. The cost of family labor was estimated on the basis of the principle of opportunity cost. It is revealed from Table 5.2 that the cost of hired labor per hectare was Tk. 33550 for combine harvester users and Tk. 37950 for combine harvester non-users, respectively. Combine harvester users hired labor cost was lower than combine harvester non-users. It is revealed from Table 5.1 that the cost of own labor per hectare was Tk. 10450 for combine harvester users and Tk. 18150 for combine harvester non-users, respectively. Combine harvester users hired labor cost was lower than combine harvester non-users.

5.7 Family Labor Cost

For rice production, family labor cost is the most important part of the production. Table 5.2 shows that total family labor cost per hectare was Tk. 10450 and Tk.

18150 for combine harvester users and combine harvester non-users rice cultivation. Combine harvester users family labor cost was lower than combine harvester non-users.

5.8 Cost of Land Preparation

Land preparation is needed to make the soil suitable for rice cultivation. The average land preparation cost of rice production was found Tk. 7410 for combine harvester users and Tk. 7410 for combine harvester non-users, respectively. Combine harvester users land preparation cost was same combine harvester non-users (Table 5.2).

5.9 Cost of Seed

Cost of seed varied widely depending on its quality and availability. Per hectare total cost of seed for rice production was estimated to be Tk. 3220 for combine harvester users and Tk. 3240 for combine harvester non-users respectively Combine harvester users seed cost was lower than combine harvester non-users. (Table 5.2).

5.10 Cost of Urea

In the study area, farmers used different types of fertilizers for cultivating rice. On an average, per hectare cost of urea were Tk. 3366 for combine harvester users and Tk. 3230 for combine harvester non-users, respectively. Combine harvester users urea cost was higher than combine harvester non-users (Table 5.2).

5.11 Cost of TSP

Among the different kinds of fertilizers used, the average costs of TSP were Tk. 2728 for combine harvester users and Tk. 2640 for combine harvester non-users, respectively. Combine harvester users TSP cost was higher than combine harvester non-users (Table 5.2).

5.12 Cost of MoP

Per hectare cost of MoP was Tk.1952 for combine harvester users and Tk. 1840 for combine harvester non-users, respectively. Combine harvester users MP cost was lower than combine harvester non-users (Table 5.2).

5.13 Cost of Zinc

Per hectare cost of Zinc were Tk. 2000 for combine harvester users and Tk. 2200 for combine harvester non-users, respectively Combine harvester users Zn cost was higher than combine harvester non-users (Table 5.2).

5.14 Cost of Irrigation

Irrigation was a leading input for rice production. The cost of irrigation water was charged at fixed rate of unit of area. The irrigated farms farmers were enjoy the irrigation facility. The irrigation cost for rice farmers were Tk. 11115 for combine harvester users and Tk. 11115 for combine harvester non-users. The cost for combine harvester non-users farms for irrigation was same combine harvester user's farmers (Table 5.2).

5.15 Cost of Pesticides

Farmers used different kinds of pesticides to control pests and diseases so that they can get higher yield of rice cultivation. The average cost of pesticides per hectare was Tk. 6650 for combine harvester users and Tk. 5465 for combine harvester non-users, respectively. Combine harvester users pesticides cost was higher than combine harvester non-users (Table 5.2).

5.16 Manure Cost

Farmers use manure in their rice field for higher production of rice. Per hectare manure cost for combine harvester users' and non-users were Tk. 6000 (Table 5.2).

5.17 Harvesting Cost

Per hectare harvesting cost for combine harvester users' was Tk. 9880 for combine harvester user and Tk.19250 for combine harvester non-user (Table 5.2).

Table 5.2 Per hectare cost of rice cultivation

Variable cost items	**Combine harvester user**			**Combine harvester non-user**		
	Quantity unit/ha	Price Tk./ unit	Total cost Tk/ha	Quantity unit/ha	Price Tk./ unit	Total cost Tk/ha
Hired labor cost	61	550	33550	69	550	37950
Family labor	19	550	10450	33	550	18150
Land preparation cost	1	7410	7410	1	7410	7410
Combine harvester/ Harvesting cost	1	9880	9880	35	550	19250
Seed cost	35	92	3220	36	90	3240
Urea cost	198	17	3366	190	17	3230
TSP cost	124	22	2728	120	22	2640
MP cost	122	16	1952	115	16	1840
Zinc cost	10	200	2000	11	200	2200
Irrigation cost	-	-	11115	-	-	11115
Pesticides cost	-	-	6650	-	-	5465
Manure cost	2000	3	6000	2000	3	6000
Total variable cost	**-**	**-**	**98321**	**-**	**-**	**118490**
Interest on operating capital (10%)	**-**	**-**	**4916**	**-**	**-**	**5925**
Land use cost	-	-	22230	-	-	22230
Total fixed cost	-	-	27146	-	-	28155
Total cost			**125467**			**146645**

