Analysis of Resource-Use Efficiency of Paddy Production in Meerut district of Western Uttar Pradesh

Agriculture

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ABSTRACT

This Study attempts to examine the resource use efficiency of Paddy production in Meerut district of Western UP. A sample of 100 farmers was selected through multistage sampling technique. Farmers were categorized on the basis of land holding into marginal, small, medium and large farmers. Cobb Douglas production function approach was used to measure the resource use efficiencies by calculating and comparing Marginal Value Products (MVPs) and acquisition cost (AC). Results depicted that ratio of MVP to AC for most of the resources were greater than 1 showing under-utilization of these resources. While the use of manure and fertilizer was found to be over utilised among all categories of farms, and irrigation was in medium and large farmers.

Introduction

India ranked first in area under Paddy (43.97 million ha) with 67 per cent under high yielding varieties and second in terms of production (104.32 million tonnes) during 2011-12 and it stood next to China in the world. But, the productivity level in India is 2.37 tonnes per hectare, compared to other major rice producing countries, *viz.,* Japan (6.52 t/ha), China (6.24 t/ha) and Indonesia (4.25 t/ha). It is generally believed that farmers in developing country like India fail to exploit full potential of technologies and/or to make allocative errors in resource use with the result that yields show wider variation, usually reflecting a corresponding variation in the management capacitates of the farmers. This shows that considerable scope exists for raising productivity and income of the farmers by improving their inefficiency. The factors responsible for inefficiencies need to be identified and eradicate properly for achieving a higher production in paddy. The launching of High Yielding Variety Programme (HYVP) in India has enhanced the importance of the study of resource use efficiency in crop production. The concept of efficiency is vital to policy makers both at micro and macro levels. It helps to policy makers, researchers and extension workers. In this context studies on efficiency in paddy cultivation focus on the possibility of increasing the paddy yield, income of farmers with conserving the resources on farms.

Methodology:

Meerut district of Western Uttar Pradesh was selected purposively for the present investigation. Out of 12 community blocks, two blocks were selected purposively on the basis of highest area and production under paddy cultivation. A complete list of all the villages of the each selected block was prepared with the help of block officials and arranged in alphabetical order. From each selected block, two villages and a total of four villages were selected randomly for the selection of the respondents.

A list of all the farmers of each of selected villages was obtained from gram pradhan of the respective villages, and the information on their land holding possess by each category of farmers were procure from the record of village revenue officer and Tehsil head quarter. All the farmers were then categorised into four size groups i.e. marginal (less than one hectare), small (1 to < 2 hectare), medium (2 to < 4 hectares) and large category (more than 4 hectares and above). From the list of the farmers 25 respondents from each village and a total of 100 farmers were selected in probability proportion to their population for the collection of data. The primary data were collected by personal interview method with the help of pre-tested and well-structured survey schedules

Estimation of production function

To examine the resources use efficiency in the production of paddy, regression analysis approach was employed. The following form of Cobb-Douglas type of production function was found suitable and apply for all categories of farms due to its wider applicability in the agricultural research.

$$Y= aX_1^{b1}X_2^{b2}X_3^{b3}X_4^{b4}X_5^{b5}X_6^{b6}$$

Where:

Y = Total output in quintals

X_1 = Expenditure on seed in Rs.

X_2 = Expenditure on human labour in Rs.

X_3 = Expenditure on machine labour in Rs.

X_4 = Expenditure on irrigation in Rs.

X_5 = Expenditure on manure and fertilizer in Rs.

X_6 = Expenditure on plant protection measures in Rs.

a= constant

b_1, b_2, b_3, b_4, b_5 and b_6 are the regression coefficient (also elasticity of production) attached to the respective variable.

Estimation of Marginal Value Productivity

Before estimation of regression equation, zero order correlation matrices were estimated to examine the presence of multi-collinearity between different pair of independent variables and to take necessary steps to get rid of this problem. To remove the multi collinearity, one of the two independent variable viz., one which have higher correlation with output was dropped.

