ECONOMIC STUDY OF BINADHAN-14 PRODUCTION IN SOME SELECTED AREAS OF BANGLADESH

M.M.A. Sarkar[1*], M.H. Rahman[1], S. Islam[1] and R. Sultana[1]

Abstract

This study was conducted to analyze the profitability of Binadhan-14 producing farmers in Mymensingh, Rangpur, Cumilla and Magura districts of Bangladesh. This study was based on primary data which were collected from 160 Binadhan-14 producing farmers. In the sampled areas data were collected through pre-designed interview schedule from May-June, 2018 for achieving the purpose. The cultivation of Binadhan-14 was profitable from the point of view of the farmers. The average net return per hectare was Tk. 36666. Benefit cost ratio was at 1.45 and 2.02 on full cost and variable cost basis implying that the Binadhan-14 cultivation at farm level was profitable. Cobb-Douglas production function was chosen to determine the factor affecting gross return of Binadhan-14 production. Most of the factors namely, human labour cost, power tiller cost, seed cost, fertilizer cost, irrigation cost and insecticides cost were statistically significant and positive. The farmers in the study areas encountered some constraints to Binadhan-14 production. The first ranked constraint was unavailability of seeds in all areas (87%). Other constraints were shattering problem (67%), lack of training (37%), lack of technical know-how (31%), lack of capital (26%) and low education level of farmers (15%). The economic return of Binadhan-14 production was encouraging to the farmers for more cultivation of the variety.

Key words: Binadhan-14, Profitability, Factors affecting, Cobb-Douglas production function.

Introduction

Rice is one of the dominant cereal dietary items of almost 15 million farm families (BBS, 2015) of Bangladesh. It provides one-sixth of rural household income, nearly 48%, of the rural employment two-thirds of per capita daily calorie intake, and half of per capita daily protein intake (Rahman *et al.*, 2016). About 81 percent of the total cropped area and over 80 percent of the total irrigated area is planted to rice. Approximately 96 percent share of the total cereal supply comes from rice alone (Alam *et al.*, 2013). Rice contributes almost o the GDP and recruites about 40% of the labor force of the country (BBS, 2020). There are three concurrent crop seasons in Bangladesh, where paddy is grown in about 42% of the land during Boro season and it accounts for the production of 19.56 million tons of clean rice, which is around 54% of the total production of the country (BBS, 2020). Although, the country already attained self-sufficiency in rice production (Jalilov *et al.*, 2019).

[1]Agricultural Economics Division, Bangladesh Institute of Nuclear Agriculture, BAU Campus, Mymensingh-2202
[*]Corresponding authors' email: mohsin@bina.gov.bd

It has serious deficit in edible oil producing crops which to be met or at least to be reduced under the challenges like limited and scattered land holdings, natural hazards, increasing temperatures, irregular and unpredictable rainfall, winter shortening, rising sea level, rice mono-cropping, and low profitability in rice cultivation (Mondal *et al.*, 2012).

Binadhan-14 is a late transplanting potential Boro which is commonly known as Braus rice variety allows Boro rice transplantation even up to last week of March and produces average yield of 6.9 t ha^{-1} in 105-125 days under proper management practices. This variety allows of any duration in the cropping pattern of short duration T. Aman rice-mustard/rapeseed-Boro rice keeping the Boro yield unaffected. It has long-fine grains with palatable to eat. This variety contributes significantly in increasing area under mustard/ rapeseed, pulses, potato and even winter vegetables and thus increased farmer's income, more employment and meets the challenges of self-sufficiency in food production.

There are some studies about the profitability of rice production in Bangladesh (Anik, 2003; Ismail *et al.*, 2010; Khan, 2005; Tasnoova *et al.*. 2006; Rahman *et al.*, 2015; Noonari *et al.*, 2015; Islam *et al.*, 2017; and Bwala *et al.*, 2018). The present study is important for rice production in the late Boro/Braus season in Bangladesh which accommodates one more crop in the existing cropping system. The study not only analyses the profitability but also identify factors affecting gross return and the farmer's major constraints about rice productions in late Boro season. Therefore, the findings of this study would guide the policy makers in designing policies that can contribute to the measures needed to improve the nation's potential for food (rice, edible oil, pulse, winter vegetables including potato) production efficiently. The specific objectives of the study were i) to determine the profitability of Binadhan-14 growers, ii) to assess the factors affecting gross return of Binadhan-14 and iii) to determine the resource allocation efficiency in Binadhan-14 rice production and (iv) to identify the major constraints to Binadhan-14 cultivation.

Materials and Methods

Selection of the study area, sample size and sampling technique:

This study was conducted in four districts of Bangladesh, viz., Mymensingh, Rangpur, Cumilla and Magura. One hundred and sixty Binadhan-14 growers, taking 40 randomly from each district were selected with the help of Department of Agricultural Extension (DAE) personnel for interview. Field investigators under the direct supervision of the researchers, collected field level cross sectional data using pre-tested interview schedule.

