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Economic Efficiency of Crop Production in Hadoti Region of Rajasthan

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ABSTRACT

Primary data obtained from 112 farmers dispersed over four blocks in the Hadoti region (Kota, Bundi, Baran, and Jhalawar districts) of Rajasthan were used to calculate the resource-use efficiency and marginal value product of mainly growing crops like wheat, soybean, gram, and *urad* production. To estimate the resource use efficiency and MVP a Cobb-Douglas production function was used. The yield of soybean was positively influenced by the use of more inputs like irrigation and human labour, gram by seed and irrigation, wheat by only machine labour, and urad by machine labour and seed, according to the study. Resource use efficiency of irrigation in soybean was found almost one, indicating that these resources are being used efficiently with full potential and that increasing their use could increase the yield of soybean. The under utilised resources need to be used more to boost the productivity of that crop in which it was used. The study will be helpful for policymakers related to resources used in the production process.

Key Words: Economics, Crop production, Resource-use efficiency, Marginal value product.

INTRODUCTION

In the year 2050, the country's population is predicted to reach 1660 million people, requiring 349 Mt of food grains (Singh *et al,* 2018). The Integrated farming system approach is the approach to face the problematic situations *i.e.,* more income, more production, and increasing efficiency of inputs. In this approach, the different agricultural enterprises can be used carefully undertaken with optimum use of resources available. Logically, every farmer would try to maximise their profit by allocating resources in an efficient manner. But as resources (both qualitatively and quantitatively) and managerial efficiency of farmers vary from farmer to farmer, the net returns per unit of inputs used also vary significantly from farm to farm (Haque , 2006). For 2019-20, total food grain production in India was estimated at 296.65 MT. The production during 2019-20 was higher by 26.87 MT than the previous five years (2014-15 to 2018-19) average production of food grain (Economic survey, 2021-22). Total pulses production during 2019-20 was approximate 23.15 MT (million tonnes) which is privileged by 2.33 MT than the five years average production of 20.82 MT. Total oilseeds production in India during 2019-20 was estimated at 33.42 MT which is higher by 1.90 MT than the production of 31.52 MT during 2018-19. The production of oilseeds during 2019-20 was higher by 4.02 MT than the average oilseeds production (Department of Agriculture Cooperation and Farmers Welfare, 2020-21). Increasing the income at the minimum possible cost through the conservation of different factors of production is always the best option for the farmer. In this study, different crops were taken from one cereal and one pulse crop *i.e.* wheat and gram were taken for cultivation in the *Rabi* season and one oilseed and one pulse crop were taken for cultivation in the *Kharif* season. Cultivation of summer pulses helps to generate income with less requirement of water. This farm income can be generated in a short period. It is also helpful for maintaining soil fertility. The

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leading states in pulses in India are Rajasthan, and Madhya Pradesh followed by Maharashtra, Uttar Pradesh, and Karnataka (Department of Agriculture Cooperation and Farmers Welfare, 2020-21).

MATERIALS AND METHODS

The concept of technical efficiency, allocative efficiency, and environmental efficiency are all included in the term resource use efficiency in agriculture. The research investigation was based on primary data. The data for the study were collected by personal interview method from the farmers'. The interview was conducted on pre-structured and pre-tested schedules during the year 2020-2021. The hadoti region (Kota, Bundi, Baran, and Jhalawar districts) was chosen because it is highly irrigated by the Chambal River and Kali Sindh, and has irrigation canals in the Kota, Baran, and Jhalawar districts. This Region was purposively selected because of its higher rainfall and irrigation percentage. From each selected district two tehsils were selected randomly. Out of eight selected tehsils, two villages from each tehsil were selected randomly and thus a total of sixteen villages spread over four tehsils in four districts had been taken up.

Selection of sample households

From selected villages a total of 5 percent was taken out for the study, According to this a representative sample of 112 households spread over all over 16 villages from all four districts were drawn randomly for a detailed survey schedule.

Resource use efficiency

The productivity of key input factors was calculated separately for the different ecologies. Cobb Douglas's production function was used to fulfill the objective. To work out the productivity Cobb Douglas's type of production function was used in the following form:

Where

Y= Gross return per hectare in ₹.

X_1= Human labour use per hectare in ₹.

X_2 = Machine use per hectare in ₹.

X_3 = Seed use per hectare in ₹.

X_4 = Irrigation per hectare in ₹.

"a" is constant and b_1, b_2, b_3, and b_4 were the elasticities of production for inputs X_1, X_2, X_3, and X_4 respectively.

Marginal Value Product

The marginal value product (MVP) and marginal factor cost (MFC) approaches are used to measure farmers' ability to achieve the best combination of different inputs to produce a given level of output while taking into account the relative prices of these inputs to determine the extent to which farmers in the study area are putting their resources to good use. The marginal value product (MVP) of input factors will be estimated by taking the partial derivatives of the respective input factors in the function as follows:

Decision rules are:

MVP/MFC > 1, The level of resource utilisation is below the optimal level, meaning that resources are under-utilised.

