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Resource Use Efficiency of Mustard and Bengalgram Cultivation in Paddy Fallows in Raichur District

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ABSTRACT

The present study was undertaken in Raichur district of NEK region to analyse the resource use efficiency of mustard and Bengal gram cultivation in paddy fallows. The data collected from 90 farmers of mustard and 60 farmers of Bengal gram by using multistage random sampling technique. Resource use efficiency was analyzed using Cobb-Douglas production technique with five variables, namely, seed, fertilizer, human labor, machine labour and Plant protection chemicals (PPC). The results of the study showed that seeds, fertilizer and human labor were significant at 1 percent whereas,only human labour was significant at 1 percent. The results also revealed that MVP to factor price ratio for fertilizer (0.47), machine labor (-4878.15) and PPC(-1.00) were less than one, suggesting these resources were over utilized in the cultivation of mustard by the farmers. In Bengal gram cultivation, seed (0.76) and PPC (-1.00) were over utilized by the farmers. In mustard cultivation, seed (1809.71) was underutilized and in Bengal gram cultivation, fertilizer and machine labors were underutilized. Findings suggested higher scope for higher seed rate in Mustard and higher application of fertilizer and machine labours in Bangal gram cultivation in paddy fallows in the study area.

Keywords: Paddy fallows, mustard cultivation, Bengal gram cultivation, resource use efficiency, allocative efficiency

Mustard is an essential edible oils seed crop in India after groundnut both in area and production, meeting the 50 percent of the population of the oil requirement of the states of Utter Pradesh, Punjab, Rajasthan, Madhya Pradesh, West Bengal, Orissa, and Assam. India is one of the largest producers of mustard in the world. The production of mustard in India is around 16.2 million tonnes which accounts for 18% of the total oil seed production of the world. Mustard is the major *Rabi* oil seed crop of India. Mustard accounts for nearly 30 percent of the total oilseeds produced in the country. India, the area under mustard cultivation was 5762 hectares with production of 6821 tons and productivity of 1184 Kg/ha. Indian mustard (*Brassica juncea*) is significantly

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cultivated in Rajasthan, Gujarat, Haryana, Madhya Pradesh, and Uttar Pradesh, contributing to 81.5 percent of the area and 87.5 percent of production. The highest productivity states in India are Gujarat (1396 kg/ha), Haryana (1343 kg/ha), and Rajasthan (1185kg/ha). Rajasthan is the largest mustard producer in the country, with a contribution of (54%) to the country's total mustard production, followed by Punjab and Haryana, which simultaneously contributes (14%) in India (D.E.S, New Delhi, 2014).

The role of pulses in Indian agriculture needs hardly any emphasis. India is a premier pulse-growing country in the world. The pulse is an integral part of the cropping system of all over the country because of these crops fit in well in the crop rotation and crop mix followed by them (Ganeshkumar *et al.*, 2013). Bengal gram is the primarily produced pulse crop in India and is cultivated in 10.56 m. ha with the production of 11.37 mt. Bengal gram is mainly cultivated in Madhya Pradesh (4.5 mt), Maharashtra (1.8 mt), Rajasthan (1.6 mt), Andhra Pradesh (0.58 mt), Karnataka (7.83 mt), Uttar Pradesh (5.78 mt), and Gujarat (33.7 mt).

In Kalyan Karnataka (KK) region, mustard and Bengal gram are growing in the paddy fallows in the *rabi* season because of a lack of water availability for paddy cultivation in the subsequent season. Along with these crops, bajra, and foxtail millets are also being practiced in KK region. To take advantage of available residual moisture and supplement their income, farmers in the Raichur district are mainly growing the mustard and Bengal gram crop in the paddy fallows, and it is also evidenced that area under these crops is increasing in the KK region in general and Kalyan Karnataka in particular (Ramesh *et al.*, 2017). However, no information/limited information available on resource use, efficiency, and economics of cultivation which is otherwise very important for the farming community. Thus, the paper analysis the resource use efficiency of mustard and Bengal gram cultivation in the Paddy fallows of the Raichur district of KK region.

MATERIALS AND METHODS

The present study was undertaken in the Raichur district of Karnataka state. Raichur district is situated between 15˚09′ and 6˚34′ North latitude and 75˚46′ and 77˚35′ East longitude and in between two major rivers, namely Krishna and Tunga bhadra.

