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A COMPARATIVE ECONOMIC ANALYSIS OF BR-28, BR-29 AND HYBRID *HIRA* RICE PRODUCTION IN SELECTED AREAS OF KURIGRAM DISTRICT

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Abstract

This study was designed to determine the costs, returns and relative profitability of BR-28, BR-29 and Hybrid *Hira* rice production. A total of 90 farmers out of which 30 producing each were selected randomly from three villages of Nageswari Upazila of Kurigram district in Bangladesh. It revealed that cultivation of BR-28, BR-29 and Hybrid *Hira* was a profitable business from the viewpoint of farmers. Analysis of costs and returns showed that variable cost was found to be higher for BR-28 variety. The return per hectare above variable cost for BR-28 was found Tk 44764.26 while for BR-29 and Hybrid *Hira* variety, it was Tk 53290.24 and 64305.62, respectively. Total cost per hectare for BR-28 was Tk 92635.04 and for BR-29 and for Hybrid *Hira* variety, it was Tk 92464.07 and 86160.81, respectively. Return above total cost for Hybrid *Hira* was found higher than BR-28 and BR-29 varieties. Therefore, production of Hybrid *Hira* was found more profitable compared to BR-28 and BR-29. It was observed from Cobb-Douglas production function that most of the included variables had significant impact on rice production. The study also identified some problems faced by the farmers and they were more severe for the production of Hybrid *Hira* variety compared to HYV's BR-28 and BR-29 varieties. The study, therefore, suggests for taking some measures to solve the problems in order to expand production of selected rice varieties in the study areas as well as other parts of the country.

Keywords: Rice, production costs, returns, profitability

Introduction

Rice is the amazing grain that shapes the diets, culture, economy and the way of life in Bangladesh. It is the staple food for entire 146.1 million people (MoF, 2010) of Bangladesh. Bangladesh agriculture sector is dominated by paddy production. As the dominant crop, rice largely determines the rate of progress in the agricultural sector. In fact, the entire growth in crop production is explained by the growth in food crop production, particularly rice. Moreover, Rice is often regarded as a political commodity in Bangladesh (Schultz, 1978).

Agriculture is the key indicator of the economic progress of Bangladesh. Without modernizing agriculture, it is impossible to produce sufficient food grain to meet food demand for its increased population. The large scale adoption of modern rice with increased production helps the country to achieve food self-sufficiency. The cultivation of high yielding varieties can help to increase agricultural production to create a surplus with a tremendous goal in the process of economic development (Mustafi and Azad, 2000). Among the high yielding varieties (HYVs), boro rice comprises the largest portion of total rice production of the country (BBS, 2009)

In this study, economic profitability of the three boro varieties namely BR-28, BR-29 and Hybrid *Hira* has been compared. All of the three varieties are grown in the same season and compete with each other for limited resources. BR-28, BR-29 and Hybrid *Hira* are claimed to be very promising HYVs. The comparative advantages of BR-28, BR-29 and Hybrid *Hira* and their potentialities in terms of profitability, farmers' capabilities in adopting the technology and their acceptance level are yet to be known. A limited number of studies (Hanifa, 2009; IRRI, 2006;

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Mondal, 2005; Zamman, 2002; Mustafi and Azad, 2000; Hassan, 2000; Das, 2000; BRRI, 1999-2000; Ali, 1998; Chowdhury, 1997; Lin, 1994) were conducted on rice production as a whole but no comparative economic study has yet been conducted on BR-28, BR-29 and Hybrid *Hira* varieties in the study area. Therefore, a comparative economic analysis is needed to determine the superiority of the one over others. It is expected that the present study will provide some valuable information to the farmers. The farmer will also get information regarding the relative costs and returns of production of these three rice varieties. So, the findings of the study may help the comparative suitability of the varieties specific to the study areas. It will also be helpful to the extension workers and will aid them to know the various problems faced by the farmers. Moreover, the study will also generate useful information for the researchers and the policy makers about the sustainability of the three varieties.

