J. Bangladesh Agril. Univ. 3(1): 189–195, 2005 ISSN 1810-3030

Profitability and resource use efficiency of BR-29 Boro paddy production in Jamalpur district

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Abstract

This study was designated to determine the costs, returns and relative profitability of BR-29 Boro paddy production in Bangladesh from the viewpoints of small, medium and large farmers of Dewanganj upazila in Jamalpur district. In total 60 sample farmers of which 25 were small, 20 medium and 15 large were purposively selected from each of the selected strata for the study. Primary data were collected from the selected farmers. A simple cost and return analysis was done to determine the profitability of BR-29 Boro paddy production. The major findings of the present study were that BR-29 is a profitable enterprise from the view points of small, medium and large farm groups. The net returns per hectare were Tk.11154, Tk.14854 and Tk. 7046 for small, medium and large farmers, respectively. Undiscounted BCRs for BR-29 Boro paddy were calculated at 1.33, 1.44 and 1.20 in the case of small, medium and large farmers respectively. Cobb-Douglas production function was also applied to determine the effects of individual inputs on production of BR-29 Boro paddy. It was observed that most of the included variables had significant impact on BR-29 Boro paddy under different farm size groups .Out of seven variables included in the function, six variables had positive impact on returns from BR-29 Boro paddy production. The impact of insecticides was negative in the case of medium and large farmers, respectively.

Keywords: Profitability, BR-29 Boro paddy

Introduction

Paddy plays a vital role in the economy of Bangladesh. A substantial area is devoted to paddy production and a large number of farmers have been growing paddy in the country. Though paddy is being cultivated extensively in Bangladesh, per hectare yield is much lower in comparison with that of other paddy growing countries of the world. In order to meet this deficit, yield per unit area of paddy should be increased. Since horizontal expansion of paddy area is not possible due to heavy population pressure on land, HYV Boro paddy has been gaining much importance in Bangladesh. The average per hectare yield of BR-29 Boro paddy is higher than that of Aus and Aman. The modern variety (MV) rice and production technologies developed by BRRI contributed tremendously to national economy of Bangladesh. In 1970-71, when BRRI was established, overall adoption of all MV rice was only 4.64 percent of the total rice area and individually, MV Aus covered only 1 percent, MV Aman occupied 1.41 percent and MV Boro shared 35.34 percent of the rice area respectively (Mustafi and Azad 2000). BR-29 Boro paddy has been gaining popularity for its higher production in the study area.

The issues regarding the existence of actual relationship between farm size, productivity and resource use efficiency have remained inconclusive. The relationship is perhaps influenced by the state-of-art. A divisible and scale neutral technology may exhibit a quite different picture in terms of productivity-efficiency and farm size than a non-divisible technology. Thus, the relationship observed at a point of time in the past may not hold to situations of to-day. Whatever relationship exists, the phenomenon is of crucial importance particularly in an economy like Bangladesh where land ownership is highly unequal, per hectare productivity of crops is low, per capita land is highly inadequate and where a large number of small, medium and marginal farms steer the agriculture. Besides, the implicit objective behind the provision of subsidized inputs and output price support is to make use of the full potential of the available technology, boost up production and achieve efficiency in resource use. Investigation relating to resource use efficiency is, therefore, very important in order to know whether technological improvement has brought any change in the inputs use. The present paper aims at examining the profitability, relationship of inputs productivity, resource use efficiency and return to scale with farm size in the production of BR-29 paddy.

Methodology

Data for the present study were collected in 2001 from selected farmers of six villages namely: Dangdhara, Kawniarchar, Nimaimary, Bagharchar, Bindurchar and Makhonerchar of Jamalput district.. Sixty farmers from the six villages were selected by using stratified random sampling technique. BR-29 producers were categorized into three groups: small farmers less than 1.0 hectare; medium farmers-1.00 to 3.00 hectares and large farmers-more than 3.00 hectares of BR-29 cultivable land. A total of 60 farmers comprising 25 small, 20 medium and 15 large farm were finally selected for the study.

The model

The following algebraic equation was developed to assess the cost and return (i.e., profit) of BR-29 Boro paddy production.

$$\pi = P_y Y + P_{BY}.B_Y - \sum_{i=1}^{n} (Pxi.Xi) - TFC$$

Where, π = Net return per hectare, Py = Per unit price,Y = Total quantity of product per hectare, P_{BY} = Per unite price of the by-product, By = Total quantity of per hectare by – product, Pxi = Per unit price of i th input for producing of BR-29 Boro paddy, Xi = Total quantity per hectare of i th input used for producing of BR-29 Boro paddy, TFC = Total Fixed cost involved in producing per hectare of BR-29 Boro paddy.

