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PROFITABILITY ANALYSIS OF BINADHAN-20 PRODUCTION IN SOME SELECTED AREAS OF BANGLADESH

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Abstract

This study was conducted to analyze the profitability of Binadhan-20 producing farmers in Mymensingh, Jamalpur and Rangpur districts of Bangladesh. This study was based on primary data which were collected from 150 Binadhan-20 producing farmers. In the sampled areas data were collected through pre-designed interview schedule from February-March, 2022 for achieving the purpose. In the study, costs and return analysis were done on both cash cost and full cost basis for estimating profitability. The cultivation of Binadhan-20 was profitable from the viewpoint of the farmers. The study found that Binadhan-20 production is profitable. The average net return per hectare was Tk. 29964. The net return was highest in Rangpur (Tk. 31735/ha) followed by Mymensingh (Tk. 30142/ha) and Jamalpur (Tk. 28015/ha), respectively. Benefit cost ratio was 1.41 and 2.02 on full cost and cash cost basis implying that the Binadhan-20 cultivation at farm level was profitable. Cobb-Douglas production function was chosen to determine the factor affecting gross return of Binadhan-20 production. All of the factors namely, human labour cost, power tiller cost, seed cost, fertilizer cost, irrigation cost, wedding cost and insecticides cost were statistically significant and positive. The regression coefficients for farming experience and agricultural training under all areas had negative but significant relationship at 5% and 10% level, respectively. The regression coefficient of age was positive and significant at 5% level. Under all areas, the regression coefficient of education and farm size was positive but not significant. The farmers in the study areas encountered some constraints to Binadhan-20 production. The first ranked constraint was unavailability of seeds in all areas (92%). Other constraints were lack of training (65%), lack of technical know-how (40%), natural calamities (36%), lack of capital (26%) and low education level of farmers (14%). The economic return of Binadhan-20 production encouraging to the farmer's for more production.

Key words: Binadhan-20, 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) in Bangladesh. It alone contributes about 4.5% to the GDP (BBS, 2020). It provides one-sixth of rural household income, half of the rural employment (nearly 48%), two-thirds of per capita daily calorie intake, and half of per capita daily protein intake (Rahman F *et al*, 2016). Rice covers about 81 percent of the total cropped area and over 80 percent of the total irrigated area. Approximately 96 percent share of the total cereal supply comes from rice alone (Alam MS *et al*; 2013).

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Bangladesh is autonomous in rice (Mainuddin M *et al,* 2015; Timsina J *et al,* 2018). Production with an average per capita consumption of 134 kg per annum, compared to the world average of 57 kg per annum (Mottaleb KA *et al;* 2016). It is the most leading crop and produces a major distribute of farmers' income and employment (Sarker MAR *et al,* 2012; Alam MJ *et al;* 2016). In Bangladesh, rice is grown in three distinct seasons; namely Boro (January to June), Aus (April to August) and Aman (August to December) (Bapari MY *et al;* 2016). It is grown in four ecosystems viz., irrigated rice (Boro), rainfed or partially irrigated (transplanted Aus and Aman), rainfed upland (direct-seeded Aus), and deepwater (broadcast Aman).

Rice provides 76 percent of the people's average calorie intake and 66 percent of protein intake consumption. The country is now producing about 33.0 million tons to feed 160 million people (Barmon BK *et al;* 2012). This indicates that the growth of rice production was much faster than the growth of population (Sarker MNI 2017). Food self-sufficiency mostly depends on rice production. The total contribution of the rice production is about 70 percent of the total agricultural contribution to GDP. Thus, it is often argued that self-sufficiency in food might be attained by enhancing the overall productivity of rice (Chowdhury NT 2013). Considering the food habit of the people of Bangladesh, 'rice security' should also address the 'nutrition security'. In this country, rice is not only the carbohydrate-supplying food, but also the major provider of protein, micronutrients, and health benefits. Antioxidants supplied by rice contribute to relieve oxidative stress, and preventing cancer, cardiovascular problems and complications of diabetes (Shozib HB *et al;* 2020).

