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Productivity and Resource Use Efficiency of Boro Rice Production

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Abstract

This study was attempted to measure and compare resource use efficiency and relative productivity of farming under different tenure conditions in an area of *Bhola* district. A random sampling technique was used in the study. Sample farmers were classified as owner, crop share tenant and cash tenant farmers. A total of 90 samples, 30 from each class were selected on the basis of random sampling technique. The study explored the difference in the efficiency and productivity among owner, cash tenant and crop share tenant. Total cash expenses as well as total gross costs for producing HYV Boro rice was highest in owner farms and lowest in crop share tenant's farm. When individual inputs were concerned it was observed that expenses on human labor shared a major portion of expenses in the production of HYV Boro rice where owner operators used more hired labor in compare to other groups. However, the cash tenant farmers were more efficient than owner and crop share tenant farmers. Due to poor resource base the crop share tenants were unable to invest on modern farm inputs. It may be mentioned that in Bangladesh the predominant tenancy arrangement is share cropping, which is an inefficient form of tenure arrangement in compare to cash tenancy.

Keywords: Land tenure, Profitability, Efficiency, Elasticity of production

Introduction

Agricultural development in an agrarian economy largely depends on the existing nature of man-land relationship. Crop-sharing is one of the earliest forms of production organization in agriculture. It is still a matter of considerable importance in present agriculture in many countries. According to Bishop and Toussaint (Bishop and Toussaint, 1958) both land lord and tenant are utilizing inputs belonging to other party. Each party may consider the inputs contributed by the other party to have a zero price. In this case, there will be a tendency to use the other person's input up to the point where the value of the marginal product is zero. For example, the tenant's labor has no price to the landlord. The landlord tends to push the use of the tenant's labor, in so far as he is able to reach the point where additional labor brings no return. That is, land lord would like to see enough labor used so that the value of the marginal product of labor would be zero. The tenant on the other hand, considers the price of land zero. He has incentive to use additional land as long as the value of the marginal product of the land greater than zero. But the land has a cost to the landlord. For this reason a conflict of interest may develop. The crucial problem of growth in agriculture in Bangladesh is how to increase the output per unit of input. One way of approaching this problem of improving agricultural production efficiency is to examine whether the present pattern of ownership and use of resources is efficient or inefficient. Due to natural hazards, crop share tenants do not usually take the risk of extra investment in their farm business. A crop share tenant is quite unable to seek any technological improvement in organizing his farm business. Resource use and production under different tenure groups of farms in the less developed countries has been one of the most widely discussed and controversial issues in development literature. The focus of this study is to measure and compare the resource use efficiency and land productivity of owner, crop share tenant and cash tenant farmers. Share renting can be an efficient means of farm production. To avoid almost inevitable conflicts between landlords and tenants, variable costs, such as seed and fertilizer should be shared in the same proportion as returns. For example, if the tenant gets tow- thirds of the crop, he should pay two-thirds of the variable costs. Although a tenant and landlord do not share the labour and land costs, sharing of as many costs as feasible, and sharing costs in the same proportion as they share the return will tend to bring about greater profit for the farm and for each individual (Bishop and Toussaint, 1958).

In Bangladesh most of the farmers are landless. For this reason they cultivate land under different tenure systems. There are different types of tenure arrangements exist in Bangladesh. These arrangements influence the efficiency with which inputs are used. They also affect the degree of uncertainty encountered in the operation of a farm. Although innumerable breakdowns are possible, most tenure arrangements can be placed in one of the three main classes in coastal region of Bangladesh namely- (i) Owner Operator: An owner farming can be expressed as one where the land is owned by operator himself and who bears all the costs of production including management and supervision. Owners as a

group generally have more freedom in their production plans than any other tenure classes. (ii) Cash Tenant Operator: A cash tenant is a rural household who has temporary possession of land in accordance with the terms of a written or oral agreement specifying the amount due in cash to the owner(s) of the land. This tenant group paid lump sum amount money to the land owner for using his land. In this tenancy the tenants uses all inputs and get all of the outputs. (iii) Cash Share Tenant Operator: This group includes those farmers who use the land of land owner by crop share basis. Land owner provide only land and the tenant provide all other input cost to produce boro rice. After harvesting the land owner and the tenant share the output. The objective of the study is to measure and compare relative productivity and efficiency of boro rice production under different tenure conditions.

Materials and Methods

The study was conducted to determine relative impact on resource use and productivity of farmers producing irrigated HYV Boro rice under different tenure systems in six villages namely Daskhandi, Jinnagar, Char Nizam, Aminabad, Osmanjong, Shibar hat in Charfassion Upazila under Bhola district. This study was based on field level data. The data are collected by the survey method. Collected data were classified, tabulated and analyzed in accordance of the objectives set for the study. Both tabular and statistical techniques were used to find important relationships among the relevant variables.