Sampling and data collection

The paper analyzes the data collected from a sample 150 farmers, which constituted 90 mustard farmers and 60 bengal gram farmers who raised these crops in paddy fallows. The multistage stratified random sampling technique was used for the collection of data. In the first stage, the Raichur district was selected as the district is reported to have the highest area under mustard as per anecdotal evidence and concerned officers at state and district officials. In the second stage, three taluks, namely Manvi, Sindhanur and Raichur, were selected based on the highest area under mustard in paddy fallows. In the third stage, 9 villages (3 villages from each *taluk* were selected. Sample mustard and Bengal gram farmers were post classified into three groups vis.,small farmer with 2.5 to 5 acres of land, medium farmers with 5 to 25 acres of land, and large farmers with more than 25 acres of land, respectively, to understand the socio-economic differences across the subgroups. The selected farmers were interviewed randomly to get the required information regarding mustard and Bengal gram crop production.

Analytical tools and techniques used

The empirical proofs from previous studies suggest that among the many mathematical functions, log-linear form of Cobb-Douglas production function is the most appropriate one to analyze the resource use efficiency in crop production (Dhakal *et al.*, (2015). Hence, the following form of the Cobb-Douglas production function is used for analysis.

Functional form: $Y = aXi^{bi} e^{u}$

Where,

Y = Output (Returns); a = Constant or intercept of the function; Xi = Independent/Explanatory variable; bi = Regression coefficient; e^{u} = Error term × 1= Seed (Kg); X_2 = Fertilizer (Kg); X_3 = Human labour (₹); X_4 = Machine labour (Hrs); X_5 = Plant protection chemicals; b_1 to b_5 = Production elasticities or Regression coefficients of respective resources X_1 to X_5.

In this functional form, Y is the dependent variable and X_1, X_2, X_3, X_4 and X_5 are independent variables considered on a per-acre basis. The regression coefficients obtained from this function are called elasticities of production. The sum of the regression coefficients indicates the returns to scale.

Estimation of MPP and MVP

The MPP of different inputs was estimated by taking the first order partial derivative of output (Y) with respect to concerned input appearing in the production function.

$$Y = X_1 b_1 X_2 b_2 X_3 b_3 X_4 b_4 X_5 e^u$$

MPP of X_1 is $Dy/Dy_1 = ab_1 X_1 b_1 - 1 X_2 b_2 X_3 b_3 X_4 b_4 X_5 b_5 e^u$

$Dy/dx_1 = bi$

(i) Marginal Physical Product (MPP)

$MPPxi = bi$

Where,

bi = Regression co-efficient of particular independent variable,

xi = Geometric mean of independent variable,

(ii) Marginal Value Product (MVP)

MVP_{xi} = Price per unit of output

(iii) Marginal Factor Cost (MFC)

MFC_{xi} = Price per unit of input

Resource use efficiency

After estimating the MVP, the resource use efficiency of different resources judged with the help of MVP to factor cost (Px) ratio as under,

MVP/MFC = 1 signifies optimum use of resource

MVP/MFC < 1 indicates Excess utilization of resource

MVP/MFC > 1 means Under utilization of resource

RESULTS AND DISCUSSION

Resource use efficiency in mustard and Bengal gram production

Estimated values of coefficients and related statistics of Cobb-Douglas production function for mustard are shown in Table 1. The dependent variable in the regression analysis was gross return realized per acre from mustard and Bengal gram while seeding, fertilizer, human labor, machine labor and PPC were independent variables.

Out of five independent variables included in regression analysis in mustard production, seed, fertilizer, and human labor were found to be significant at 1 percent. The regression coefficient for seed was 0.69, which indicated a 1 percent increase in the seed use in the production to increase in the gross return by 0.69 percent. Similarly, an increase in fertilizer use by 1 percent, lead to increase in the gross return by 0.06 percent. Concerning human labour, 1 percent increase in the use of human labor would increase the gross returns by 0.07 per cent. Similarly, Dhakal *et al.*, (2015), using Cobb-Douglas production function, reported human labor and fertilizer as a significant factors on mustard production in Chaitwan district of Nepal.

The regression coefficients of machine labor (-0.45) and PPC (-0.01) were negative and-significant indicating no scope to increase these resources.