Among the three rice crops, Aman is the most important crops in Bangladesh. Two types of Aman rice are grown in this country. One is called broadcast Aman which is sown in the month of mid March to mid April in the low lands and another is transplant Aman, which is planted during late June to August. At present it is the second largest crop in the country in respect of the volume of production after boro rice. Binadhan-20 is a zinc and iron rich (life cycle 125-130 days) Aman rice variety which contributes significantly in changing farmers' income and employment generation and meets the challenges to self sufficiency in food production. It is notable that the area coverage of Aman is the largest as a single crop and Boro remains the second in Bangladesh.

The present study is important for rice production in Bangladesh. The study not only analyses the profitability but also identify factors affecting gross return and the major constraints farmers face in rice production. The results of the study will be helpful to the policy maker to formulate future policy considering farmers production constraints and the researcher for further study in this aspect. The specific objectives of the study were: (i) to know the socio-economic characteristics of Binadhan-20 growers; (ii) to determine the profitability of Binadhan-20 growers; (iii) to assess the factors affecting gross return of Binadhan-20 and (iv) to identify the major constraints in Binadhan-20 production.

Materials and Methods

Selection of the study area, sample size and sampling technique

This study was conducted in three districts namely Mymensingh, Jamalpur and Rangpur in Bangladesh. A total of 150 Binadhan-20 farmers taking 50 farmers from each district were randomly selected with the help of Department of Agriculture Extension (DAE) personnel for interview. Data enumerator under the direct supervision of the researchers collected field level cross sectional data using pre-tested interview schedule for this study.

Method of data collection and period of study

Data for the present study were collected from sample Binadhan-20 farmers through face to face interview method using a pre-tested interview schedule. Data were collected researcher with the help of trained enumerators for the period of February-March, 2022.

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 as frequencies, percentages, mean and standard deviation. Descriptive statistics were used to analyze and compare the socioeconomic characteristics. Total cost was composed of total variable costs (TVC) and total fixed costs (TFC). The gross return (GR) was computed as total rice output multiplied by the market price of Binadhan-20. 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 production of Binadhan-20 is likely to be influenced by different factors, such as, seed, labor, power tiller, chemical fertilizer irrigation, etc. 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:

$$Y = AX_1^{b1}X_2^{b2}...................X_n^{bn}e^{ui}$$

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 as follows:

$$\ln Y = a + b_1 \ln X_1\ b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + b_7 \ln X_7 + b_8 \ln X_8 + b_9 \ln X_9 + b_{10} \ln X_{10} + b_{11} \ln X_{11} + b_{12} \ln X_{12} + Ui$$

Where,

Y = Yield (kg/ha)
X_1 = No. of Power tiller
X_2 = Human labor
X_3 = Seed (kg/ha)
X_4 = Fertilizer (kg/ha)
X_5 = No. of Irrigation
X_6 = No. of Weeding
X_7 = Insecticides
X_8 = Age
X_9 = Education
X_{10} = Farm size
X_{11} = Farming experience
X_{12} = Agricultural training

a = Constant value

$b_1 b_2$ .... b_{12} = Co-efficient of the respective variables and
U_i = Error term.

Results and Discussion

Socio-economic profile of the Binadhan-20 farmers

Age is an important factor that influences farmer's decision to adopt improved technologies. The average age of the Binadhan-20 farmers was about 44 years with minimum age of 16 years and the maximum of 72 years. About 91 percent of farmer's occupation was agriculture. The sample farmers were grouped into five categories based on their level of education. Majority of the Binadhan-20 farmers (68.3% of the total farmers) had primary and secondary levels of education. Only 5.3 percent Binadhan-20 farmers were found to have completed their higher level of education. Twenty six percent of the farmers had basically no education. Length of experience in crop farming is also an important factor that influences farmers' level of adoption for new technologies. The average length of experience of Binadhan-20 farmers was 22.8 years. The average farm size per household was estimated at 1.2 ha. The highest farm size was found in Rangpur (1.45 ha.) followed by Mymensingh (1.23 ha.) and Jamalpur (0.92 ha.), respectively. The average yearly household income was Tk. 191686. The highest household income was found in Mymensingh (Tk. 218564) followed by Rangpur (Tk. 185652) and Jamalpur (Tk. 170843), respectively (Table 1).