MVP/MFC < 1, The level of resource utilisation is above the optimal level, meaning that resources are over-utilised.

MVP/MFC = 1, The level of resource utilisation is optimal level, meaning that resources are efficiently-utilised.

In Cobb - Douglas production function MVP of X_i, the i^{th} input factor is given by the following formula:

Where,

= Geometric mean of Total product in terms of value (₹)

= Geometric mean of resource input X_i

b = production elasticities of X_i

After calculating each resource's marginal value product (MVP), needs to be compared to its marginal fixed cost. The marginal fixed cost of the

Table 1. Regression coefficients of different crop production in the study area.

Particulars	Intercept In log	Regression coefficients of					R^2
		Human labour	Machine labour	Seed	Irrigation		
Soybean	2.2504	0.0233*	-0.0000	-0.0250	0.9997*	0.9981	0.99
Urad	0.31174	0.0214	0.1194*	0.4576*	0.0428	0.6412	0.71
Wheat	0.2354	0.3461	0.1580*	-0.0848	0.0006	0.4199	0.98
Gram	0.9786	0.3665*	-0.0401	0.1939*	0.4748*	0.9951	0.81

*Note: * Shows the significance level at 1%*

marginal value product in monetary terms is one rupee.

RESULTS AND DISCUSSION

Resource Use Efficiency of cultivated crops

In the present study, the value of regression coefficients of all the variables or expected resource-use efficiency in different crop production. The R^2 score was 0.99, 0.71, 0.98, and 0.81 for soybean, urad, wheat, and gram respectively. It indicates that the explanatory factors in the model affected 99 percent in soybean, 71 percent in urad, 98 percent in wheat, and 81 percent in a gram of the variability in yield. As a result, increasing the usage of inputs like human labour in soybean and gram, machine labour in urad and gram, seed in urad and gram, and irrigation in soybean and gram will boost the yields.

The coefficient of elasticity of production (regression coefficient) of human labour was positive and significant in soybean and wheat crop cultivations. It means that for every 1% increase in human labour (value term), the gross return will grow by 0.0233 percent in soybean crop cultivation and 0.3665 percent in gram crop cultivation, with all other variables in the equation remaining constant at their geometric mean levels. For urad and wheat, the elasticity of production of human labour was insignificant.

In the urad and wheat crops, the coefficient of elasticity of machine labour was found to be positive and significant. It means that for every 1% increase in animal labour (value term), the gross return will grow by 0.1194 per cent in urad crop cultivation and 0.1580 per cent in wheat crop cultivation, with all other variables in the equation remaining constant at their geometric mean levels. In soybean and gram crop conditions, it was negative but insignificant. Because the coefficient's elasticity was statistically small, there was no effect of machine labour on gross returns. This could be due to the operational practices' consistent application of machine labour (measured in monetary terms). In both urad and gram cropping conditions, the coefficient of elasticity of seed was found to be positive and substantial. It was calculated that for every 1% increase in seed (value term), the gross return would increase by 0.4576 percent in urad and 0.1939 percent in gram cropping conditions with keeping the other variable resources considered in the equation constant at their geometric mean level. In the case of soybean and wheat, the coefficient shows a negative and insignificant value.

In both soybean and gram cropping conditions, the coefficient of elasticity of irrigation was found to be positive and significant. This means that for every 1% increase in a variable (value term), the gross return will increase by 0.9997 percent in soybean and 0.4748 percent in gram cultivation, assuming all other variables in the equation remain constant at their geometric mean levels. In the wheat, the irrigation regression coefficient was determined to be positive and negligible. Economic efficiency of variables, except harvesting, was found more than one, indicating that resources are being used at sub-

Table 2. Marginal value of productivity (MVP) of various inputs in soybean cultivation.

Particulars	Human Labour	Machine Labour	Seed	Irrigation
MVP	0.0796	-0.0001	-0.2068	8.8038
Price	1.0000	1.0000	1.0000	1.0000
Difference	-0.9204*	-1.0001	-1.2068	7.8038*
SE of MVP	0.0028	0.0030	0.0154	0.0143

** shows the significance level at 1 percent*

optimum levels and there exists the possibility of enhancing the yield crop by increasing their use (Karthick *et al,* 2013). In the soybean and gram crop situation, the total of the regression coefficients of variables such as human labour, machine labour, seed, and irrigation are nearly one *i.e.* 0.9981 and 0.9951. It suggests that there are constant scale returns. Furthermore, the factors are being utilised to their full potential, and if positive and significant variables such as human labour and irrigation are raised, production will grow as well. The total of the regression coefficients of the variables human labour, machine labour, seed, and irrigation is less than one in the urad and wheat crop cultivation, *i.e.* bi = 0.6412 and 0.4199. It means that there decreasing returns to scale in this condition. As a result, to use of resources is not optimal, they must be used in lesser quantities.

