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Resource Use Efficiency in Integrated Farming Systems of Banswara District of Rajasthan

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ABSTRACT

The present study was undertaken to analyze the resource use efficiency in integrated farming systems of Banswara district of Rajasthan by using the multistage sampling plan. This district was purposively selected for the study. A total sample of 60 households were selected from the study area in which 30 households from irrigated and remaining 30 households from rainfed condition. Both Linear and Cobb-Douglas Production function was employed to analyze the resource use efficiency. In the present study, the linear production function had shown the better results in terms of statistical criteria. The results of the present study revealed that some inputs namely machine labour, and human labour were over utilized among overall farming systems. The seeds, fertilizers, FYM and plant protection measures were under-utilized in rainfed area while labour, feed and concentrates were under-utilized for livestock activities in irrigated area of Banswara district. Therefore, it can be concluded that there was a much scope for reorganization of these resources to optimize their use to enhance the return in the study area.

Keywords: Linear production function, resource use efficiency, farming systems and Banswara district

The country's population is expected to reach 1660 million in the year 2050 and for which 349 million tonnes of food grains will be required. To meet this requirement for increasing population, there is a need to double the productivity of agricultural crops from the existing level of productivity. Since there is no further scope for horizontal expansion of land for cultivation of farm enterprises, the emphasis should be on vertical expansion by increasing the productivity using the available resources properly and choosing the best enterprise mix. In this context, Integrated Farming System approach is one of the important solutions to face this particular situation, as in this approach the different enterprises can be carefully undertaken and the location specific systems need to be developed, based on available resources which will result into sustainable development. Farming system represents integration of farm enterprises such as cropping system, animal husbandry, fisheries, forestry, poultry etc. for optimal utilization of resources bringing prosperity to the farmer. As the land resource is limited, production and productivity per unit area need to be increased in order to meet the growing demand of food. Integrated Farming System seems to be the possible farmer's friendly solution to meet the continuous increase in demand for food, stability of income and diverse requirements of food grains, vegetable, milk, egg, meat etc. thereby improving the nutrition status of the farmers with limited resources, especially small farmers. In case of rural areas, MVP of only green fodder was found to be highly significant with negative sign. This indicates that green fodder was over utilized (Sharma and Rajpali, 1989). The variation in the gross returns explained by the variables included in the production function analysis was to the extent of 89.49 per cent and 99.03 per cent in maize and sunflower, respectively. The resource use efficiency indicated that land, manures and fertilizers together had maximum influence on gross returns of maize followed by sunflower (Nagraj *et al.*, 1996). The land was the single most factors

that greatly influenced the gross returns. Babatunde and Baluwade (2004) reported that the marginal value product of all the resources were positive but land was more productive than others inputs. The use of operating credit and fertilizer were efficient. Farmland and purchased inputs were underutilized while labour was over-utilized. Increasing the farm size and purchased inputs used and decreasing the level of labour use would increase food crop production in the study area.

Rajasthan (the largest state of Indian union) occupies nearly 10.4 per cent geographical area of the country. Agriculture and allied activities accounted for nearly one fourth of the State Domestic Product against 14 per cent at national level. Therefore, agriculture despite all odds, considered to be the main stay of rural masses. The agriculture in most part of the state is rainfed and is prone to high production risk The farming systems models practiced by the farmers include various combinations of field crops, horticulture crops and livestock.

Out of 10 agro-climatic regions of the state, the two regions viz; sub-humid southern plains and aravalli hills zone (IV A), and humid-southern plains zone (IV-B) falls in Southern Rajasthan and are relatively more diversified for crop and livestock production. In these regions crops like maize, jowar, cotton, black gram, soybean, groundnut, cluster bean etc. are grown in *kharif* and crops like wheat, barley, rapeseed and mustard, gram, isabgol, etc. are grown in *rabi season*. There is substantial area under different vegetables in these regions. Among livestock, buffalo, goat and sheep are the most dominating animals.