Tubular technique: Tabular technique of analysis is generally used to find out the crude association or difference between two variables. In this study tabular technique was used to illustrate the whole picture of analysis.

Statistical technique: Cob-Douglas production function is used to estimate the effects of various inputs for the production of HYV Boro rice in different tenural arrangements. Four independent variables namely, human labor cost, seed cost, fertilizer cost and insecticide cost were taken into consideration which are likely to have an impact on production of HYV Boro rice. All variables were expressed in monetary terms. The power tiller cost, land use cost and irrigation cost as a variable have not been considered. Because these cost were fixed per hectare for all the farmers for producing HYV Boro rice.
To determine the contribution of the most important variables in the production process, the following specification of the model is applied:

$$Y = aX_1^{b1}X_2^{b2}X_3^{b3}X_4^{b4}e^u$$
$$\text{Or } 1nY = \ln a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + U$$

Efficiency of Resource Allocation

In order to test the efficiency, the ratio of marginal value product (MVP) to the marginal factor cost (MFC) for each input is computed and tested for its equality to 1, i.e;

$$\frac{MVP}{MFC} = 1$$

The marginal productivity of a particular resource represents the additional to gross returns in value term caused by an additional one unit of that resource, while other inputs are held constant. When the marginal physical product (MPP) is multiplied by the product price per unit, the MVP is obtained. The most reliable, perhaps the most useful estimate of MVP is obtained by taking resources (Xi) as well as gross return (Y) at their geometric means (Dhawan and Bansal, 1977). Since all the variables of the regression model were measured in monetary value, the slope co-efficient of those explanatory variables in the function represented the MVPs, which are calculated by multiplying the production co-efficient of given resources with the ratio of geometric mean (GM) of gross return to the GM of the given resources, i.e.;

$$\ln Y = \ln a + b_i \ln X_i$$

$$\frac{dY}{dXi} = bi \frac{Y}{Xi}$$

Where,

$$\text{Therefore, MVP } (Xi) = b_i \frac{Y(GM)}{Xi(GM)}$$

Y = Mean value of GM of gross return in Tk.
X_i = Mean value of GM of the ith variable input in Tk.

MFC is the price of per unit of input. If the MFCs of all the inputs expressed in terms of an additional, Tk, in calculating the ratio of MVP to MFC, the denominator will always be one, and therefore, the ratio will be equal to their respective MVP.

Results and Discussions

Profitability of boro rice production

A farm earns profit when its net return is above its total costs. Profitability is the main aim of any farm. In recent years boro rice cultivation increases through out the country. Government gives emphasis in boro rice production because about 60% of total rice comes from boro season in our country (BBS,2007). Profitability of boro rice production is represented below.

Table 1. Total costs and returns for Producing HYV Boro rice in per hectare

Items	Owner	Percentage of total cost	Cash tenant	Percentage of total cost	Crop share tenant	Percentage of total cost
Cash cost						
Human labor	16610.00	30.40	14410.00	26.28	12320.00	25.33
Animal labor	400.00	0.73	100.00	0.18	200.00	0.41
Power tiller	4000.00	7.32	4000.00	7.29	4000.00	8.22
Seedlings	200.00	0.37	600.00	1.09	240.00	.49
Fertilizer	13454.20	24.62	14150.00	25.81	11333.25	23.3
Insecticides	1839.99	3.37	2224.15	4.06	1213.19	2.50
A. Total cash cost	35504.19	64.98	35484.15	64.72	29305.44	60.27
Non cash cost						
Human labor	1650.00	3.02	2860.00	5.23	2640.00	5.43
Animal labor	100.00	0.19	200.00	0.36	130.00	0.27
Seedlings	1200.00	2.19	600.00	1.09	1120.00	2.30
Cow dung	1325.10	2.42	875.22	1.60	733.71	1.51
Irrigation	6175.00	11.30	6175.00	11.26	6175.00	12.70
Interest on operating capital	437.81	0.80	384.01	0.70	271.53	0.55
Land use cost	8250.00	15.10	8250.00	15.05	8250.00	16.96
B. Total non-cash cost	19137.91	35.02	19344.23	35.28	19320.24	39.73
Total Cost (A+B)	54642.10		54828.38		48625.68	
Gross Return (GR)	Tk. 92594.30		Tk. 102647.00		Tk. 73540.86	
Return above cash cost	57090.11		67162.85		44235.42	
Return above non cash cost	73456.39		83302.77		54220.62	
Return above total cost (NR)	37952.20		47818.62		24915.18	

Source: Field Survey, 2008

Total cash cost is higher in owner operator (35504.19) compare to other two operators. It is because owner operator use more hired labor. Non-cash cost is highest in cash tenant compare to others. Total cost of production of boro rice is highest in cash tenant operator i.e. Tk 54828.38. Cash tenant used all the inputs in required level. In the net return we can see from the Table 1 that cash tenant operator earn more than other two operator , it is because the cash tenant use the land as his own. He rent it for one or more year and no crop give up to the land owner as a result he uses it intensively and gets highest return.

