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Resource Use Efficiency of Sustainable Farming Practice: A study of Maize and Rajmash Intercropping under North-Western Himalayan Region of J&K

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ABSTRACT

The Himalayan region extends all along the Northern boundary of India. The diverse eco-habitat of Himalayan region hosts a wide range of plant diversity as well as crop diversity on which native people rely for their food and nutritional security. Keeping in mind the end goal to expand the yield of crops and improve the livelihood security of hill farmers, distinctive frameworks have been identified, one of these frameworks is intercropping. The present study has been carried out under North-Western Himalayan region of J&K state. Bhaderwah and Bhalla blocks of Doda district of the state were selected purposively as these two blocks are having maximum area and farmers under maize and rajmash intercropping in the district. A sample of 100 farmers was drawn using multistage sampling technique. Cobb-Douglas production function and marginal value productivity (MVP) were the analytical tools used in analyzing the data. The results of the study revealed that elasticity coefficients of human labour (0.621) and manure & fertilizers (0.467) were positively significant at 5 per cent and 1 per cent, respectively while seed (-0.474) gave a significant negative elasticity coefficient. The coefficients for machine labour (0.125) and plant protection chemicals (0.413) were found to be statistically insignificant. The significant value of R^2 (0.88) indicated that the explanatory variables included in the model explained 88 per cent variation in the dependent variable (gross returns). The positive value of MVP for human labour and manure & fertilizers showed that additional one rupee spent on these inputs would add Rs. 3.172 and Rs.5.274, respectively while the negative MVP value of seed (-3.251) indicated that use of this input was more than the optimum and would decrease the gross returns with each additional unit of this input.

Key words: *Cobb-Douglas production function, Marginal value productivity, Elasticity*

INTRODUCTION

Intercropping means the simultaneous cultivation of more than one species in the same field which often results in a more efficient utilization of resources, more stable yields and a method to reduce problems with weeds, plant pathogens and nitrogen losses. Intercropping is a way to restore diversity in an agricultural ecosystem and helps in sustainable agricultural production.

Intercropping is a crop management system involving two or more economic species growing together for at least a portion of their respective production cycles and planted significantly close to each other so that inter-specific competition can occur[8]. In advanced as well as developing countries, intercropping plays a vital role for subsistence food production. The main advantage of intercropping is increasing production per unit area compare to a single cultivation due to the better use of environmental factors such as light, water and nutrients in the soil. It tends to give higher yield than sole crops, greater yield stability and efficient use of nutrients[6]. To accelerate sustainable intensification of agricultural production, it is required to develop intercropping systems that are very profitable and stable under conditions with abiotic imperatives (water, supplements and climate). Agricultural planners have taken attention to intercropping systems, which decrease inputs use in sustainable agriculture by exploiting natural resources more effectively[4]. Cereals and legumes intercropping have become a popular combination among farmers probably due to the ability of legumes to combat erosion and raise soil fertility levels[3]. Integral effects of intercrops can be expressed as complementary use of resources, accordingly reducing competition between crop species and enhancing greater acquisition of limiting resources[2].

In Jammu & Kashmir, maize and rajmash intercropping is an important component of farming system to ensure livelihood status of farmers. Maize is one of the most important food crops in the world. It is the highest yielding crop with multiple uses for food and industrial purposes and is considered as the queen of the cereals. Maize is one of the most important food and strategic crops and rajmash is rich in protein, so they can produce a complete starch and protein food per unit area according to their physiological and morphological characteristics. The North-Western Himalayan region of J&K exhibits a great variation in the agro-climates and indicates the inherent agriculture potential for cultivation of rajmash crop[1]. Singh and Singh[7]. obtained higher net return (Rs. 10032 /ha) and gross return (Rs. 11941 /ha) with maize + rajmash (1:2) intercropping system. Padhi[5] observed that an intercropping of maize with rajmash realized higher net return (Rs. 12,677 /ha) and B: C ratio compared to other intercropping systems. In J&K, the main districts where maize and rajmash intercropping is done are Doda, Poonch, Rajouri, Udhampur, Ramban, Kathua and Reasi districts and dry temperate areas of Kishtwar district. However, unfortunately there is, at present, no proper and economically viable inter-cropping system in practice. Some of the notable problems related to maize and rajmash intercropping in the study area includes small farm size, inappropriate decision on how best to allocate resources, tools are simple and hand operated, very limited mechanization etc. Therefore, it is important to examine the resource use efficiency in the maize and rajmash intercropping system. This will be used to determine the direction of resource adjustments that could lead to higher productivity and income.

Keeping in view these facts, the present investigation was attempted with the objective to study the resource use efficiency of maize and rajmash intercropping in the Doda district of J&K state. In order to guide the present study, the null hypothesis was that, the intercropping in the study area is resource efficient.