Thus, the keeping above facts in mind, it was worthwhile to examine the resource use efficiency in different integrated farming systems and different integrated farming systems adopted by farmers in Banswara district of Southern Rajasthan.

METHODOLOGY

Southern Rajasthan comprises of eight districts viz., Udaipur, Chittorgarh, Bhilwara, Rajsamand, Dungarpur, Banswara, Pratapgarh and Sirohi. These districts fall in agro-climatic region IV-A and IV-B. Among these districts,Banswara is highly-tribal dominated district and it belongs to zone IV-B. This district was purposively selected for the study of integrated farming systems, as it has high potential for development of agriculture and livestock. Multistage sampling plan was used. Two tehsils were selected in such a way that one having highest proportion of irrigated area and other one having highest share of rainfed area to total net sown area so that selected tehsils represented irrigated and rainfed farming systems in tribal areas. Thus, Kushalgarh tehsil from rainfed area and Banswara tehsil from irrigated area, respectively, were selected. Two villages from each of selected tehsils were selected randomly. Thus, in all four villages were selected 15 farm households from each village were randomly selected. Thus, a total sample of 60 households were selected from four villages of Banswara district. Both primary and secondary data were collected.

The data collected during the period of investigation were scrutinized, tabulated and analyzed by using different analytical tools. Functional analysis was carried out to examine relationship between various inputs and output and to analyze various factors affecting integrated farming systems. Both Linear and Cobb-Douglas production functions were tried. Linear production function had shown better results in terms of statistical criteria. For examining the resource use efficiency, the MVP of those inputs were worked out whose regression coefficients were statistically significant in the estimated production function.

The following functional forms of linear production function was used to measure the resource use efficiency as used by Babatunde and Boluwade (2004) and Mesike*et al.* (2009). The Functional form was:

$$Y = f(X_1, X_2, X_3, \ldots\ldots\ldots\ldots, X_K)$$

Where,

Y = Output [value term from farming system (₹)]

X_1, X_2, X_3,..... X_K were input factors representing land, labour, capital, etc.

Where,

Input Factors	Name of Input Factors in Different Enterprises of Farming Systems in Banswara district of Rajasthan			
	Crop	**Dairy**	**Goat**	**Poultry**
X_1	Land	Dairy Number	Goat Number	Poultry Number
X_2	Seed	Human Labour	Human Labour	Human Labour

X_3	Fertilizes & FYM	Dry Fodder	Dry Fodder	Poultry Feed
X_4	Human Labour	Green Fodder	Green Fodder	—
X_5	Bullock Labour	Concentrates	Concentrates	—
X_6	Machine Labour	—	—	—
X_7	Irrigation	—	—	—
X_8	Plant Protection Measure	—	—	—

Resource use efficiency

For profit maximization, there exists resource use efficiency, if inputs were used in right proportion. A necessary condition for its MVP should be equal to its price. Mathematically, there exists resource use efficiency in respect of the use of i^{th} input if:

$$MVP_i = P_i,$$

Where,

P_i is the unit price of i^{th} input.

For examining the resource use efficiency, the MVP of those inputs were worked out whose regression coefficients were statistically significant in the estimated production function. Any deviation of MVP of i^{th} input from its unit price, was termed as resource use inefficiency. The higher the difference between MVP of an input and its price, the higher were the resource use inefficiency and vice versa. Further t-test was used to test the statistical significance of the difference between the MVP of i^{th} input and its unit price.

The t-test for this purpose were computed as:-

$$t = \frac{MVPi - Pi}{SE(MVPi)}$$

Where,

SE (MVP_i) = Standard error of MVP of i^{th} input

Standard errors of linear production function was worked out as:

Linear: $SE(MVPi) = SE(\hat{b}_i)$

Where,

$SE(\hat{b}_i)$ = the standard error of regression coefficients associated with Xi input.