Materials and Methods

The present study was conducted in three villages, namely, Bhabanipur, Hatibanda and Jhakuabari in Nageswari Upazila of Kurigram District. The main reasons in selecting the study areas were availability of a large number of BR-28, BR-29 and Hybrid *Hira* paddy producers. Easy accessibility and good communication facilities were available and better co-operation from the respondents was found for the collection of reliable data. Field survey method was applied to collect primary data for the study. For sampling, at first a list of the farmers who produced either BR-28 or BR-29 or Hybrid *Hira* was prepared. Then from the list, 30 farmers of each BR-28, BR-29 and Hybrid *Hira* were randomly selected. The data collected by the researcher herself during July to September, 2011. The data were analyzed using tabular and statistical techniques, Farm business analytical techniques, such as, enterprise costing and gross margin analysis were used for analysis of profitability. Finally, Cobb-Douglas production function was used to examine the effects of the independent variable on the dependent variables of the production of BR-28, BR-29 and Hybrid *Hira* rice.

In order to determine the contribution of variable inputs, Cobb-Douglas form of production functions were initially estimated for BR-28, BR-29 and Hybrid *Hira* rice. Data were converted to per hectare to facilitate the analysis. Seven variables were hypothesized to explain the production of selected paddy variety.

The specification of the Cobb-Douglas production function was as follows:

$$Y_i = a\, X_1^{b1} X_2^{b2} X_3^{b3} X_4^{b4} X_5^{b5} X_6^{b6} X_7^{b7} e^{ui}$$

It can be written in linear form as follows:

$$\ln Y = \ln a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + b_7 \ln X_7 + u_i\,;$$

Where,

ln = natural logarithm
Y= gross return (Tk ha^{-1});
X_1= human labor cost (Tk ha^{-1});
X_2= tillage cost (Tk ha^{-1});
X_3=seeds/seedlings cost (Tk ha^{-1});
X_4= fertilizer cost (Tk ha^{-1});
X_5= manure cost (Tk ha^{-1});
X_6= irrigation cost (Tk ha^{-1});
X_7= insecticides cost (Tk ha^{-1});
i= 1, 2, 3…n;

a= constant or intercept term; $b_1, b_2, b_3, b_4, b_5, b_6, b_7$ = production coefficient of the respective input variable to be estimated; and u_i= error term.

Results and Discussion

Profitability of rice production

There are some necessary inputs such as seed, human labor, fertilizer, manure, insecticides, irrigation, etc. without which it is not possible of running agricultural production. So the farmer had to incur costs for these different input items. Labor was mainly used for land preparation, transplanting of seed or seedlings, harvesting, etc. It can be seen from Table 1 that in the case of BR-28, BR-29 and Hybrid *Hira* rice, total labor costs per hectare were Tk 38021.42, 39750.63 and 38999.68, respectively (Table 1).

Table 1. Per hectare human labor use and its cost for producing BR-28, BR-29 and Hybrid *Hira* rice

Items of cost	BR-28 (Tk ha^{-1})	BR-29 (Tk ha^{-1})	Hybrid *Hira* (Tk ha^{-1})
Land preparation	2410.20	2390.72	2448.39
Transplanting	5757.71	6010.34	5877.24
Weeding	9637.28	10628.02	9995.30
Fertilizer application	2372.06	2355.04	2243.76
Insecticide application	459.32	491.57	683.90
Harvesting and carrying	7753.69	7617.73	7604.00
Threshing and drying	9631.16	10257.21	11838.91
Total	**38021.42**	**39750.63**	**38999.68**

Source: Field survey, 2011

The analysis of costs and returns revealed that the farmers had to incur higher cost (Tk 92635.04) in producing BR-28 rice than that of BR-29 (Tk 92464.07) and Hybrid *Hira* rice (Tk 86160.81). Total cost of animal labor was Tk 1636.82, 1295.02 and 1064.30 for BR-28, BR-29 and Hybrid *Hira* rice, respectively (Table 2).