Resource Use Efficiency

A Cobb-Douglas production function of the following logarithmic for was specified.

$$\text{Log } Y = \log a_0 + \sum_{i=1}^{7} a_i \text{ Log } X_i + u$$

Where, Y= Value of main product and by-product (in Taka), X_1= Cost of human labour (Tk/ha), X_2= Cost of seed (Tk/ha), X_3 = Cost of fertilizer and manure (Tk/ha), X_4= Cost of insecticides (Tk/ha), X_5= Cost of animal labour (Tk/ha), X_6= Cost of power tiller (Tk/ha), X_7= Cost of irrigation (Tk/ha), u= Stochastic error term.

Allocation efficiency of the factor inputs was defined as the ratio of marginal value products to the marginal factor input costs. When the marginal value product (MVP) just equals the marginal factor cost (MFC), the profit is maximized. Resource use efficiency of an input is tested by the formula: $\frac{MVP(Xi)}{MFC(Xi)} = 1$.

According to Dhown and Banpal (1977), the useful estimate of MVP is obtained by taking the geometric mean (GM) of the resources (Xi) as well as the gross return (Y). MVP is computed by multiplying the co-efficient of a given resource with the ratio of the geometric mean of the resource i.e $dy/dx_i = b_i . Y / X_i$, thus MVP (Xi) = $b_i \frac{\bar{Y}(\overline{GM})}{\bar{X}_i(GM)}$

Where $\bar{Y}$ = Mean value (GM) of gross return in taka, $\bar{Xi}$ = Mean value (GM) of different variable inputs in taka, dy/dxi = Slope of the production function as well as MVP of the i th input since both the dependent and explanatory variables were expressed in monetary terms.

Results and Discussion

Cost and Return of BR-29 Boro Paddy Production

BR-29 Boro paddy technology requires a large number of inputs. Table 1 shows costs and returns of BR-29 Boro paddy production according to farm categories. The average per hectare gross returns of BR-29 Boro paddy were Tk 45010, Tk 48623 and Tk 42802 for small, medium and large farms respectively. Medium farmers earned the highest amount of gross margin (Tk 18948/ha) whereas the large farmers earned the lowest amount of gross margin (Tk 11179/ha) from their BR-29 Boro paddy production. The highest net returns (Tk.14855/ha) earned by the medium farmers whereas the large farmers earned the lowest amount of net return (Tk 7046/ha) from BR-29 Boro paddy production. On the other hand small farmers earned the highest amount of cash margin (Tk 33998/ha) and the large farmers earned the lowest amount of cash margin (Tk. 26116). Undiscounted BCRs on cash cost basis were found to be 4.09, 3.29 and 2.57, and on variable cost basis were found to be 1.51, 1.64 and 1.35 and on full cost basis were found to be 1.33, 1.44 and 1.20 in the case of small, medium and large farms respectively, which indicate that the medium farmers earned the highest return.

Resource Use Efficiency

Result of the estimated production functions of different types of farmers is presented in Table 2. In terms of R^2 and F values, the goodness of fit of all equations are good. R^2 for BR-29 Boro paddy production were 0.74, 0.78 and 0.73 for small, medium and large farms which indicated that independent variables included in the model explained 74 percent, 78 percent and 73 percent of the variation in BR-29 Boro paddy production for small, medium and large farmers respectively. The F-values of the equations were 10.97, 10.617 and 144.890 for small, medium and large farmers respectively. These three F-Values are highly significant at 1 percent levels implying that all the included explanatory variables were important for explaining the variation in BR-29 Boro paddy output for small, medium and large farmers respectively.

Table 1. Summary Results of per Hectare Costs and Return of Small, Medium and Large Farms

Types of cost and Return	Farm size		
	Small	Medium	Large
Yield (kg/ha)	6323	6817	6027
Gross return (Tk./ha)	45010	48622	42802
Gross cost (Tk./ha)	33855	33768	35756
Variable cost (Tk./ha)	29760	29675	31623
Cash cost (Tk.)	11011	14791	16686
Net return (Tk.)	1155	14855	7046
Gross margin (Tk.)	15250	18948	11179
Cash margin (Tk.)	33999	33832	26116
Benefit-cost ratio (cash-cost basis)	4.09	3.29	2.57
Benefit-cost ratio (Variable-cost basis)	1.51	1.64	1.35
Benefit-cost ratio (Full-cost basis)	1.33	1.44	1.20
Cost of per unit output (cash-cost basis)	1.74	2.17	2.77
Cost of per unit output (variable-cost basis)	4.71	4.35	5.25
Cost of per unit output (Full-cost basis)	5.35	4.95	5.93