Method of data collection and period of study:

Data were collected from sampled Binadhan-14 growers through face to face interview method using the interview schedule mentioned, above. Field level primary data were collected by the researcher with the help of trained enumerators for the period of May-June, 2018.

Analytical techniques:

Collected data were edited, summarized, tabulated and analyzed to fulfill the objectives of the study. The data were analyzed with the help of suitable statistical measures like frequencies, percentages, mean and standard deviation. Descriptive statistics were also used to analyze and compare the socioeconomic characteristics. The total cost was composed of total variable costs (TVC) and total fixed costs (TFC). The gross return (GR) was computed as total output multiplied by the market price of Binadhan-14. Profits or gross margin (GM) was defined as GR-TVC, whereas the net return (NR) was defined as GR-TC. Finally, the Benefit Cost Ratio (BCR) was computed as GR/TC.

Statistical Analysis:

The following Cobb-Douglas type production function was used to estimate the parameters. The functional form of the Cobb- Douglas multiple regression equation was as follows:

$$Y= AX_1^{b1}X_2^{b}2.....X_n^{bn}e^{ui}$$

The production function was converted to logarithmic form so that it could be solved by least square method i.e.

$$\ln Y= a+b_1 \ln X_1 + ... + b_n \ln X_n + e^{ui}$$

The empirical production function was the following:

$$\ln Y= a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + Ui$$

Where,

Y = Yield/Gross return (kg ha^{-1})

X_1 = Human labor (Man days ha^{-1})

X_2 = Power tiller (Tk. ha^{-1})

X_3 = Seed (kg ha^{-1})

X_4 = Fertilizer (kg ha^{-1})

X_5 = Irrigation (Tk. ha^{-1})

X_6 = Insecticides (Tk. ha^{-1})

a = Constant value b_1 b_2 ..... b_6 = Co-efficient of the respective variables and

U_i = Error term.

Results and Discussion

Economic profitability of Binadhan-14 production

Profitability is one of the major criteria for determination of acceptance of a crop. The cost of Binadhan-14 production, gross return, gross margin, net return and the benefit cost ratio (BCR) for Binadhan-14 cultivation are being discussed in the following sections (Table 1 and Table 2).

Cost of Binadhan-14 cultivation

The cost of human labour, land preparation, power tiller, seed, fertilizers, pesticides and irrigation cost were taken into consideration in calculating cost of Binadhan-14 production. Beside this, interest on operating capital was also considered as the cost of Binadhan-14 production. Total cost consists of variable cost and fixed cost that covered 72% and 28% of total cost for Binadhan-14 production (Table 1).

The average cost of Binadhan-14 cultivation was Tk. 80824 and Tk. 58158 per hectare on full cost and cash cost basis, respectively. The highest production cost was attributed to human labour (50.9%), followed by irrigation (10.8%), power tiller (7.8%), and land use (7.7%). The cost of Binadhan-14 cultivation was found the highest in Cumilla (Tk. 85764/ha) followed by that in Magura (Tk. 83344/ha), Mymensingh (Tk. 80874/ha) and Rangpur (Tk. 73314/ha), respectively (Table 1).

Table 1. Cost of Binadhan-14 production at different locations

Cost Component	Cost of production (Tk. ha^{-1})				All areas	% of total cost
	Mymensingh	Rangpur	Cumilla	Magura		
Variable Cost	58654	52918	60613	60445	58158	72.0
Hired labour (Man days)	24676	23342	26065	24945	24757	30.6
Power tiller	6669	5558	7040	5928	6299	7.8
Seed	2408	2223	2149	2594	2344	2.9
Fertilizers:						
Urea	2371	2223	2594	2668	2464	3.0
TSP	2445	2668	2490	2816	2605	3.2
MP	1667	1853	1890	2038	1862	2.3
Cow dung	5669	5299	5328	5817	5528	6.8
Pesticides	2297	1853	2223	2075	2112	2.6
Irrigation	8892	6669	9114	10374	8762	10.8
Int. on operating capital	1560	1230	1720	1190	1425	1.8
Fixed Cost	22220	20396	25151	22899	22667	28.0
Family labour	15784	14895	18323	16724	16432	20.3
Land use cost	6436	5501	6828	6175	6235	7.7
Total Cost (A+B)	80874	73314	85764	83344	80824	100

Source: Field survey, 2018

Return from Binadhan-14 production

The average return from Binadhan-14 production at different locations is shown in Table 2. The average yield of Binadhan-14 was 5631 kg ha^{-1}. The yield was highest at Magura (6378 kg ha^{-1}) followed by Cumilla (5962 kg ha^{-1}), Mymensingh (5442 kg ha^{-1}) and Rangpur (4741 kg ha^{-1}). The total return from Binadhan-14 production consists of the values of Binadhan-14 and straw.