The marginal value product of resources was estimated by taking the partial derivatives of output with respect to the concerned input and multiplying by the price of output. This procedure is explained below:

$$Y= a\ X_1^{b1}\ X_2^{b2}\ X_3^{b3}\ X_4^{b4}\ X_5^{b5}\ X_6^{b6}$$

The partial derivative of output (Y) with respect to input (X_1) is:

$$dy/dX_1 = b_1 aX_1^{b1-1}X_2^{b2}X_3^{b3}X_4^{b4}X_5^{b5}X_6^{b6}$$

$$=(b_1/X_1)a\ X_1^{b1}\ X_2^{b2}\ X_3^{b3}\ X_4^{b4}\ X_5^{b5}\ X_6^{b6}$$

$$= (b1.)\ Y/X_1$$

Where

Y/X_1 = average physical product of X_1 (APP$_{X1}$)

dY/dx_1 = marginal physical product of $X_1(MPP_{X1})$

b_1 = regression coefficient (elasticity of production) of input X_1.

This MPP_{X1} could be obtained by multiplying its regression coefficient (b_1) by its APP at geometric mean levels of both Y and X_1 and the marginal value productivity of X1 (MVP_{X1}) could be obtained by multiplying the MPP_{X1} by the price of output (PY) i.e.

$MVPx_1 = MPPx_1 . Py = b_1. Y / x_1. Py$, and in general for the i th resource.

$MVPx_i = MPPx_i . Py = b_i. Y / x_i . Py$,

Estimation of resource use efficiency
The resource use efficiency, marginal value productivity (MVP) of resources was compared with their respective Acquisition Costs (AC). The significance of the difference of MVPs of inputs with its AC was tested by computing `t` value as following.

$$t_{cal} = \frac{MVPxi - Pxi}{S.E\ of\ MVPxi}$$

$$S.E\ of\ MVPxi = \sqrt{AVP\ xi^2\ x\ V(bi)}$$

$$= AVPxi\ x\ S.E.\ of\ bi$$

Where,

bi = Regression coefficients of ith input.

MVPxi = Marginal value products of ith input

Pxi = acquisition costs of ith input

S.E. = standard error

AVPxi = average value of product of ith input

V (bi) = variance of ith elasticity coefficient

If the $t_{cal} > t_{tab}$ indicates statistically significant, shows deviation from optimality in resource use and hence the existence of inefficient use of resources which, further indicate that the profit could be increased from the enterprise by adjusting the input in appropriate direction.

Result and discussion
Regression coefficient and coefficient of multiple determinations.

The table1 shows the value of R^2 for different categories of farms which explained 92, 96, 94 and 99 per cent variation in output on the marginal, small, medium and large farms respectively explained by the variables included in the equation, while rest of the variation in the yields was due to the factors not taken into consideration. The table also reveals that the regression coefficient (which are known as elasticity of production in case of Cobb-Douglas production function) of seed was found to be positive for all farm size group but significant only for marginal and small farmers at 10 percent and 5 percent level of significance, indicate that one per cent increase in seed expenses would increase the output by 0.11 and 0.24 per cent, keeping the other variable resources in the function as constant at their geometric mean level. The elasticity coefficient of human labour turned out to be positive and found significance for marginal (0.27), small (0.32), and medium (0.31) size of farms at 1 percent level of significance which indicate that one percent increase in the human labour expenses would increase output by 0.27, 0.32 and 0.31 per cent on these farms. Expenditure on machine labour the regression coefficient was found to be significant at 10 and 1 percent level of significance on small (0.16) and medium (0.43) farm, which explains that one per cent in-

crease in machine labour cost, would increase output by 0.16 and 0.43 per cent on these farms. The coefficient of expenditure on irrigation was observed to be positive and significant at 5 percent level of significant, only for marginal farm size, but in case of medium farm size it was positive and insignificant. The regression coefficient of expenditure on manure and fertilizer was found to be positive and significant only for marginal farmer at 1 percent level of significant. The regression coefficient of expenditure on plant protection found to be positive and significant at 5 and 1 percent level of significance for marginal (0.11) and small farms (0.23) and positive and insignificant on medium and large farms.