Source: Field survey, 2022

5.18 Total Variable Cost

Therefore, from the above different cost items it was clear that the total variable cost of rice production were Tk. 98321 and Tk. 118490 per hectare for combine harvester users and combine harvester non-users for rice cultivation. Combine

harvester user's total variable cost was lower than combine harvester non-users (Table 5.2).

5.19 Fixed Cost

In the study area, it was estimated that per hectare total fixed cost for rice cultivation was Tk. 27146 and 28155 for combine harvester users and combine harvester non-users in rice cultivation.

5.20 Land Use Cost

For rice production, land use cost is the most important part of the production. Table 5.2 shows that total land use cost per hectare per year was Tk. 22230 for both combine harvester users and combine harvester non-users for rice cultivation.

5.21 Interest on Operating Capital

It is evident from table 5.2 that interest on operating capital per hectare was Tk. 4916 and 5925 for combine harvester users and combine harvester non-users in rice cultivation.

5.22 Total Cost of Rice Production

Total cost was calculated by adding all the cost of variable and fixed inputs. In the present study per hectare total cost of producing rice per years was found to be Tk. 120551 and Tk. 140720 for combine harvester users and combine harvester non-users for rice cultivation. Combine harvester users total cost of production was lower than combine harvester non-users (Table 5.2).

5.23 Return of Rice Production

5.24 Gross Return

Return per hectare of rice production is shown in Table 5.4. Per hectare gross return was calculated by multiplying the total amount of product with respective per unit price and then adding the value of by-product. Therefore, the gross return was found to be Tk. 165128 per hectare for combine harvester users and Tk. 159998 for combine harvester non-users. Combine harvester user's gross return was higher than combine harvester non-users.

5.25 Gross Margin

Gross margin was calculated by deducting the total variable cost from the gross return. On the basis of the data, gross margin was found to be Tk. 66807 for combine harvester users and Tk. 41508 per hectare for combine harvester non-users. Combine harvester user's gross margin was higher than combine harvester non-users (Table 5.4).

5.26 Net Return

Net return or profit was calculated by deducting the total production cost from the gross return. On the basis of the data the net return was estimated as Tk. 39661 and Tk. 13353 per hectare for combine harvester users and non-users. Combine harvester user's net return was higher than combine harvester non-users (Table 5.4).

Table 5.3 Per hectare return of rice production

Items	**Combine harvester user**			**Combine harvester non-user**		
	Quantity (kg/ha)	Price (Tk/kg)	**Total (Tk/ha)**	Quantity (kg/ha)	Price (Tk/kg)	**Total (Tk/ha)**
Rice	6351	22.5	142898	6123	22.5	137768
By product			22230			22230
Total			165128			159998

Source: Field Survey, 2022

Table 5.4 Comparative profitability of rice production

Sl. No.	Items	Combine harvester user	Combine harvester non-user
A.	Gross return (GR)	165128	159998
B.	Total variable costs (TVC)	98321	118490
C.	Total costs (TVC+TFC)	125467	146645
D.	Net return (GR-TC)	39661	13353
E.	Gross margin (GR-TVC)	66807	41508
F.	Benefit-cost ratio (BCR) = GR/TC	1.32	1.09

Source: Field Survey, 2022

5.27 Benefit Cost Ratio (undiscounted)

Benefit cost ratio (BCR) was found to be 1.32 and 1.09 for combine harvester user and combine harvester non-user respectively which implies that one taka investment in rice production generated Tk. 1.32 and Tk. 1.09 (Table 5.4). From the above calculation it was found that combine harvester users' profitability was higher than combine harvester non-user in Bangladesh.

5.28 Concluding Remarks

It was evident from the results that per hectare total variable cost for rice cultivation were more than per hectare total fixed costs for rice production. Rice production provides higher returns to the farmers. Rice cultivation is gaining popularity in the country gradually due to its high yield potentiality and high demand in the national market. Sample farmers showed their opinion that higher yield and income encouraged them to continue rice production. From the above discussion it can be concluded here that rice production is a profitable business for farmers in the study area.