Resource Use Efficiency

Resource Use Efficiency means how efficiently the farmer can use his resources in production process. It is very important because our resource is very limited. For calculating resource use efficiency we consider four factors namely labour, seedling, fertilizer and insecticide.

Table 2. Estimated production function for different respondents

The estimated production function for owner
$\mathbf{lnY = 13.26 + 0.126\ lnX_1 + 0.083\ lnX_2 + 0.067\ lnX_3 + 0.355\ lnX_4}$ (0.211) (0.130) (0.119) (0.034)
The estimated production function for cash tenant
$\mathbf{lnY = 16.88 + 0.122\ lnx_1 + 0.038\ lnx_2 + 0.574\ lnx_3 + 0.112\ lnx_4}$ (0.337) (0.136) (0.246) (0.154)
The estimated production function for crop share tenant
$\mathbf{LnY = 15.96 + 0.050\ lnx_1 + 0.540\ lnx_2 + 0.013\ lnx_3 + 0.019\ lnx_4}$ (0.160) (0.233) (0.230) (0.351)

The impact of selected four variables on gross income are given below-

Table 3. Estimated values of co-efficient and related statistics of Cobb-Douglas production function model

Explanatory variable	Owner	Cash Tenant	Crop share tenant
Intercept	13.26	16.88	15.96
Human labor cost (X_1)	0.126*** (0.211)	0.122 (0.337)	0.050** (0.166)
Seedling cost (X_2)	0.083* (0.130)	0.038* (0.136)	0.540* (0.233)
Fertilizer cost (X_3)	0.067* (0.119)	0.574** (0.246)	0.013* (0.230)
Insecticide cost (X_4)	0.355** (0.034)	0.112** (0.154)	0.019** (0.351)
R^2	0.85	0.91	0.71
F - value	34.80	51.30	28.21
Returns to scale	0.63	0.85	0.62

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

Human labor cost (X_1)

The regression co-efficient of human labor cost for owner farmer was 0.126 which was significant at 10 percent level of confidence. It indicates that considering all other factors constant, one percent increase of human labor cost would increase gross return by 0.126 percent. For cash tenant the co-efficient is 0.122 and is significant at 5 percent level which implies that keeping all other factors constant, one percent increase in labor cost would increase gross return by 0.122 percent. Again for crop share tenant the co-efficient of human labor cost was 0.050 and it becomes significant at 5 percent level. It implies that keeping all other factors constant, one percent increase in labor cost would increase gross return by 0.050 percent.

Seedling cost (X_2)

The co-efficient for seed cost were positive and significant at 1% level for owner, cash tenant and crop share tenant operator. It indicates that keeping other factors constant, 1 percent increase in seed cost would increase the gross return by 0.083, 0.038 and 0.540 percent for owner, cash tenant and crop share tenant operator respectively.

Fertilizer cost (X_3)

Co-efficient of fertilizer cost were significant at 1 percent level which indicated that holding other factors constant one percent increase in fertilizer cost would increase the gross return by 0.067, 0.574 and 0.013 percent for owner, cash tenant and crop share tenant operator respectively.

Insecticide cost (X_4)

The regression co-efficient of insecticide cost were positive for owner, cash tenant and crop share tenant operator and significant at 5 percent level. It indicates that keeping all other factors constant 1 percent increase in insecticide cost would increase gross return by 0.355, 0.112 and 0.019 percent respectively.

Value of R^2

The co-efficient of multiple determinations R^2 of the model were 0.85, 0.91 and 0.71 for owner, cash tenant and crop share tenant operator respectively. R^2 of 0.85 for owner operator indicates that about 85 percent of the variations in gross return of owner operator have been explained by the explanatory variables, which were included in the model. This was 91 percent for cash tenant operators and 71 percent for crop share tenant operators.

F -Value

The F - values of the equation derived for owner, cash tenant and crop share tenant operator were 34.80, 51.3 and 28.21 which were highly significant at 1 percent level implying that all the explanatory variables were important for explaining the variations in gross returns of the operators.