5.3.2: Marginal value productivities of various resources
The most profitable farm organization results from adding each resource until the added income covers its added costs. Thus, when the added return was less than the added cost of resources it reflect that too much of resources were being used and vice versa. The economic interpretation of marginal value productivity has been given with respect to only those variables whose elasticity coefficient was found to be statistically significant. The marginal value productivities (MVPs) of different resources for all size group of farms are given in table no.2. This examination of the table indicates that in case of marginal farms the MVP of expenditure on seed, human labour, machine labour, irrigation, manure and fertilizer and on plant protection were Rs.7.03, 1.37, -0.18, 1.716, 1.65 and 4.49, respectively which indicate that the increase of one rupee expenditure on seed, human labour, irrigation, manure & fertilizer and plant protection at their mean level, would increase the return by Rs.7.03, 1.37, 1.71, 1.65 and 4.49, respectively. But the expenditure on machine labour would reduce the gross return by Rs. 0.18. The higher MVP of seed on marginal farms was due to low level of resources use and the MVP of human labour (1.37) on marginal farms was nearly optimum level use of resources and the negative MVP (-0.18) of machine labour on marginal farms was due to over utilization of resources. On small farms, the MVP of seed, human labour, machine labour, irrigation, was found to be more than Acquisition cost while for manure & fertilizer MVP found negative The maximum marginal value productivity of seed on small farms was due to low level use of resources. As regards the medium farmers MVP of expenditure on seed, human labour, machine labour, irrigation, manure & fertilizer and plant protection worked out to be Rs. 7.23, 1.52, 10.57, 0.64, -0.54 and 1.95, respectively. Other than manure and fertilizer all resources found to be underutilized. In case of large farms MVP of machine labour shows the over utilization while other inputs like seed, irrigation, human labour and plant protection found underutilized.

Comparison of marginal value productivities of resources with their acquisition costs:
MVP's of all the resources at their geometric mean level were compared with their corresponding AC. The AC was the cost price plus interest and their difference from (MVPs) were tested statistically for their significance with the help of 't' test. The acquisition cost of resources was in value terms and worked out per unit rupees, plus interest at the rate of 7 per cent per year. The interest rate was taken into account only for half of the period of the crop remains standing in the field. Thus, the acquisition cost for such resources were worked out to be Rs. 1.035.

The MVPs, the acquisition costs, their differences, standard error and calculated "t" value for paddy are presented in table 2. As it is evident from the table that the marginal value product of seed (7.0352), human labour (1.714), irrigation (1.7165), manure and fertilizer (1.6557) and expenditure on plant protection (4.49) in case of marginal farms were higher than their acquisition costs, indicating that there was a need to increase the level of these resources to obtain the optimum returns from paddy production.

In case of small farm size groups the MVP of seed, human labour, machine labour and plant protection were found to be statistically significant at 5 , 1, 10 and 1 level of significant respectively, and higher than its acquisition cost. The level of these

resources to be increased to get maximum profit from paddy. For the medium farmers, the MVP of expenditure on seed, irrigation, manure and fertilizer and plant protection was not statistically different from their acquisition cost. However, the MVP of expenditure on human labour (1.5221) and machine labour (10.5725) was found significantly higher than its acquisition costs at 1 percent level of significant on these size of farms and indicate the scope to increase the level of expenditure on human and machine labour.

This is also inferred from the table 2 that the marginal value productivity of expenses on seed, human labour , machine labour, irrigation and manure and fertilizer and plant protection was not statistically significant on large farms , which indicate that the resources were under optimal utilization.

Conclusion

It emerges from the foregoing discussion that all size group of farms have used seed less than its recommended level, while plant protection chemical at optimal level on marginal, medium and large categories of farms. The irrigation was found to be optimally used on small, medium and large size group of farms and other resources like machine labour at lower level on medium farms and it needs to be optimally utilized. Manure and fertilizer was also over utilized of the large size group of farms. Therefore, it is concluded that there is ample scope to increase the farm net return by the proper adjustment of the variable resources in the existing production system.