Source: Field survey 2001

Table 2. Estimates of Production Function According to Various Farm Size Groups

			Co-efficient and standard error								
Farm size groups	No. of observation	Constant	Human labour	Seed	Fertilizer and manure	Insecticides	Animal labour	Power tiller	Irrigation	$\bar{R}^2$	F Value
Small	25	.488	0.031 (0.019)	0.146** (0.058)	0.455* (0.128)	0.004 (0.014)	0.048 (0.031)	0.049*** (0.026)	0.513** (0.191)	0.744	10.970*
Medium	20	5.779	0.132** (0.060)	0.307** (0.118)	0.0796** (0.029)	- 0.288 (0.179)	0.007 (0.013)	0.178* (0.057)	0.357 (0.302)	0.780	10.617*
Large	15	6.133	0.159* (0.033)	0.026 (0.022)	0.081* (0.018)	- 0.031*** (0.015)	0.014 (0.010)	0.042 (0.041)	0.333* (0.060)	0.726	144.89*

Note: *Significant at 1% level
** Significant at 5% level.
*** Significant at 10% level.
Figures in the parentheses indicate standard error.

As far as three production functions are concerned, cost of fertilizer and manure for small farmers, cost of power tiller for medium farmers and cost of human labour, cost of fertilizer and cost of irrigation for large farmers appeared to be the most important variables significant at 0.01 probability level contributing positively to the BR-29 Boro paddy production. Cost of animal labour and cost of insecticides did not show significant effect on the production of BR-29 Boro paddy production for small and medium farmers. The negative sign and statistical significance of cost of insecticides for large farmers indicates that large farmers used more insecticides than what was required per hectare.

In the case of small farmers, who grew BR-29 Boro paddy it can be observed from the value of MVPs that for seed (2.153), fertilizers and manure (4.825), animal labour (3.194), power tiller (2.353) and irrigation (2.601) MVPs were greater then 1 and positive indicating that there are ample opportunities for farmers to increase per hectare output by using more of these inputs (Table 3). Again the MVPs for human labour (0.259) and insecticides (0.258) were positive but less than 1 indicating that there was no scope for using more human labour and insecticides, which should lower the rate of profit. In the case of medium farmers it can be observed from the value of MVPs that for human labour (1.186), seed (3.510), fertilizer and manure (3.928), power tiller (7.356) and irrigation (4.920) MVPs were greater than 1 and positive indicating that there are ample opportunities for farmers to increase per hectare output by using more of these inputs (Table 3). The MVP of insecticides (-4.673) has a minus sign indicating over use of this resource. Again the MVP for animal labour (0.501) was positive but less than 1 indicating that there was no scope for using animal labours which should lower the rate of profit. Similarly, the MVPs for large farmers who grew BR-29 Boro paddy were 0.831, 2.575, 3.367, -6.357, 2.750, 1.281 and 2.838 for the variables of human labour, seed, fertilizers and manure, insecticides, animal labour, power tiller and irrigation, respectively (Table 3). All these MVPs are different from 1 indicating inefficient use of resources. In the case of large farmers it can be observed from the value of MVPs that for seed (2.757), fertilizers and manure (3.367), animal labour (2.750), power tiller (1.281) and irrigation (2.838) MVPs were greater than 1 and positive indicating that there are ample opportunities for those farmers to increase per hectare output by using more of these inputs. The MVP of insecticides (-6.357) has a minus sign indicating over use of this resource. Again the MVP for human labour (0.831) was positive but less than 1 indicating that there was no scope for using more human labour which should lower the rate of profit (Table 3).

Table 3. Marginal Value Products (MVPs) of Different Resources Used in the Production of BR-29 Boro Paddy for Small, Medium and Large Farmers

Inputs	Small farmers			Medium farmers			Large farmers		
	GM	Co-efficient	MVPs	GM	Co-efficient	MVPs	GM	Co-efficient	MVPs
Human labor(X_1)	6023.217	0.031	0.259	5611.269	0.132	1.186	8805.947	0.159	0.831
Seed (X_2)	3549.161	0.146	2.153	14365.568	0.307	3.510	498.006	0.026	2.575
Fertilizer and manure (X_3)	4934.883	0.455	4.825	1021.682	0.0796	3.928	1186.630	0.081	3.367
Insecticides(X_4)	811.371	0.004	0.258	3107.731	-0.288	-4.673	240.493	-0.031	-6.357
Animal labour(X_5)	786.549	0.048	3.194	703.796	0.007	0.501	251.106	0.014	2.750
Powertiller (X_6)	1089.826	0.049	2.353	1220.098	0.178	7.356	1617.507	0.042	1.281
Irrigation (X_7)	10323.265	0.513	2.601	3658.880	0.357	4.920	5786.800	0:333	2.838