MATERIAL AND METHODS

The present study was carried out in Doda district of J&K state purposively as this district is one of the major districts which practice maize and rajmash intercropping in North-Western Himalayan region of J&K state. Multistage sampling technique was used to select the ultimate sample size. At the first stage of sampling, two blocks namely, Bhaderwah and Bhalla were selected purposively as these two blocks are having maximum area and farmers under maize and

rajmash intercropping in the district. At the second stage of sampling, five villages from each block were selected randomly. Further, at the third stage, ten farmers from each village were selected randomly to constitute a sample size of 100 farmers in total. The data on the use of various resources were collected by interviewing the farmers directly through a pre-tested schedule. Thereafter, for examining the resource use efficiency, Cobb-Douglas production function was used. The fitted Cobb-Douglas production function for the present study with five input variables is given below:

$$\text{Est. Y} = a_0 X_1^{b1} X_2^{b2} X_3^{b3} \ldots X_5^{b5}$$

Where,

Y represents Gross returns (₹/ha)

X_1 represents Human labour (₹/ha)

X_2 represents Machine labour (₹/ha)

X_3 represents Cost of Seed (₹/ha)

X_4 represents Manure & fertilizers (₹/ha)

X_5 represents Plant protection chemicals (₹/ha)

$b_1 \ldots b_5$ are estimated regression coefficients.

In order to find out the productivity of different inputs used in maize and rajmash intercropping, marginal value productivity (MVP) of inputs was estimated as:

$$\text{MVP (X}_i) = b_i \frac{Y(G.M.)}{X_i(G.M.)}$$

Where,

MVP (X_i) is the marginal value productivity of ith resources

b_i is the regression Coefficient (estimated)

G.M. (Y) is the Geometric Mean of Output (yield)

G.M. (X_i) is the Geometric Mean of ith resources.

RESULTS AND DISCUSSION

The role of efficiency has been widely recognized by researchers and policy makers in increasing agricultural output. If the farmers are unable to make efficient use of the existing resources, the productivity and income of farmers cannot increased. For the present study, the results of the estimated Cobb-Douglas production function and MVPs of inputs has been presented in Table1 and 2.

The results in the Table 1 revealed that various factors of production viz. human labour, machine labour, seed, manure & fertilizers and plant protection chemicals as explanatory variables has significant contribution in the dependent variable (gross returns) as indicated by the significant value of R^2 (0.88). This means that 88 per cent variation in the dependent variable is explained by the explanatory variables included in the model. The results further revealed that human labour and manure & fertilizers was found to be significant at 5 per cent and 1 per cent level of significance, respectively which indicated that one per cent increase in investment on these resources would increase the gross returns of maize and rajmash intercropping by 0.621 per cent and 0.467 per cent, respectively. The coefficient of seed (-0.474) was negative and statistically significant which indicated that at present, this input is being excessively used and additional use of this input should be checked immediately as 1 per cent additional use of this input would decrease the gross returns by 0.474 per cent. Machine labour and plant protection chemicals were not significant but had positive coefficients, indicating a direct relationship with the dependent variable. The significant positive value of F (114.26) indicated that all the explanatory variables taken together have a significant effect on the dependent variable (Y).

Table 1: Estimation of resource use efficiency from Cobb-Douglas production function analysis

Sr. No.	Inputs	Coefficients	Standard Error
1.	Constant (α)	3.385	3.125
2.	Human labour (X_1)	0.621*	0.304
3.	Machine labour (X_2)	0.125	0.195
4.	Seed (X_3)	-0.474*	0.235
5.	Manure and Fertilizers (X_4)	0.467**	0.121
6.	Plant protection chemicals (X_5)	0.413	0.539
7.	Coefficient of Determination (R^2) = 0.88** F-Value = 114.26**		

*, ** indicates 5% and 1% level of significance, respectively.

These findings do not support our null hypothesis that, intercropping in the study area is resource use efficient, hence, null hypothesis is not accepted which implies that there exists further scope for efficient utilization of available resources in the study area.

The results related to marginal value productivity in Table 2 indicated that additional one rupee spent on human labour and manure & fertilizers would add Rs. 3.172 and Rs.5.274, respectively to gross returns implies that there existed a scope to invest more on these inputs. The negative MVP value of seed indicated that use of this input was more than the optimum and would decrease the gross returns with each additional unit of this input. The MVP estimated for machine labour and plant protection chemical revealed that additional one rupee spent on these inputs, could increase the gross returns by Rs.1.865 and Rs. 8.961, respectively.

Table 2: Marginal value productivity (MVP) of different inputs used in maize and rajmash intercropping

Sr. No.	Variables	MVP
1.	Constant (α)	-
2.	Human labour (X_1)	3.172
3.	Machine labour (X_2)	1.865
4.	Seed (X_3)	- 3.251
5.	Manure and Fertilizers (X_4)	5.274
6.	Plant protection chemicals (X_5)	8.961

CONCLUSIONS

The study has shown that there exists further scope for utilization and investment on human labour and manure & fertilizers chemicals as coefficient and marginal value productivity of these variables was found positive and statistically significant. However, the use of seed in the study area is more than optimum, which should be checked to avoid decrease in the gross returns. Machine labour and plant protection chemicals were not significant but had positive coefficient, indicated direct relationship of these variables with the dependent variable.

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