Table 1 Regression coefficient and coefficient of multiple determinations (R2) for paddy

Category of farms	Intercept	Expenditure on seed (Rs.)	Expenditure on human lab. (Rs.)	Expenditure on machine (Rs.)	Expenditure on Irrigation (Rs.)	Expenditure on manure & ferti. (Rs.)	Expenditure on plant prot. (Rs.)	R^2
	a	X_1	X_2	X_3	X_4	X_5	X_6	
Marginal	94.6455	0.1140** (0.0694)	0.27664*** (0.0708)	-0.01002 (0.3710)	0.126** (0.0505)	0.1548*** (0.036)	0.114** (0.0559)	0.920
Small	206.6331	0.2495** (0.1112)	0.32645*** (0.4210)	0.06104* (0.0358)	-0.0691 (0.0459)	-0.076 (0.0983)	0.233*** (0.0454)	0.957
Medium	42.2863	0.0992 (0.0908)	0.31576*** (0.1023)	0.437*** (0.0580)	0.0348 (0.0463)	-0.05573 (0.0485)	0.05814 (0.0495)	0.941
Large	74.9031	0.2846 (0.2945)	-0.80603 (0.9632)	-0.102 (0.1337)	-0.201 (0.7108)	-0.11207** (0.0174)	0.24442 (0.2153)	0.990

Figures in the parenthesis indicate the standard error   * Significant at 1 per cent probability level**
**** Significant at 5 per cent probability level   * Significant at 10 per cent probability level**

Table 2: Marginal value productivity (MVP) of the resources and their acquisition cost for paddy

SI. NO.	Particulars	Resources					
		Seed	Human labour	Total machine	Irrigation	Manu. and fertilizer	Plant protection
Marginal farms							
a.	M V Ps	7.0352	1.3714	-0.1886	1.7165	1.6557	4.4912
b.	Acquisition cost	1.035	1.035	1.035	1.035	1.035	1.035
c.	Difference	6.0002*	0.3364***	-1.2236	0.6815**	0.6207***	3.4562
d.	S E	0.0694	0.0708	0.0371	0.05059	0.03663	0.05594
e.	Calculated `t` value	1.6477	3.9055	-0.2695	2.5024	4.2274	2.0536
Small farms							
a.	M V Ps	16.745	1.6653	1.3494	1.1390	-0.7537	8.7259
b.	Acquisition cost	1.035	1.035	1.035	1.035	1.035	1.035
c.	Difference	15.7100**	0.6303***	0.3144*	0.1040	-1.7887	7.9609***
d.	S E	0.1112	0.4210	0.0358	0.0459	0.0983	0.04543
e.	Calculated `t` value	2.2436	4.2143	1.7044	-1.5028	-0.7747	5.2023
Medium farms							
a.	M V Ps	7.2328	1.5221	10.5725	0.6482	-0.5466	1.9545
b.	Acquisition cost	1.035	1.035	1.035	1.035	1.035	1.035
c.	Difference	6.1978	0.4871***	9.5375***	-0.3867	-1.5816	0.9195
d.	S E	0.0908	0.1023	0.0580	0.0463	0.0485	0.0495
e.	Calculated `t` value	1.0925	3.0856	7.5387	0.7507	-1.1490	1.1740
Large farms							
a.	M V Ps	23.9884	3.8594	-2.6686	0.4563	0.1211	8.2814
b.	Acquisition cost	1.035	1.035	1.035	1.035	1.035	1.035
c.	Difference	22.9534	2.8244	-3.7036	-0.5786	-0.9138**	7.2464
d.	S E	0.2945	0.9632	0.1337	0.7108	0.0174	0.2153
e.	Calculated `t` value	0.9663	0.8368	-0.7669	0.2836	2.4551	1.1348

**** Significant at 1 per cent probability level   ** Significant at 5 per cent probability level**
**** Significant at 10 per cent probability level**

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