In the case of small farmers the summation of elasticities of production of different inputs for BR-29 Boro paddy was found to be 1.246 which was greater than one implying that the small farmers allocated their resources in the irrational stage of production (stage-I) where increasing returns to scale existed. In other words, if all the inputs specified in the function were increased by 1 per cent, output of BR-29 Boro paddy would have increased by 1.246 per cent. In the case of medium farmers the summation of individual elasticity's of production of different inputs for BR-289 Boro paddy was found to be 0.772 which was less than one implying that the medium farmers allocated their resources in the rational stage of production (stage-II) where decreasing returns to scale existed. In other words, if all the inputs specified in the function were increased by 1 per cent, output of BR-29 Boro paddy would have increased by 0.772 per cent. In the case of large farmers the summation of individual elasticity's of production of different inputs for BR-29 Boro paddy was found to be0.624 which was less than 1 implying that the large farmers allocated their resources in the rational stage of production (stage-II) where decreasing returns to scale existed. In other words, if all the inputs specified in the function were increased by 1 per cent, output of BR-29 Boro paddy would have increased by 0.624 per cent.

Table 4. Test of Returns to Scale for Various Farms Size Groups.

Farm size group	Sum of regression co-efficient	F-Value	Returns to scale
Small	1.246	10.970	Increasing
Medium	0.772	10.617	Decreasing
Large	0.624	144.890	Decreasing

The results of the production function model and the findings of the earlier section revealed that the key variables included in the model were individually or jointly responsible for variation in output of BR-29 Boro paddy production. So, it confirmed that the inputs used for producing BR-29 Boro paddy in the case of every categories of farmers have impact on their respective returns.

Conclusions

It was observed from the result that BR–29 Boro paddy was a profitable enterprise. This paper used several methods for calculating the profitability and resource use efficiency. Every method was applied properly and gave the results, which were acceptable. The seven variables namely human labour, seed, fertilizer-manures, insecticides, animal labour, power tiller and irrigation cost explained 74 percent, 78 percent and 73 percent of the variation of BR-29 Boro paddy production for small, medium and large farmers respectively. Diseconomies of scale exist for the medium and large farmers, while economics of scale operate for the small farmers. Insecticides have been overutilizer by the medium and small farmers. As far as fertilizer-manure application is concerned, small, medium and large farm's utilization is economically efficient but the cost of irrigation is heavily underutilized by the small, medium and large farmers. From the present study we can see that BR-29 Boro paddy production is a profitable business. There is a bright prospect for expanding the cultivation of BR-29 Boro paddy because of its nutrition value and high income generating potential.

References

Bhuiyann, M.S. R. (1987). " Effect of Farm Size and Tenurial Status of Land on Production Efficiency in an Area of Bangladesh", The Bangladesh Journal of Agricultural Economics, X (X).

Chemnnareddy, V. (1967). " Production Efficiency in South Indian Agriculture", Journal of Farm Economics, 49 (4): 816-20.

Dhown, K.G. and R. K. Bansal, (1977), Rationality of the Use Various Factor of Production on Different Sizes in Panjab. The Journal of Agricultural Economics, 32 (3): 121-130.

Hopper, W. D. (1965). "Allocative efficiency in a Traditional Indian Agriculture", Journal of Farm Economics, 47 (3): 611-24.

Hossain, M. (1977). "Farm Size, Tenancy and Land Productivity: An Analysis of Farm Level Data in Bangladesh", The Bangladesh Development Studies, 5 (3): 285-348.

Khusro, A. M. (1964). "Returns to Scale in Indian Agriculture", Indian Journal of agricultural Economics, 19 (3 & 4): 51-80.

Mandal, D.A.S. (1980). "Farm Size, Tenure and Productivity in an Area of Bangladesh", The Bangladesh Journal of Agricultural Economics, 3 (2): 21-42.

Mazumdar, D. (1963). "Size of Farm and productivity: A Problem of Indian Peasant Agriculture", Economica, 32 (126): 161-73.

Myrdal, G. (1968). Asian Drama: An Inquiry into the Poverty of Nations, London: Allen Lane the penguine Press.

Myrdal, G. 1979). "Underdevelopment and the Evolutionary Imperative", Third World Quarterly, 1 (2): 24-42.

Raj, Krishna (1964). "Some Production Functions for the Punjab", Indian Journal of Agricultural Economics, 19 (3 & 4): 87-113.

Rao, A. P. (1967). "Size of Holding and Productivity", Economic and Political Weekly, Special Number (November 11): 1989-91.

Schultz, T. W. (1964), T. W. (1964). Transforming Traditional Agriculture, New Haven: Yale University Press.

Sen, A. K. (1962). "An Aspect of Indian Agriculture", Economic Weekly, 14 (Annual Number): 323-26.

Yotopoulos, P. A. and J. B. Nugent (1976). Economics of Development: Empirical Investigations, New York: Harper International Edition, Harper and Row, Publishers, Inc.