Table 1. Socio-economic profile of Binadhan-20 producers in the study areas

Items	Mymenisngh	Jamalpur	Rangpur	All areas
Sample size	50	50	50	150
1. Farmer's age (year)	41.4	45.7	44.3	43.8
2. Occupation (%)				
Agriculture	89	93	91	91.0
Business	6	3	5	4.7
Service	4	1	2	2.3
*Others	1	3	2	2.0
2. Level of education (%)				
Illiterate	17	35	27	26.3
Primary	48	40	41	43.0
Secondary	28	21	27	25.3
Higher Secondary	5	3	4	4.0
Degree & above	2	1	1	1.3
3. Farming experience (year)	21.6	23.1	23.8	22.8
4. Farm size (ha)	1.23	0.92	1.45	1.2
5. Household income (Tk/yr)	218564	170843	185652	191686

Source: Field survey, 2022
*Others: Rickshaw and van puller, day laborer, student, etc.

Profitability level of Binadhan-20 cultivation

Profitability is one of the major criteria for determination of acceptance of a crop. The cost of Binadhan-20 production, gross return, gross margin, net return and the benefit cost ratio (BCR) for Binadhan-20 cultivation are being discussed in the following sections:

Cost of Binadhan-20 cultivation

The cost of human labour, power tiller, seed, fertilizers, pesticides and irrigation were taken into consideration, while calculating cost of Binadhan-20 production. Beside this, interest on operating capital was also considered as the cost of Binadhan-20 production. Total cost consists of variable cost and fixed cost that covered 69.67% and 30.33% of total cost for Binadhan-20 production.

From Table 2, the average costs of Binadhan-20 cultivation were Tk. 73558 and Tk. 51249 per hectare on full cost and cash cost basis, respectively. The highest production cost was for human labour (51.78%), followed by land use (10.32%), power tiller (8.63%) and irrigation (7.19%). The cost of Binadhan-20 cultivation was found highest in Mymensingh (Tk. 76142/ha) followed by that in Rangpur (Tk. 73528/ha) and Jamalpur (Tk. 71005/ha), respectively.

Table 2. Per hectare cost of Binadhan-20 production in different locations

Cost component	Cost of production (Tk./hectare)			All areas	% of total cost
	Mymensinngh	Jamalpur	Rangpur		
Variable Cost	51802	51669	50277	51249	69.67
Hired labour (Man days)	23583	22452	24065	23366	31.77
Power tiller	6192	6832	6010	6345	8.63
Seed	1140	1065	1122	1109	1.51
Fertilizers:					
Urea	2610	2253	2471	2444	3.32
TSP	2357	2278	2216	2283	3.10
MP	1385	1233	1480	1366	1.86
Gypsum	519	898	551	656	0.89
Zinc Sulphate	1119	720	828	889	1.21
Cow dung	5011	4116	3512	4213	5.73
Pesticides	2723	2971	2210	2635	3.58
Irrigation	4701	5969	5198	5289	7.19
Int. on operating capital	458	877	610	648	0.88
Fixed Cost	24339	19335	23251	22308	30.33
Family labour	15722	13111	15323	14719	20.01
Land use cost	8617	6224	7928	7589	10.32
Total Cost (A+B)	76142	71005	73528	73558	100.00

Source: Field survey, 2022

Return from Binadhan-20 cultivation

The average return from Binadhan-20 production in different locations is shown in Table 3. The average yield of Binadhan-20 was 4238 kg/ha. The yield was highest at Rangpur (4320 kg/ha) followed by Mymensingh (4254 kg/ha) and Jamalpur (4141 kg/ha). Most of the farmers in the study areas sold their paddy just after harvest. The total return from Binadhan-20 production consists of the values of Binadhan-20 and straw.