Table 2. Per hectare costs of BR-28, BR-29 and Hybrid *Hira* rice production

(Value in Tk)

Cost items	BR-28	BR-29	Hybrid *Hira*
A) Variable cost			
Labor	38021.42	39750.63	38999.68
Power tiller	4870.43	4942.79	4142.68
Animal labor	1636.82	1295.02	1064.30
Seeds	2092.20	1867.29	2089.96
Manure/Cowdung	1059.85	993.24	907.19
Fertilizer	9992.94	8914.01	8399.22
Irrigation	11060.39	10134.53	8159.65
Insecticides	1003.10	810.85	811.73
Total variable cost (Tk ha^{-1})	**69737.15**	**68708.36**	**64574.41**
B) Fixed cost			
Interest on operating capital	1220.40	1374.17	1130.05
Land use cost	21677.48	22381.54	20456.35
Total fixed cost (Tk ha^{-1})	**22897.88**	**23755.71**	**21586.40**
Total cost (A+B) (Tk ha^{-1})	**92635.04**	**92464.07**	**86160.81**

Source: Field survey, 2011

The input costs included human labor, power tiller, animal labor, seeds/seedling, fertilizers, manures, irrigation and insecticides. Per hectare cost of seed for BR-28, BR-29 and Hybrid *Hira* rice were Tk 2092.20, 1867.29 and 2089.96, respectively and all of these cost constituted 2.23, 2.02 and 2.43 percent of the total cost, respectively. The costs of power tiller for BR-28, BR-29 and Hybrid *Hira* rice were Tk 4870.43, 4942.79 and 4142.68 per hectare which were 5.23, 5.35 and 4.81 percent of total cost, respectively. Market prices of urea, TSP, MP, gypsum, zinc sulphate and borax were Tk 12, 28, 24, 8, 90 and 90, respectively. Total costs of fertilizers were Tk 9992.94, 8914.01 and 8399.22 per hectare for BR-28, BR-29 and Hybrid *Hira* rice, respectively which covered 10.79, 9.64 and 9.75 percent of the total cost, respectively. Per hectare cost of manure for BR-28, BR-29 and Hybrid *Hira* were Tk 1059.85, 993.24 and 907.19, respectively which were 1.14, 1.07 and 1.05 percent of the total cost. Per hectare cost of insecticides were Tk 1003.10, 810.85 and 811.73 for BR-28, BR-29 and Hybrid *Hira* rice, respectively. Per hectare cost of irrigation water were Tk 11060.39, 10134.53 and 8159.65 for BR-28, BR-29 and Hybrid *Hira*, respectively, representing 11.94, 10.96 and 9.47 percent of their respective total cost (Table 2).

Results presented in Table 2 shows that per hectare land use cost amounted to Tk 21677.48, 22381.54 and 20456.35 for BR-28, BR-29 and Hybrid *Hira* rice, respectively. An average interest rate per hectare on operating capital was estimated at Tk 1220.40 ha^{-1}, 1374.17 and 1130.05 for BR-28, BR-29 and Hybrid *Hira* rice, respectively contributing 1.24, 1.32 and 1.50 percent to the respective total cost (Table 2).

The findings of the study showed that the average yields of BR-28, BR-29 and Hybrid *Hira* rice amounted Tk 6499.63, 7319.37 and 8555.67 kg per hectare, respectively (Table 3). In monetary terms, the values were Tk 108868.74, 117109.94 and 124057.15 for BR-28, BR-29 and Hybrid *Hira* rice, respectively. The gross returns (including by product) from BR-28, BR-29 and Hybrid *Hira* rice were estimated Tk 114501.41, 121998.60 and 128880.03, respectively. The average net returns per hectare were found to be Tk 21866.37, 29534.53 and 42719.22 for BR-28, BR-29 and Hybrid *Hira*, rice respectively. Further returns over gross margin for BR-28, BR-29 and