CHAPTER VI
CONSTRAINTS OF RICE CULTIVATION

Introduction

There may be some constraints for rice cultivation in the existing socio-economic context of Bangladesh. Therefore, an attempt was made to identify the major constraints and constraints of rice cultivation in the study area and to discuss the solutions of these constraints so that the owners of the rice cultivation can obtain better economic gain from rice cultivation. In order to identify various constraints of rice cultivation questions were asked to the owners/managers of the rice cultivation and findings are reported in this section.

6.1 Seasonality of Fertilizer

Fertilizer is the most important item for rice cultivation. Table 7.1 clearly indicates that all of the rice cultivation in the study area faced the problem for non-availability of fertilizer. In local markets, sometimes they did not find some of fertilizer ingredients in proper time. In the study area 56.67 percent of combine harvester non-users farmers mentioned this problem and 45.8 percent of combine harvester user's farmers mentioned this problem.

6.2 Unavailability of Improved Seeds

Unavailability of adequate number of improved seeds was another major problem for the owners of the rice farm. In the study area all the owners of the rice farms faced the problem of unavailability of improved seeds. Limited number of seeds farms in our country which was insufficient to meet up the requirement of seeds of the rice farms. Each of the rice farm owners, excepting a lucky few, had to spend a substantial time and energy for purchasing the seeds. In most cases, advance payments were necessary for the purchase of seeds, but there was no certainty when the owners of the farm would get their seeds. Sometimes, the farm owners

may have to wait 1 to 2 months. In the study area 72.4 % of combine harvester user farmers mentioned this problem and 51.66 % of combine harvester non-users farmers mentioned this problem.

6.3 Diseases and Pests Attacks

Outbreak of diseases and pests attack is one of the most important problems in the study area. About thirty eight per cent of rice cultivation complained about various diseases. In the study area 42.5 % of combine harvester user farmers mentioned this problem and 38.33 % of combine harvester non-users farmers mentioned this problem

6.4 Lack of Credit Facilities

Money is essential to run any business smoothly. It is also true in case of poultry farming. Inadequate institutional credit is the most crucial constraints for the development of private poultry industry in our country. In recent years, many poultry farm owners of the study area are interested to expand their poultry farms, because both eggs and meat have a great demand in the home market. But they cannot expand the farms, due to lack of capital. Moreover, in Bangladesh, bank credit disbursement system is very lengthy and full of corruption. In the study area 84.5 % of combine harvester user farmers mentioned this problem and 86.67 % of combine harvester non-users farmers mentioned this problem.

6.5 Lack of Skill Manpower

Technical knowledge on rice farming is essential for the development of rice sector. But in the study area skill manpower were not available. In the study area 26.9 % of combine harvester user farmers mentioned this problem and 35.6 % of combine harvester non-users farmers mentioned this problem.

6.6 Transport/Communication Facilities

About 25 per cent of rice farm owners argued that they had to pay excessive cost for the lack of adequate transport /communication facilities. In the study area 18.6 % of combine harvester user farmers mentioned this problem and 25.3 % of combine harvester non-users farmers mentioned this problem

6.7 Irregular Fluctuation of Rice Prices

Most of the owners complained that they did not have actual price of rice compared to their cost. Lower price of rice is the most important marketing problem. Farmers complained that they were not getting reasonable price. Sometimes, the price of rice was lower than the cost of production. In the study area 51.6 % of combine harvester user farmers mentioned this problem and 21.67 % of combine harvester non-users farmers mentioned this problem.

Table 6.1: Distribution of farmers according to constraints faced in rice production in the study area

Sl.	Nature of Constraints	Combine harvester users %	Combine harvester non-users %
1	Seasonality of fertilizers	45.8	56.67
2	Unavailability of improved seeds	72.4	51.66
3	Diseases and pest attack	42.5	38.33
4	Lack of credit facilities	84.5	86.67
5	Lack of skill manpower	26.9	35.6
6	Transport/communication facilities	18.6	25.3
7	Irregular fluctuation of rice price	51.6	21.67

CHAPTER VII
SUMMARY, CONCLUSION AND RECOMMENDATION

This chapter narrates the summary of the earlier chapters. On the basis of empirical outcomes, conclusion has been made. It also concentrates on the policy recommendations, limitations on the study for development of rice production in the study area.