Table 3. Profitability of Binadhan-20 cultivation in different locations

Type	Study areas			All areas
	Mymensinngh	Jamalpur	Rangpur	
Yield from Binadhan-20 (Kg/ha.)	4254	4141	4320	4238
Return from Binadhan-20 (Tk./ha)	97848	91105	97210	95388
Return from straw (Tk./ha)	8436	7915	8054	8135
Total return (Tk./ha)	106284	99020	105264	103523
Total variable cost (Tk./ha)	51802	51669	50277	51249
Total Cost (Tk./ha)	76142	71005	73528	73558
Gross margin (Tk./ha)	54481	47351	54987	52273
Net return (Tk./ha)	30142	28015	31735	29964
Rate of return (BCR)				
BCR on full cost	1.40	1.39	1.43	1.41
BCR on variable cost	2.05	1.92	2.09	2.02

Source: Field survey, 2022

The average gross margin was found Tk. 52273/ha on variable cost basis. Gross margin was highest in Rangpur (Tk. 54987/ha) followed by Mymensingh (Tk. 54481/ha) and Jamalpur (Tk. 47351/ha), respectively. The average net return per hectare was Tk. 29964. The net return was highest in Rangpur (Tk. 31735/ha) followed by Mymensingh (Tk. 30142/ha) and Jamalpur (Tk. 28015/ha), respectively. Benefit cost ratio was estimated at 1.41 and 2.02 on full cost and variable cost basis implying that the Binadhan-20 cultivation at farm level was profitable.

Factors affecting production of Binadhan-20

To determine the effects of the explanatory variables, linear and Cobb-Douglas model were initially estimated for Binadhan-20 production. Some of the key variables are explained below.

The contribution of specified factors affecting production of Binadhan-20 could be seen from the estimation of regression equation in Table 4.

The regression coefficients for power tiller and human labor for Binadhan-20 under all areas were positive and significant at 1% level. On the other hand, coefficients for fertilizers and insecticides were found to be positively significant at 5% level and coefficient of seed, irrigation and weeding were positively significant at 10% level under all areas. The positive sign indicated that using more of these inputs in Binadhan-20 production could increase the yield to some extent.

The regression coefficients for farming experience and agricultural training under all areas had negative but significant relationship at 5% and 10% level, respectively. The regression coefficient of age was positive and significant at 5% level. Under all areas, the regression coefficient of education and farm size was positive but not significant.

Coefficient of multiple determinations (R^2)

The coefficient of multiple determination (R^2) tells how well the sample regression line fits the data. It is evident from Table 4 that the values of R^2 were 0.751, 0.881 and 0.791 for Mymensingh, Jamalpur and Rangpur districts, respectively. This means that around 75, 89 and 79 percent of the variations in gross return for Binadhan-20, respectively were explained by the independent variables included in the model. The value of R^2 under all areas was 0.807 means that 81 percent of the variations in gross return were explained by the independent variables included in the model.

F-value

The F-values of Mymensingh, Jamalpur and Rangpur districts were 9.510, 8.462 and 8.539 which were highly significant at 1% level of probability implying that all the explanatory variables were important for explaining the variations in gross returns of the Binadhan-20 variety in the study area (Table 4). The F-values of all areas were 8.837 which was highly significant at 1% level of probability implying that all the explanatory variables was important for explaining the variations in gross returns of the Binadhan-20.

Table 4. Estimated values of regression co-efficient and related statistics of Cobb-Douglas production function for Binadhan-20 cultivation