Marginal value productivity

Marginal value productivity of input (i=1….n) for the linear functions is given as follows:-

Linear: $MVPi = \hat{b}_i$

Where,

$\hat{b}_i$ = the estimated regression coefficient associated with i^{th} input.

RESULTS AND DISCUSSION

Production function and resource use efficiency

In order to maximize the profit from an enterprise, the optimum use of resources is imperative. This was examined through the productivity of resources used in the production activity. Linear production function was selected based on appropriate sign and statistical significance of parameters estimated accompanied by higher coefficient of multiple determination (R^2).

Rainfed condition of Banswara district (crops)

All the coefficient of inputs were found positive. Seed (X_2), Fertilizer and FYM (X_3), Bullock Labour (X_5), Machine Labour (X_6) and Plant Protection Measures (X_7) were found to be significant and positive contributor to the gross return. The ratios of MVP/MFC for fertilizers and FYM and seed were more than unity. This indicated that in the crop production these resources were under utilized in the production process. Thus, there is ample scope of greater exploitation of these resources to maximize the production and increase the gross return.

Table 1: Linear production function for crops in rainfed condition of Banswara district

Sl. No.	Variables	Coefficients	Standard Error	t-Value
1	Intercept	5880.116	16009.269	0.367
2	Land (X_1)	0.146	1.317	0.111

3	Seed (X_2)	5.134***	1.701	3.017
4	Fertilizers and FYM (X_3)	2.678*	0.869	3.082
5	Human Labour (X_4)	0.116	0.314	0.368
6	Bullock Labour (X_5)	1.851*	1.421	1.303
7	Machine Labour (X_6)	0.593***	0.212	2.798
8	Plant Protection Measures (X_7)	1.660***	0.680	2.442
R Square		0.93		

*** = 1% Level of Significance, ** = 5% Level of Significance, * = 10% Level of Significance.

Table 2: Resource use efficiency for crops in rainfed condition of Banswara district

Variables	MVP	P	MVP-P	SE (MVP)
Seed	5.134	1.000	4.134***	1.701
Fertilizers & FYM	2.678	1.000	1.678*	0.869

MVP = Marginal Value Productivity, P = Price, SE = Standard Error.

Irrigated condition of Banswara district (crops)

The coefficient for Seed (X_2), Fertilizer and FYM (X_3) and Plant Protection Measures (X_7) exerted positive and significant influence to the gross return. The ratio for MVP/MFC on seed, and human labour was found positive and more than unity. This indicated that, it is profitable to use additional units of these resources in the production process to enhance the return. Similar findings were observed by Suresh and Keshava Reddy (2006).

Table 3: Linear Production Function for Crops in Irrigated Condition of Banswara District

Sl. No.	Variables	Coefficients	Standard Error	t-Value
1	Intercept	-44985.661	32314.645	-1.392
2	Land (X_1)	-1.512	1.001	-1.510
3	Seed (X_2)	10.494***	2.677	3.921
4	Fertilizers and FYM (X_3)	0.715**	1.604	0.446
5	Human Labour (X_4)	3.397	0.672	5.052
6	Bullock Labour (X_5)	0.825	0.846	0.976
7	Machine Labour (X_6)	0.316	0.320	0.987
8	Plant Protection Measures (X_7)	0.747***	3.505	0.213
9	Irrigation (X_8)	4.723**	1.619	2.916
R Square		0.99		

*** = 1% Level of Significance, ** = 5% Level of Significance, * = 10% Level of Significance.

Table 4: Resource use efficiency for crops in irrigated condition of Banswara district

Variables	MVP	P	MVP-P	SE MVP
Seed	10.494	1.000	9.494***	2.677
Irrigation	4.724	1.000	3.724**	1.620

MVP = Marginal Value Productivity, P = Price, SE = Standard Error.

This indicated that, it is profitable to use additional units of these resources in the production process to enhance the return. Similar findings were observed by Suresh and Reddy (2006).