Returns to scale

The summation of all the production co-efficient indicates returns to scale. For HYV Boro rice production in owner, cash tenant and crop share tenant operator the rumination of the coefficients were 0.63, 0.85 and 0.62 which means that the production functions exhibit decrease returns to scale.
For estimating resource use efficiency we need to calculate MVPs in different tenant arrangements.

Table 4. MVPs of inputs in production function

Inputs	Geometric mean	Co-efficient	MVP
Owner Operator			
Gross return (Y)	92506.82		
Human labor cost (X_1)	18245.90	0.126	0.639
Seedling cost (X_2)	1397.02	0.083	5.496
Fertilizer cost (X_3)	13421.71	0.067	0.462
Insecticide cost (X_4)	1786.05	0.355	18.387
Cash tenant operator			
Gross return (Y)	102449.40		
Human labor cost (X_1)	17256.32	0.122	0.724
Seedling cost (X_2)	1195.02	0.038	19.962
Fertilizer cost (X_3)	14129.54	0.574	4.162
Insecticide cost (X_4)	2217.24	0.112	5.175
Crop share tenant operator			
Gross return (Y)	73302.27		
Human labor cost (X_1)	14892.40	0.050	0.246
Seedling cost (X_2)	1356.64	0.540	29.177
Fertilizer cost (X_3)	11311.40	0.013	0.084
Insecticide cost (X_4)	1212.16	0.019	1.149

Incase of owner operators it can be seen from Table that the values of MVPs that for seedling and insecticide are greater than one and positive (5.496 and 18.387 respectively) indicating that the farmers had opportunities to increase per hectare output by using more seedling and insecticide. Again the MVPs for human labor and fertilizer were 0.639 and 0.462, which are positive but less than one. It indicates that there was no scope for spending more for labor which would decrease profit.

Similarly the MVPs for cash tenant are positive and greater than one for seed (19.962), fertilizer (4.162) and insecticide (5.175) which indicates that there was still scope to increase profit by using of these inputs. On the other hand, MVPs for human labor (0.724) indicates positive values but less than one. That means the farmers should limit the use of labor.

Again the MVPs for crop share tenant operator was 29.177 for seedling, and 1.149 for insecticide which indicates that there was still scope to increase profit by using of these inputs. On the other hand, MVPs for human labor (0.246) and fertilizer (0.084) were positive but less than one. That means the share tenant should limit the use of labor and fertilizer.

Elasticity of production

The elasticity of production refers to the percentage change in output in relation to the percentage change in input. The concept of elasticity can be applied to the production function to determine the stage in which farmers are allocating their resources.

Table 5. Elasticity of HYV boro rice production

Inputs	Elasticity		
	Owner	Cash tenant	Crop share tenant
Human Labor	0.13	0.12	0.05
Seed	0.08	0.04	0.54
Fertilizer	0.06	0.57	0.01
Insecticide	0.36	0.11	0.02
Total	0.63	0.85	0.62

In this study, the scale of production for all farmer were estimated by summation the values of the co-efficients (b_i) as we see below that the co-efficients of Cobb-Douglas production functions give the direct measure of returns to scale indicate the stage of production.

Elasticities for all type of respondent categories were less than one which indicates that the growers allocated their resources in the rational stage of production (Stage-II) where diminishing returns to scale existed.

Conclusion

From the above discussions it may be concluded that cash tenant operators were found more efficient than those of owner and crop share tenant operators. Again cash tenants were more efficient in production because they were eager to earn more profit from their investment. So they had to put better effort in producing rice and had got better output. The actual mode of production covering Bangladesh agriculture has been a debatable issue. The existing land tenure arrangement is the major determinant of mode of production, which is a vital constraint for achieving the higher level of production efficiency in agriculture of Bhola district. Based on the findings of the present research, the following recommendations are put forward.

(i) The cost of sharing between land owner and crop share tenant should be 50:50 in the case of all inputs except land and labor;
(ii) Measures should be taken to ensure more equitable distribution of resources in crop share tenant farmers;
(iii) Measures to provide micro credit to be taken so that, even very small farmers can get the credit facilities to acquire cash tenancy mode of production in replace of crop share tenancy.

If major land reform measures are not feasible under the given socio-political conditions of Bangladesh, certain selective reform measures may be attempted, i.e., one of the often suggested measures is sharing variable inputs in proportion to the share of output. This can give at least some intermediate solution to the whole problem of attaining higher level efficiency in agricultural production. The irrigation system of the coastal region more specially in Bhola district is to uplift water from the canal to the rice field through low lift Pump. But the availability of water in the canal is decreasing day by day. Government should have to take initiative to dig up the canal frequently to ensure available water in the canal that helps to grow HYV Boro rice.

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