7.1 Summary

Combine harvester users age between 36-50 years of accounted for 55.0 % of the total sampled rice farmers while combine harvester non-users farmers middle aged 36-50 years constituted 50.0 %. There are 40 % sample combine harvester users' farmers whose age was above 50 years. From the Table find that farmers' combine harvester non-users age between upto 35 years of accounted for 2.5 % of the total sampled rice farmers while combine harvester user farmers' upto 35 years constituted 5.0 %. There are only 47.5 % sample combine harvester non-user farmers' whose age was above 50 years.

The result reveals that the highest 37.5 % of the combine harvester user farmers attained secondary educational level. Farmers had who higher secondary constituted 15.0% while 9.0% of the combine harvester users farmers were in illiterate. The data reveals that the highest 40.0 % of the combine harvester non-user farmers attained secondary educational level. Farmers had who higher secondary constituted 7.5% while 20.0% of the combine harvester non-users farmers were in illiterate. Combine harvester user farmers were primary level of education constituted 25.0% while 32.5% of the combine harvester non-users farmers were primary level of education.

The farmers between 16-30 years of experience accounted for 47.5 for combine harvester users and 50.0 % for combine harvester non-user, respectively of the total sampled rice farmers while farmers' upto 15 years constituted 22.5 and 15.0 %. There are 30.0 % combine harvester users and 35 % combine harvester non-user sample farmers whose experiences were above 30 years.

Data indicates that the small farm holder constitutes the highest proportion (57.5 %) followed by medium farm holder (30.0 %) and (5 %) marginal and 7.5 % of the farmers had large farm size respectively. On the other hand combine harvester non-users, data indicates that the small farm holder constitutes the highest proportion (62.5 %) followed by medium farm holder (32.5 %) and (2.5 %) marginal and 2.5 % of the farmers had large farm size. Data indicates that the medium farm holder constitutes the highest proportion (87.5 %) followed by small farm holder (2.5 %) and (0 %) marginal and 10.0 % of the farmers had large farm size respectively. On the other hand combine harvester non-users, data indicates that the medium farm holder constitutes the highest proportion (77.5 %) followed by small farm holder (15.0 %) and (0 %) marginal and 7.5 % of the farmers had large farm size. In case of combine harvester users, the highest proportion (77.5 %) of the respondents had 151-250 thousand expenditure that was followed by (12.50 %) and (10.0 %) family expenditure. In case of combine harvester non-users, 85.0 % had 151-250 thousand family expenditure followed by 15.0 % had above 250 thousand expenditure.

Data indicates that 17.5 % families of combine harvester user farmers consisted of 3-4 members, 50.0 % families consisted of 5-6 members, 32.5 % families consisted of above 6 members. Data also indicates that 10.0 % families of combine harvester non-user farmers consisted of 3-4 members, 42.2 % families consisted of 5-6 members, 47.5 % families consisted of above 6 members. The highest 55 % families of combine harvester user farmers consisted of above 300

(Tk. ‘000’), 33.3 % families consisted of 201-300 (Tk. ‘000’) and 11.7 % families consisted of above upto 200 (Tk. ‘000’). Data indicates that 46.9 % families of combine harvester non-user farmers consisted of above 300 (Tk. ‘000’), 37.6 % families consisted of 201-300 (Tk. ‘000’) and 15.5 % families consisted of upto 200 (Tk. ‘000’).

The cost of hired labor per hectare was Tk. 33550 for combine harvester users and Tk. 37950 for combine harvester non-users. Total family labor cost per hectare was Tk. 10450 and Tk. 18150 for combine harvester users and combine harvester non-users rice cultivation. The average land preparation cost of rice production was found Tk. 7410 for combine harvester users and Tk. 7410 for combine harvester non-users. Per hectare total cost of seed for rice production was estimated to be Tk. 3220 for combine harvester users and Tk. 3240 for combine harvester non-users. On an average, per hectare cost of urea were Tk. 3366 for combine harvester users and Tk. 3230 for combine harvester non-users. The average costs of TSP were Tk. 2728 for combine harvester users and Tk. 2640 for combine harvester non-users. Per hectare cost of MoP was Tk.1952 for combine harvester users and Tk. 1840 for combine harvester non-users.