Rainfed condition of Banswara district (dairy)

The expenditure on green fodder (X_3) and concentrate (X_4) were exerted a significant positive contribution to the total return at one per cent level of significance. The estimated coefficients for all other variables, such as human labour (X_1) and dry fodder (X_3) were found positive but statistically non-significant on the total return of dairy production enterprises. The ratios of MVP to MFC for the variables like green fodder and concentrate were found more than one which implies that there is scope for investment on these resources to increase the profitability of the dairy enterprise.

Table 5: Linear production function for dairy cattle in rainfed condition of Banswara district

Sl. No.	Variables	Coefficients	Standard Error	t-Value
1	Intercept	-105859.68	28048.56	-3.774
2	Human Labour (X_1)	0.549	0.978	0.561
3	Dry Fodder (X_2)	0.044	0.217	0.202
4	Green Fodder (X_3)	11.697***	5.068	2.308
5	Concentrates (X_4)	10.450***	2.702	3.868
R Square		0.96		

*** = 1% Level of Significance, ** = 5% Level of Significance, * = 10% Level of Significance.

Table 6: Resource use efficiency for dairy cattle in rainfed condition of Banswara district

Variables	MVP	P	MVP-P	SE MVP
Green Fodder	11.697	1.000	10.697***	5.068
Concentrates	10.450	1.000	9.450***	2.702

MVP = Marginal Value Productivity, P = Price, SE = Standard Error.

Production function for goat in Banswara district

The expenditure on green fodder (X_3) was significantly positive contributor to the total return at one per cent level of significance as depicted in Table 7. However, the estimated coefficients for variables, such as human labour (X_1), dry fodder (X_2) and concentrate (X_4) were found positive but statistically non-significant implying that variation in the levels of these inputs will not have much significant impact on the total return generated. The value of R^2 was observed to be 0.99. The resource use efficiency was not worked out for this situation as none of the significant variable had value more than unity.

Table 7: Linear production function for goats in Banswara district

Sl. No.	Variables	Coefficients	Standard Error	t-Value
1	Intercept	20874.995	4591.335	4.547
2	Human Labour (X_1)	0.117	0.259	0.453
3	Dry Fodder (X_2)	2.125	0.425	5.000
4	Green Fodder (X_3)	0.033***	4.741	0.007
5	Concentrates (X_4)	1.507	0.547	2.756
R Square		0.99		

*** = 1% Level of Significance, ** = 5% Level of Significance, * = 10% Level of Significance.

Production function for poultry in Banswara district

The production function analysis for poultry was found to be a good fit to the data as indicated by the calculated R^2 (coefficient of multiple determination) which was observed to be 0.99 for the selected variable (Table 8).The expenditure on human labour (X_1) and poultry feed (X_2) had positive contribution to the total return but statistically non-significant. Similar results were found by Kumar and Rai (2006). Thus, in Banswara district having different farming systems, the study revealed that there is a scope for reorganizing various resources to improve their productive efficiencies. Therefore, in this district, the use of resources showing negative coefficients should be decreased to achieve the optimality in the resource use and use of resources showing more than unity in production should be encouraged to enhance the profitability.

Table 8: Linear production function for poultry in Banswara district

Sl. No.	Variables	Coefficients	Standard Error	t-Value
1	Intercept	11470.650	12790.695	0.897
2	Human Labour (X_1)	0.731	0.297	2.464
3	Poultry Feed (X_2)	2.175	0.558	3.899
R Square		0.99		

*** = 1% Level of Significance, ** = 5% Level of Significance, * = 10% Level of Significance.

SUGGESTIONS AND POLICY IMPLICATIONS

The results of production function analysis revealed that, some of the inputs namely machine labour and human labour were over utilized in farming systems. Whereas, seeds and other resources (fertilizers, FYM and PPC) were under-utilized in rainfed area of Banswara district. Labour, feed and concentrates are under utilized for livestock activity in irrigated area of Banswara districts. Therefore, there is a scope for reorganization of these resources to optimize their use to enhance return in the study area.

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