Explanatory variables	Study areas						All areas	
	Mymensingh		Jamalpur		Rangpur			
	Co-efficient	T-value	Co-efficient	T-value	Co-efficient	T-value	Co-efficient	T-value
Intercept	2.121*** (0.821)	4.130	3.510*** (1.221)	4.410	4.632*** (0.610)	8.412	3.120*** (1.240)	5.651
Power tiller (X_1)	0.211** (0.012)	1.446	0.212** (0.081)	3.211	0.311*** (0.081)	2.215	0.281*** (0.071)	4.232
Human labor (X_2)	0.098** (0.082)	1.530	0.210** (0.142)	2.351	0.318*** (0.092)	2.211	0.218*** (0.073)	4.421
Seed (X_3)	0.611* (0.122)	7.110	0.311* (0.091)	3.311	0.142* (0.081)	2.110	0.172* (0.141)	2.840
Fertilizer (X_4)	0.217** (0.068)	4.411	0.231* (0.091)	2.251	0.214** (0.081)	2.510	0.411** (0.162)	3.641
Irrigation (X_5)	0.022* (0.311)	0.520	0.045* (0.042)	1.280	0.087* (0.071)	2.172	0.052* (0.640)	2.181
Weeding (X_6)	0.091* (0.081)	1.720	0.281* (0.121)	3.836	0.135* (0.090)	2.241	0.241* (0.071)	4.410
Insecticides (X_7)	0.250** (0.118)	3.419	0.181* (0.121)	1.610	0.184** (0.162)	1.841	0.321** (0.180)	3.210
Age (X_8)	0.311** (0.080)	2.725	0.251** (0.112)	3.521	0.311* (0.080)	3.424	0.381** (0.091)	2.821
Education (X_9)	0.062 (0.060)	2.417	0.095 (0.081)	1.411	0.136 (0.210)	1.386	0.098 (0.081)	1.426
Farm size (X_{10})	0.021 (0.280)	1.854	0.141 (0.081)	2.816	0.124 (0.091)	2.412	0.021 (0.212)	1.610
Farming experience (X_{11})	0.534* (0.224)	3.419	-0.312** (0.081)	2.412	-0.651* (0.251)	3.258	-0.514** (0.211)	4.511
Agricultural training (X_{12})	0.242* (0.90)	2.481	-0.122* (0.181)	2.351	-0.217* (0.080)	3.811	-0.115* (0.091)	2.620
Coefficient of multiple determination (R^2)	0.751		0.881		0.791		0.807	
F-value	9.510***		8.462***		8.539***		8.837***	
Returns to scale	1.058		1.026		1.082		1.055	

Source: Field survey, 2022

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

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Return to Scale

The summation of all the production coefficient indicates return to scale. The sum of elasticity coefficients were 1.058, 1.026 and 1.082 in case of Binadhan-20 meaning increasing return to scale (Table 4). This means that, 1 percent increase in all inputs simultaneously would result on average 1.058, 1.026 and 1.082 percent increase in gross return of Binadhan-20. The coefficients of under all areas was 1.055 means that 1 percent increase in all inputs simultaneously would result on average 1.055 percent increase in gross return of Binadhan-20 in the study areas. This value being greater than 1 means that the farmers are operating at the region of increasing return to scale. It implies that, the farmers still have the scope to allocate more inputs in Binadhan-20 as it will generate a higher return than production cost.

Major constraints to Binadhan-20 cultivation

Binadhan-20 is a profitable rice variety in the study areas. The farmers in the study areas encountered some constraints to Binadhan-20 production. The constraint ranked first was unavailability of Binadhan-20 varieties seeds in all areas. Other constraints were lack of proper training (65%), lack of technical know-how (40%), natural calamities (36%), lack of capital (26%) and low education level of farmers (14%) (Table 5).

Table 5. Major constraints to Binadhan-20 cultivation in the study areas

Sl. No.	Constraints	Percent of farmers responded				Rank
		Mymensinngh	Jamalpur	Rangpur	All areas	
1.	Unavailability of seed	88	94	95	92	1
2.	Lack of proper training	60	65	70	65	2
3.	Lack of technical know-how	30	82	8	40	3
4.	Natural calamities	30	25	53	36	4
5.	Lack of capital	17	50	12	26	5
6.	Low education level of farmers	10	15	18	14	6

Source: Field survey, 2022

Conclusion

Binadhan-20 production in the study areas is profitable. All of the factors namely, human labour cost, power tiller cost, seed cost, fertilizer cost, irrigation cost, weeding cost and insecticides cost are very important for Binadhan-20 cultivation. The yield performance and economic return of Binadhan-20 production were encouraging the farmers and area coverage of this variety is increasing day by day in the study areas. There is a need of proper guide to farmers about Binadhan-20 production management practices in the study areas.

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