Per hectare cost of Zinc were Tk. 2000 for combine harvester users and Tk. 2200 for combine harvester non-users. The irrigated farms farmers were enjoy the irrigation facility. The irrigation cost for rice farmers were Tk. 11115 for combine harvester users and Tk. 11115 for combine harvester non-users. The average cost of pesticides per hectare was Tk. 6650 for combine harvester users and Tk. 5465 for combine harvester non-users. Farmers use manure in their rice field for higher production of rice. Per hectare manure cost for combine harvester users’ and non-users were Tk. 6000.

The total variable costs of rice production were Tk. 98321 and Tk. 118490 per hectare for combine harvester users and combine harvester non-users for rice cultivation. Per hectare total fixed cost for rice cultivation was Tk. 27146 and 28155 for combine harvester users and combine harvester non-users in rice cultivation Total land use cost per hectare per season was Tk. 22230 for both combine harvester users and combine harvester non-users for rice cultivation. Interest on operating capital per hectare was Tk. 4916 and 5925 for combine harvester users and combine harvester non-users in rice cultivation. Per hectare total cost of producing rice per years was found to be Tk. 125467 and Tk. 146645 for combine harvester users and combine harvester non-users for rice cultivation.

The gross return was found to be Tk. 165128 per hectare for combine harvester users and Tk. 199998 for combine harvester non-users. On the basis of the data, gross margin was found to be Tk. 66807 for combine harvester users and Tk. 41508 per hectare for combine harvester non-users. On the basis of the data the net return was estimated as Tk. 39661 and Tk. 13353 per hectare for combine harvester users and non-users. Benefit cost ratio (BCR) was found to be 1.32 and 1.09 for combine harvester user and combine harvester non-user respectively which implies that one taka investment in rice production generated Tk. 1.32 and Tk. 1.14.

7.2 Conclusion

The study showed that rice cultivation is profitable in the study area. Combine harvester non-user received lower profit than combine harvester user. Although rice production was profitable as others crop cultivation, but the farmers were not so much interested to grow a huge bulk of rice continuously, because of fluctuating market price of the rice. Therefore, there is a need to ensure a reasonable market price of rice at the harvesting period and that should be stable.

Moreover, the government should take necessary steps to overcome these constraints and to expand the production of rice in different areas of Bangladesh. Lack of credit facilities was ranked lst problem and transport/communication facilities were ranked the last.

7.3 Recommendation

Based on the findings of the present research, the following recommendations are put forward.

- There should be a clear adequate policy statement and strategy on combine harvester users to encourage farmers to adopt new, easy, economic technologies related to combine harvester.
- Identification of appropriate machinery for farmers and continuance of maximum subsidy to some extent in distribution of combine harvester.
- Farm machinery fair can be organized at upazila level annually by DAE for disseminating and promoting locally made/improved/imported cost effective and eco-friendly combine harvester.
- Government should provide up to 70% subsidy in popularizing selected combine harvester.
- Credits should be available at commercial banks and NGOs.

7.4 Limitation of the Study

During the period of data collection, the following problems were encountered by the author:

i. Most of the respondents were now not well educated. They had no preceding idea approximately such examine. They have been suspicious about the researcher and therefore did not cooperate and it became consequently hard to provide an explanation for the cause of

this research to convince them. At last, the respondents were convinced.

ii. Most of the farmers have been afraid of imposition of taxes. Their tension become that the researcher might use the statistics in opposition to their interest.

iii. The respondents (farmers and intermediaries) did not keep records of their farming business and business activities; they had difficulty in recalling information. It was an added problem to the researcher to collect the reliable data because most of the fanners provided information from their memory.

iv. Sometimes the producer-respondents have been no longer available at their home because they remained busy with their outdoor work. This is why some times greater than two visits have been required to get data from them. So, the author had to give more time and effort to acquire the information.

v. The respondents continually had a tendency not to offer correct information regarding the scale in their preserving, profits and expenditure received from special tasks. Because maximum of the respondents within the have a look at location thought that the investigator was a government officer. They to start with hesitated to reply the question regarding their earnings and expenditure. The respondent's notion that new taxes would be imposed on them if accurate records was furnished. When they understood then they gave applicable information.

vi. Farmers furnished statistics in local devices of measures in reaction to questions which created complexity in analyzing the information.

vii. There changed into a time issue so all information and different important statistics was amassed within the shortest possible time.

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