The average gross margin was found Tk. 59332/ha on variable cost basis. Gross margin was highest in Magura (Tk. 69680/ha) followed by Cumilla (Tk. 61079/ha), Rangpur (Tk. 53712/ha) and Mymensingh (Tk. 52857/ha) (Table 2). The average net return per hectare was Tk. 36666. The net return was highest in Magura (Tk. 46781/ha) followed by Cumilla (Tk. 35928/ha), Rangpur (Tk. 33316/ha) and Mymensingh (Tk. 30637/ha), respectively. Benefit cost ratio was estimated at 1.45 and 2.02 on full cost and variable cost basis, respectively, implying that the Binadhan-14 cultivation at farm level was profitable.

Table 2. Profitability of Binadhan-14 cultivation in different locations

Type	Study areas				All areas
	Mymensingh	Rangpur	Cumilla	Magura	
Yield from Binadhan-14 (kg ha^{-1})	5442	4741	5962	6378	5631
Return from Binadhan-14 (Tk. ha^{-1})	109112	103780	119538	127560	114998
Return from straw (Tk. ha^{-1})	2399	2850	2154	2565	2492
Total return (Tk. ha^{-1})	111511	106630	121692	130125	117490
Total variable cost (Tk. ha^{-1})	58654	52918	60613	60445	58158
Total Cost (Tk. ha^{-1})	80874	73314	85764	83344	80824
Gross margin (Tk. ha^{-1})	52857	53712	61079	69680	59332
Net return (Tk. ha^{-1})	30637	33316	35928	46781	36666
Rate of return (BCR)					
BCR on full cost	1.38	1.45	1.42	1.56	1.45
BCR on variable cost	1.90	2.02	2.01	2.15	2.02

Source: Field survey, 2018

Factors affecting gross return of Binadhan-14 production

To determine the effects of the explanatory variables, linear and Cobb-Douglas model were initially estimated for Binadhan-14 rice production. Some of the key variables are explained below.

Human labour cost (X_1)

In Table 3 most of the parameters are statistically significant and positive. The regression coefficients for Binadhan-14 under Mymensingh, Rangpur, Cumilla and Magura districts were positive and significant. The coefficient of Mymensingh, Rangpur and Cumilla districts were significant at 5% level implying that the 1 percent increases in the labour use cost increase the gross return from rice by 0.080, 0.302 and 0.399 percent, respectively. The coefficient of Magura districts was significant at one percent level and it was 0.225 percent. This indicated that 1 percent increase in human labour cost keeping other factors constant, would increase the gross returns by 0.225 percent (Table 3).

Power tiller cost (X_2)

Table 3 showed that the coefficient of power tiller cost in Mymensingh and Magura districts was 0.020 and 0.010, which was found to be significant at 5 percent level. It

indicates that 1 percent increase in power tiller cost keeping other factors constant would be able increase the gross returns by 0.020 and 0.010 percent, respectively. The coefficient of power tiller cost under Rangpur and Cumilla district was positive but not significant.

Seed cost (X_3)

The coefficient of seedling cost of the Binadhan-14 production was statistically significant at 1 percent level of significance for Magura district. The result implies that 1 percent increase in the seedling cost for Magura district, keeping other factors constant, would result in an increase in gross return from rice by 0.702 percent.

The coefficient of seedling cost of the rice production was statistically significant at 10 percent level of significance for Mymensingh, Rangpur and Cumilla districts were 0.690, 0.150 and 0.230. The result implies that 1 percent increase in the seedling cost for Mymensingh, Rangpur and Cumilla districts farming systems, keeping other factors constant, would result increase in gross return from rice by 0.690, 0.150 and 0.230 percent, respectively.

Fertilizer cost (X_4)

The coefficient of fertilizer cost was statistically significant at 10 percent level of significance for Cumilla district (Table 3). The result implies that 1 percent increase in the fertilizer cost for Cumilla district, keeping other factors constant, would result in an increase in gross return from rice by 0.780 percent. The coefficient of fertilizer cost under Mymensingh, Rangpur and Magura districts were positive but not significant.

Irrigation cost (X_5)

Table 3 showed that the coefficient of irrigation cost in Mymensingh and Rangpur districts was 0.020 and 0.050, which was found to be significant at 10 percent level. It indicates that 1 percent increase in irrigation cost keeping other factors constant would be able increase the gross returns by 0.020 and 0.050 percent, respectively. The coefficient of irrigation cost under Cumilla and Magura was positive but not significant.