Hybrid *Hira* rice were found to be Tk 44764.26, 53290.24 and 64305.62, respectively. On the basis of gross costs per hectare production cost of BR-28, BR-29 and Hybrid *Hira* rice were estimated at Tk 92635.04, 92464.07 and 86160.81, respectively. Results in Table 3 shows that BCR of BR-28, BR-29 and Hybrid *Hira* rice production was emerged as 1.24, 1.32 and 1.50, respectively that Tk 1.24, 1.32 and 1.50 would be earned by spending each Tk 1.00 investing in the rice production, respectively. From the above, it was clear that Hybrid *Hira* production was more profitable than BR-28 and BR-29 in the study area. In Bangladesh, although the government took many initiatives to improve the farmers' condition and their development, the experience obtained from field level shows that the farmers are facing a lot of problems as they complained that they do not get required quantity of quality seeds, fertilizers, pesticides, technical support and finally, the fair price the of their product.

Table 3. Per hectare costs and returns of producing BR-28, BR-29 and Hybrid *Hira* rice

(Value in Tk)

Particulars	BR-28	BR-29	Hybrid *Hira*
Average Yield (Kg)	6499.63	7319.37	8555.67
Gross Return (Tk)	114501.41	121998.60	128880.03
Total variable cost (Tk)	69737.15	68708.36	64574.41
Total fixed cost (Tk)	22897.88	23755.71	21586.40
Gross cost (Tk)	92635.04	92464.07	86160.81
Gross margin (Tk)	44764.26	53290.24	64305.62
Net Return (Tk)	21866.37	29534.53	42719.22
BCR (undiscounted)	1.24	1.32	1.50

Source: Field survey, 2011

Factors affecting gross return of selected rice production

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

Human labor cost (X_1): The coefficient for human labor cost was 0.337 which was positive and significant at one percent level for BR-29. The coefficient indicates that keeping other factors constant, 1 percent increase in human labor cost would increase the gross return by 0.337 percent. The coefficients of human labor cost for BR-28 and Hybrid *Hira* were not statistically significant (Table 4).

Tillage cost (X_2): The regression coefficient for tillage cost was positive for Hybrid *Hira* rice at 1 percent level of significance (Table 4). It revealed that 1 percent increase in the tillage cost, holding other factors constant would increase gross return by 0.079 percent. The coefficients of tillage cost for BR-28 and BR-29 were not statistically significant.

Seed cost (X_3): The regression coefficient of seed cost was positive for BR-29 and Hybrid *Hira* rice and significant at one percent and five percent levels respectively, but it was insignificant for BR-28. It indicated that 1 percent increase in seed cost, keeping other factors constant would increase gross returns by 0.111 and 0.087 percent for BR-29 and Hybrid *Hira* rice, respectively (Table 4).

Fertilizer cost (X_4): For BR-28 and Hybrid *Hira* the coefficients were positive and significant at 5% and 10% levels, respectively which indicated that 1 percent increase in the cost of fertilizer, keeping other factors constant, would increase gross return by 0.180 and 0.209 percent, respectively. Regression coefficient of BR-29 was found statistically insignificant (Table 4).

Manure cost (X_5): In the case of BR-28 and BR-29, the coefficients of manure were positive and significant at 1% levels but it was insignificant for Hybrid *Hira* rice. It revealed that 1 percent increase in manure cost, keeping other factors constant, would increase gross returns by 0.082 and 0.116 percent for BR-28 and BR-29 rice, respectively (Table 4).

Irrigation cost (X_6): Irrigation cost for BR-28 rice had positive and statistically significant coefficient at 1% level, but it was insignificant for both BR-29 and Hybrid *Hira* rice. It implies that 1 percent increase in the cost of irrigation, holding other factors constant, would increase gross return by 0.478 percent for BR-28 rice (Table 4).