The Marginal Value Productivity of Cultivated Crops

The results related to the marginal value product (MVP) of soybean are given in Table 2. The difference between marginal value productivity (MVP) and marginal factor cost (MFC) for irrigation was found positive and significant in the case of the soybean crop, indicating that the resource was underutilised and that more of these inputs could be used to increase soybean productivity. However, the difference in MVP for human labour was negative but significant and less than its price, indicating that the resource was over-utilized and that the quantity of human labour needed to be reduced for improving soybean cultivation profitability. The difference between MVP and MFC of machine labour and seed resources was found negative and non-significant in the study area.

The difference between marginal value productivity (MVP) and marginal factor cost (MFC) in the case of urad crop machine labour and seed both resources were found to be positive and significant, indicating that the resources were underutilised and that more of these inputs might be employed to boost urad productivity. According to a study by Dauda *et al* (2014) the ratio of resources like farm size, seed material, and fertilizer were underutilized because their ratio was greater than 1 while family and hired labor ratio of MVP/MFC shows over utilization which means all resources were no efficiently utilized in the study area. The difference in MVP and MFC for human labour, on the other hand, was negative, non-significant,

Table 3. Marginal value of productivity (MVP) of various inputs in urad cultivation.

Particulars	Human Labour	Machine Labour	Seed	Irrigation
MVP	0.0994	3.1391	13.4905	1.6415
Price	1.0000	1.0000	1.0000	1.0000
Difference	-0.9006	2.1391*	12.4905*	0.6415
SE of MVP	0.1168	0.0363	0.0773	0.0795

** shows the significance level at 1 percent*

Table 4. Marginal value of productivity (MVP) of various inputs in wheat cultivation.

Particulars	Human Labour	Machine Labour	Seed	Irrigation
MVP	2.0546	2.5304	-1.5687	0.0245
Price	1.0000	1.0000	1.0000	1.0000
Difference	1.0546	1.5304*	-2.5687	-0.9755
SE of MVP	0.4132	0.0363	0.0444	0.0042

** shows the significance level at 1 percent*

and less than its unit price (MFC). The difference between MVP and MFC of irrigation was found to be positive and non-significant.

The difference between marginal value productivity (MVP) and marginal factor cost (MFC) for machine labour was found positive and significant in the case of the wheat crop, indicating that the resource was underutilised and that more of these inputs could be used to increase wheat productivity. However, the difference in MVP and MFC for seed and irrigation was negative but non-significant, and for human labour it was positive and non-significant in the study area. Seed and irrigation were also found positive and non-significant in a study done by Singh *et al* (2020).

The difference between MVP and MFC for seed and irrigation was found positive and significant in the case of gram crop, indicating that the resource was underutilised and that more of these inputs could be used to increase gram productivity. However, the difference in MVP for human labour was positive but significant and less than its unit price, indicating that the resource was over-utilized and that the quantity of human labour needed to be added for improving gram cultivation profitability. The difference between MVP and MFC of machine labour was found negative and non-significant in the study area.

CONCLUSION

The sum of the regression coefficients of factors namely human labour, machine labour, seed, and irrigation in the soybean and gram crop situations were found to be almost one. It implies that the scale of returns is constant. Furthermore, the components are being fully utilised, and if positive and significant variables like human labour and irrigation are increased, productivity will increase as well. In the urad and wheat crop cultivation, the total of the regression coefficients of the selected variables human labour, machine labour, seed, and irrigation is less than one. In this case, it means that the returns to scale are declining. As a result, to use of resources is not optimal, they must be used in lesser quantities. For irrigation the efficiency was found positive and significant in the case of the soybean crop, indicating that the resource was underutilised and that more of this input could be used to increase soybean productivity. For urad crop machine labour and seed resources were found

Table 5. Marginal value of productivity (MVP) of various inputs in gram cultivation.

Particulars	Human Labour	Machine Labour	Seed	Irrigation
MVP	1.5186	-0.4847	2.2495	6.0672
Price	1.0000	1.0000	1.0000	1.0000
Difference	0.5186*	-1.4847	1.2495*	5.0672*
SE of MVP	0.1167	0.0653	0.0802	0.0656

** shows the significance level at 1 percent*

to be positive and significant, indicating that the resources were underutilised and that more of these inputs might be employed to boost urad productivity. Machine labour was found positive and significant in the case of the wheat crop, indicating that the resource was underutilised and that more of these inputs could be used to increase wheat productivity. It was found that seed and irrigation were positive and significant in the case of gram crop, indicating that these resources were underutilised and that more of these inputs could be used to increase gram productivity. Meeusen and Broeck (1977) revealed no relationship between the efficiency phenomenon and the other structural characteristics of the production process. These results could be helpful for the government to give credit and subsidy to the farmers and policymakers to frame the policy related to resources used in the production process.

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