Insecticides cost (X_6)

The coefficient of insecticides cost in Mymensingh and Magura districts were 0.257 and 0.580, which was found to be significant at 5 percent level (Table 3). It indicates that 1 percent increase in insecticides cost keeping other factors constant would be able increase the gross returns by 0.257 and 0.580 percent, respectively.

The coefficient of insecticides cost was statistically significant at 10 percent level of significance for Rangpur and Cumilla districts was 0.186 and 0.221. The result implies that 1 percent increase in the insecticides cost for Rangpur and Cumilla districts, keeping other factors constant, would result increase in gross return from rice by 0.186 and 0.221 percent, respectively (Table 3).

Table 3. Estimated values of regression co-efficient and related statistics of Cobb-Douglas production function for Binadhan-14 production

Explanatory variables	Study areas							
	Mymensingh		Rangpur		Cumilla		Magura	
	Estimated Co-efficient	T-values	Estimated Co-efficient	T-values	Estimated Co-efficient	T-values	Estimated Co-efficient	T-values
Intercept	2.558* (0.651)	4.070	2.528* (0.851)	4.010	4.950* (0.510)	9.78	4.170* (0.850)	4.890
Human labour cost (X_1)	0.080** (0.040)	1.710	0.302** (0.119)	2.995	0.399** (0.186)	3.861	0.225*** (0.086)	4.713
Power tiller cost (X_2)	0.020** (0.010)	2.550	0.312 (0.084)	2.845	0.059 (0.626)	2.192	0.010** (0.010)	1.980
Seed cost (X_3)	0.690* (0.050)	8.410	0.150* (0.080)	2.010	0.230* (0.160)	2.139	0.702*** (0.248)	4.379
Fertilizer cost (X_4)	0.287 (0.061)	4.713	0.250 (0.080)	2.930	0.780* (0.130)	5.820	0.054 (0.120)	2.182
Irrigation cost (X_5)	0.020* (0.300)	0.530	0.050* (0.040)	1.130	0.079 (0.122)	2.355	0.430 (0.198)	3.415
Insecticides cost (X_6)	0.257** (0.109)	3.139	0.186* (0.156)	1.456	0.221* (0.147)	2.889	0.580** (0.161)	4.879
Coefficient of multiple determination (R^2)	0.746		0.778		0.820		0.845	
F-value	8.436		9.336		10.114		11.238	
Returns to scale	1.020		1.056		1.078		1.088	

Source: Field survey, 2018

Note: *** Significant at 1% level, ** Significant at 5% level, * Significant at 10% level (Figures in the parentheses indicates the standard errors)

Coefficient of multiple determination (R^2)

The coefficient of multiple determination (R^2) tells how well the sample regression line fits the data. It is evident from Table 3 that the values of R^2 were 0.746, 0.778, 0.820 and 0.845 for Mymensingh, Rangpur, Cumilla and Magura districts, respectively. This means that around 75, 79, 82 and 84 percent of the variations in gross return for Binadhan-14 rice, respectively were explained by the independent variables included in the model.

Return to Scale

The summation of all of the production coefficient indicates return to scale. The sum of elasticity coefficients was 1.020, 1.056, 1.078 and 1.088 in case of Binadhan–14 meaning increasing returns to scale. This means that, 1 percent increase in all inputs simultaneously would result on average 1.020, 1.056, 1.078 and 1.088 percent increase in gross return of Binadhan-14. This value being greater than 1 means that the farmers are operating at the region of increasing return to scale.

Major constraints to Binadhan-14 cultivation

Binadhan-14 was a profitable rice variety in the study areas. Farmers faced various constraints to Binadhan-14 cultivation. In Table 4, about 87% farmers opined unavailability of seed as a top ranked problem of Binadhan-14 cultivation. Other constraints were shattering problem (67%), lack of training (37%), lack of technical know-how (31%), lack of capital (26%) and low education level of farmers (15%).

Table 4. Major constraints to Binadhan-14 cultivation in the study areas

Sl. No.	Constraints	Percent of farmers responded					Rank
		Mymensingh	Rangpur	Cumilla	Magura	All areas	
1.	Unavailability of seed	88	94	89	76	87	1
2.	Shattering problem	60	65	70	74	67	2
3.	Lack of training	30	82	8	28	37	3
4.	Lack of technical know-how	30	25	53	15	31	4
5.	Lack of capital	17	50	12	25	26	5
6.	low education level of farmers	10	15	18	20	15	6

Source: Field survey, 2018

Conclusion

Binadhan-14 production is profitable in the study areas. All of the factors namely, human labour cost, power tiller cost, seed cost, fertilizer cost, irrigation cost and insecticides cost are very important for Binadhan-14 cultivation. Binadhan-14 farmers received high return on its investment. But some constraints and factors were influenced during the cultivation process. There is a need of proper guide to farmers about Binadhan-14 rice production in the study areas.

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