The resource use efficiency analysis of bengalgram production suggests that, regression coefficient for human labor (0.45) was positive and significant at 1 per cent level in Bengal gram cultivation. The regression co efficient for human labour was 0.45, which had indicated that 1 per cent increase in the use of human labor would increase the gross return by 0.45 percent. Similar results were observed by Sable Vivekanand (2011) that the regression coefficient for human labor was a positive and significant factor in Bengal gram production in the Amaravati district of Maharashtra.

The regression coefficient for PPC (-0.01) was negative but significant at 1 per cent level. The regression coefficient for PPC was -0.01, which indicated that 1 percent increase in PPC would decrease the gross return by -0.01 per cent. The regression coefficient of seed (0.04), fertilizer, and machine labor (0.01) was positive but non-significant, indicating that, there is scope to increase in the use of these resources to get more gross returns in Bengal gram cultivation.

The sum of the regression coefficients of different inputs used was 0.35 for mustard production. This indicated that the production function exhibited a decreasing return to scale, implying that, if all the

Table 1: Resource use efficiency of mustard and Bengal gram

Sl. No.	Resources	Mustard			Bengalgram		
		Coefficients	Std error	t-value	Coefficients	Std error	t-value
1	Intercept	10.80**	4.73	2.28	5.81*	0.85	6.82
2	Seed (Kg)	0.69*	0.10	6.80	0.04	0.12	0.33
3	Fertilizer (Kg)	0.06*	0.02	3.35	0.00	0.01	0.64
4	Human labour (₹)	0.07*	0.01	5.03	0.45*	0.09	4.84
5	Machine labour (Hrs)	-0.45	0.73	-0.62	0.01	0.12	0.12
6	PPC (₹)	-0.01	0.01	0.22	-0.01	0.00	-2.69
7	F value	44.68*			184.01*		
8	R square	0.73			0.94		
9	Adjusted R square value	0.71			0.94		
10	Return to scale	0.35			0.50		

inputs specified in the function are increased by 1 percent, the gross income will increase by 0.35 percent. In the case of Bengal gram production, the sum of regression coefficients of different inputs was 0.50. This also indicated decreasing returns to scale implies, I fall the inputs increased by 1 percent, the gross income would increase by about 0.50 percent. This shows that returns to scale in Bengal gram production were relatively higher than mustard production. The sum of all coefficients used was less than unity indicates decreasing returns to scale. These findings are in line with the study of Singh *et al.*, (2018).

It can be concluded from the resource use efficiency analysis that, seeds, fertilizers and human labor were efficiently utilized in mustard cultivation, as the coefficient of this variables positive andsignificantat1percent—While only human labour was efficiently utilized in Bengal gram cultivated.

Coefficient of multiple determination (R^2) was used to express the variation of gross return by factors included in the production process, which was 0.73 for mustard production. This indicates that 73 percent of variations in the gross returns were expressed by independent variables included (seed, fertilizer, human labor, machine labor and PPC) in the mustard production. The coefficient of multiple determination (R^2) for Bengal gram cultivation was 0.94, which implies 94 percent of variations in the gross returns of Bengal gram production were explained by independent variables (seed, fertilizer, human labor, machine labor, and PPC) included in the Bengal gram production function.

The coefficients of F-test for mustard (44.68) and Bengal gram (184.01) were significant at a 1 percent level, indicating a good fit of both the model for estimating the coefficients.

Allocative efficiency of resources in mustard production

To see whether the resources used in mustard production were correctly allocated or not, Marginal Value Product (MVP) to factor price ratio was worked out, and the results are presented in Table 2.

Among the inputs used in the production of mustard, if the MVP to factor price (Px) ratio is more than one, then it indicates the underutilization of the resources; if MVP to factor price (Px) ratio is less than one, it indicates the excess utilization of resources. At an overall level, findings suggested that seed (1809.71) was underutilized in the production of mustard. It implied that more profit could be obtained by increasing their use level, indicating the scope to increase the use of this resource. MVP to MFC ratio for human labor (1.00) indicated optimal resource use. MVP to MFC ratio for fertilizer (0.47), machine labor (-4878.15) and PPC (-1.00) indicated the excess use of the resources. Analysis infers that they were lacking in commercial latitude in cultivating mustard. They needed to reallocate available resources to increase the returns from cultivating mustard by proper management of resources.