The coefficients of multiple determinations, R^2 values of the model were 0.738, 0.790 and 0.770 for BR-28, BR-29 and Hybrid *Hira* rice, respectively. R^2 0.738 for BR-28 indicates that about 73.8 percent of variations in gross return have been explained by the explanatory variables, which were included in the model. R^2 0.790 for BR-29 reveals about 79 percent of variations and R^2 0.770 reveals about 77 percent variation in the gross returns from BR-29 and

Hybrid *Hira* rice have been explained by the explanatory variables included in the model respectively (Table 4). The values of adjusted R^2 are 0.659, 0.723 and 0.693 indicating that after taking into account the degrees of freedom (df) those adjusted R^2, explanatory variables in the model still explain about 65.9, 72.3 and 69.3 percent of the total variations in gross returns from BR-28, BR-29 and Hybrid *Hira* rice, respectively.

Table 4: Estimated values of coefficients and related statistics of selected rice varieties

Explanatory variables	**BR-28**	**BR-29**	**Hybrid *Hira***
Constant	3.790	5.067	6.543
	(1.461)	(1.507)	(1.575)
Human labor (X_1)	0.099	0.337***	0.107
	(0.080)	(0.131)	(0.086)
Tillage cost (X_2)	-0.015	0.028	0.079***
	(0.059)	(0.096)	(0.031)
Seed cost (X_3)	0.017	0.111***	0.087**
	(0.043)	(0.041)	(0.043)
Fertilizer cost (X_4)	0.180**	-0.020	0.209*
	(0.098)	(0.082)	(0.122)
Manure cost (X_5)	0.082***	0.116***	0.080
	(0.032)	(0.042)	(0.057)
Irrigation cost (X_6)	0.478***	0.090	0.025
	(0.184)	(0.085)	(0.094)
Insecticides cost (X_7)	0.002	0.034	-0.003
	(0.019)	(0.0340	(0.031)
R^2	0.738	0.790	0.770
Adjusted R^2	0.659	0.723	0.693
F-value	9.267***	11.802***	10.027***
Returns to Scale ($\sum b_i$)	0.843	0.696	0.584

*Source: Author estimation, 2011; The figures in the parentheses are standard errors; *** Significant at 1 percent level; ** Significant at 5 percent level; * Significant at 10 percent level*

The F-values of the equation derived for BR-28, BR-29 and Hybrid *Hira* varieties were 9.267, 11.802 and 10.027 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 selected rice varieties in the study area (Table 4).

The summation of all the regression coefficients of the estimated production functions of BR-28, BR-29 and Hybrid *Hira* were 0.843, 0.696 and 0.584 found to be less than 1 which indicated that the selected rice growers allocated their resources in the rational stage of production (Stage II) respectively, where diminishing returns to scale exists.

The study also identified the problems and constraints in BR-28, BR-29 and Hybrid *Hira* rice production. Some major problems faced by the farmers were lack of capital, problems of seed purity, seed collection problem, problems of high price of seed, problem of high price of fertilizers and insecticides, low germination rate, low prices of output, attack by insect, lack of marketing facilities, lack of market information, etc.

Though, all of the three varieties were found profitable, Hybrid *Hira* paddy was found more profitable than BR-28 and BR-29 varieties with respect to yield, gross return and net return. Therefore, it could be concluded that a considerable scope exists in the study areas to increase the productivity of BR-28, BR-29 and Hybrid *Hira* rice to increase income, employment and nutritional status of the farmers.

There are remarkable variations in input use particularly manure, animal labor, power tiller, fertilizer, irrigation, insecticides etc. and other practices in the study areas. Most of the farmers did not follow the recommended doses of input use. National and International Research Institutions should strengthen their human resources for Hybrid rice research and seed production. To increase the productivity of Hybrid rice, the cost of seed should be kept rational and within farmers economic capacity. Finally, government should come forward to address the problems and constraints of the rice farmers and try to solve those in time.

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