Table 2: Allocative efficiency of resources in mustard production

Resource	Geometric mean	MPP	MVP	Factor price (Px)	MVP/P* Ratio
Seed (Kg)	1.55	2412.95	180971.16	100.00	1809.71
Fertilizer (Kg)	26.47	13.20	79.18	170.00	0.47
Human labour (₹)	263.29	0.07	—	—	1.00
Machine labour (Hrs)	0.50	-4878.15	-1585397.90	325.00	-4878.15
PPC (₹)	266.52	-0.01	—	—	-1.00

Note: MPP: Marginal physical product, MVP: Marginal value product.

Table 3: Allocative efficiency of resources in Bengalgram production

Resource	Geometric mean	MPP	MVP	Factor price (Px)	MVP/P*Ratio
Seed (Kg)	28.76	17.56	614.77	804.30	0.76
Fertilizer (Kg)	46.50	1.19	47.70	40.60	1.17
Human labour (₹)	2285.08	0.45	—	—	1.00
Machine labour (Hrs)	1.96	90.15	37864.15	810.00	46.75
PPC (₹)	1628.33	-0.01	—	—	-1.00

MPP: Marginal physical product, MVP: Marginal value product

It is revealed from table 2 that a marginal product with respect to seed was ₹ 2412.94. It implied that in addition of one unit seed to the geometric mean the other returns of mustard would be ₹ 2412.94. Similarly, adding one unit of fertilizer to the geometric mean, the other returns of mustard would be ₹ 13.20.

It can be said from the above analysis that the seed was underutilized, thus indicating the scope for increase in the use of this resource to obtain the optimum returns in mustard cultivation.

Allocative efficiency of resources in Bengalgram

The results in the Table 3 depicted that, among the inputs used for the production of mustard, which have a positive and significant influence at the farmer's level, if the MVP to factor price (*Px*) ratio is more than one, indicated the underutilization of the resources. The MVP to factor price (*Px*) ratio is less than one, indicating the excess utilization of resources. At the overall level, the ratio for machine labor (46.75) and fertilizer (1.17) indicated the underutilization of resources in production. It implied that more profit could be obtained by increasing their level of use and indicated that there was scope to increase the resource use. With regard to ratios of seed (0.76) and PPC (-0.01) indicated the excess utilization of resources in the Bengal gram production. Whereas optimum utilization of human labor (1.00) was seen.

It is revealed from Table 3 that the marginal product for seed, fertilizer, and human labor and machine labor were ₹ 17.56, ₹ 1.19, ₹ 0.45, and ₹ 90.15, respectively. It was inferred that the addition of one unit of seed, fertilizer, human labor, and machine labor to geometric mean the gross return would increase by ₹ 17, ₹ 56, ₹ 1.19, ₹ 0.45, and ₹ 90.15 respectively. The findings are in line with the study by Dalvi *et al.,* (2018).

It is revealed from the above analysis that the seed and PPC were underutilized, thus indicating the scope for increase in the use of these resources to get the optimum returns in Bengal gram cultivation.

CONCLUSION

Mustard is an important oilseed crop in India. The consumption of mustard oil is largely seen in the northern part of India. Mustard and Bengal gram cultivation in paddy fallows in the KK region is increasing has been increased in recent years to take advantage of residual moisture available in the field. Five variables were used in the functional analysis, namely, seed (X_1), fertilizer (X_2), human labor (X_4), machine labour and PPC (X_4), for analyzing the resource use efficiency. The functional analysis was observed as decreasing returns to scale. The high value of R^2 of 0.73 and 0.94 for mustard and Bengal gram, respectively, indicate 73 and 94 percent variations in the returns explained by included factors. X_1, X_2 and X_3 variables were found statistically significant in mustard production, and X_3 variable was found statistically significant in Bengal gram production. The value of MVP for X_1 was observed to be more than unity in mustard production, and fertilizer and PPC were observed to be more than unity indicating more scope for increasing these factors to obtain the optimum returns. The findings infer higher scope for higher seed rate in Mustard and higher application of fertilizer and machine labors in Bangal gram cultivation in paddy fallows in the study area enhance the income of the farming households in the study area.

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