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Resource productivity and resource use efficiency in pulses production on medium farm in Marathwada

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ABSTRACT

The study of resource productivity; resource use efficiency and optimum resources used with respect to various explanatory variables in pulse crops pigeonpea and green gram was undertaken on medium farm during agricultural year 2005-06 in Marathwada region of Maharashtra. The data was taken from cost of cultivation scheme Marathwada Agricultural University, Parbhani the sample of 100 medium farm size farmers throughout the zone was tabulated and analyzed by appropriate statistical tools. The result revealed that, in case of pigeonpea area and bullock labour was positive and significant at 1 and 5 per cent level, respectively. Coefficient of multiple determination was (R^2) 0.70 which indicated 70 per cent variation in independent variable, the sum of elasticity was 0.83 which indicated that decreasing return to scale. With regard to green gram area was positive and significant at 1 per cent level, the sum of elasticity was 1.01 per cent which indicated increasing return to scale coefficient of multiple determination was 0.86 which indicated that 86 per cent variation in explanatory variable.

Key words : Pigeonpea, Green gram, Production function, Resource use efficiency.

INTRODUCTION

Agricultural sector, at present provides livelihood about 65 to 70 per cent of the total population. The sector provides employment to 58.4 per cent of country's workforce and is the single largest private sector occupation. According to agricultural census (2000-01), percentage of area of medium farm to total farm in India is 25.35 per cent, in Maharashtra 32.74 per cent and in Marathwada region a land holding under medium farm is 27.7 per cent.

The geographical area of India is 329 million hectares which contributes 2.4 per cent of the world area in which 141.10 million hectares under net sown area. The geographical area of Maharashtra state is 30.76 million hectares at which 22.25 million hectare under agricultural which contributes 72.40 per cent. The geographical area of Marathwada region is 6.44 million hectares. Out of which 6.13 million hectare area is under agriculture.

Pigeon pea is one of the food legumes grown and consumed extensively in South Asia, Africa and Latin America. India accounts for about 90 per cent of world production of pigeon pea. The total production of pigeon pea in India during 2001-2002 was 2.37 million tones and area under pigeon pea was 3.46 million hectares. (Singhal, 2003).

The crop productivity is largely dependent upon the resource use efficiency. However, resource use and productivity in one or the other way are related to farm size. The relationship between farm size and productivity is dependent upon many factors like fertility, tenurial arrangement, managerial efficiency, cropping pattern, type of soil, intensity of input uses, agricultural prices, marketing policies, and governmental policies etc. which are not under direct control of the cultivators.

Keeping these points in view the study was undertaken in Marathwada region with a specific objective *i.e.* resource productivity and resource use efficiency in pulse crops.

MATERIALS AND METHODS

Marathwada region of Maharashtra was purposively selected in order to study the farm business analysis. Multiple stage sampling design was used for selection of zone, tehsils, villages and farms. Twenty eight tehsils under the assured rainfall zone were selected from the eight districts of region because of their involvement in cost of cultivation scheme. From each cluster villages, two farmers of medium categories were selected. Thus, total 100 sample farms were selected. Data pertain to the year 2006-07.Technique like tabular analysis, budgeting technique, non-linear and multiple regression analysis, frequency and percentage method were used to analyze the data.

Strong inter-correlations among independent variables were identified for solving problem of collinearity in estimating production function. The variables which had non-significant correlation significant with respect to pigeon pea and green gram production were also dropped in estimating production function. Thus for pigeonpea and green gram seven independent variables were included in both linear and Cobb-Douglas production functions. On the basis of goodness of fit (R^2), Cobb-Douglas production function was found to be the best fit to the data to estimate the resource productivity, resource use efficiency and

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optimum resource use. The fitted equation is as follows:

$$Y = aX_1^{b1}.X_2^{b2}.X_3^{b3} \text{ ——— } X_n^{bn}.e^u$$

where, Y = production of pulses kg/ha), a=intercept, b_i = partial regression coefficient of specific resource (i=1,2,…..,6),X_1=area of crop(ha/farm), X_2=Hired human labour (man day/farm), X_3=Bullock labour, X_4=seed(kg/farm), X_5 =nitrogen(kg/farm), X_6 =phosphorus (kg/farm), X_7=family labour(man day/farm), and e= error term. The function was transformed into log-linear form as follows:

$$\text{Log}Y = \log a + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 \text{ ——— } b_n \log X_n + u \log e$$

RESULTS AND DISCUSSION

Estimates of Cobb-Douglas production function in pigeonpea production:

Regression coefficient with respect to various independent variables was estimated and is presented in Table 1. It evident that elasticity of land resource was positive (0.46) and significant at 1 per cent level indicating that there is scope to increase the land resource under pigeonpea cultivation. The elasticity of bullock labour was positive and significant at 5 per cent level. There is scope to increase its unit mean as 1 per cent increase in use of bullock pair there will be increase in production of pigeon pea by 0.33 per cent. Hired human labours and nitrogen's regression coefficient was positive but non significant indicating that there is scope to increase use of hired human labour and nitrogen for maintaining good growth of plants. Seed, phosphorus and family labour have negative regression coefficient and non significant indicating that there is no scope to increase amount of these resources. Coefficient of multiple determination (R^2) was 0.70 which was implied that 70.00 per cent variation in pigeonpea production was explained due to variation in all independent variables. 'F' value was highly significant (13.23). The sum of regression coefficients was 0.83 which indicated that decreasing return to scale.

Resource use efficiency, resource productivity and optimum resource use with respect to various independent variables were calculated and are presented in Table 1. It is revealed from table that marginal productivity with respect to area of pigeonpea was highest as 3.94 quintals followed by bullock labour; hired human labour and nitrogen were 0.194, 0.025 and 0.022, respectively. It was inferred that if area of pigeonpea increased by 1 per cent the production would increase by 3.94 quintals. Similarly, as per unit increase in bullock labour, hired human labour and nitrogen there will be increase in production by 0.194, 0.025 and 0.022 quintals, respectively.

In case of resource use efficiency, it is also evident from Table 1, that pigeonpea production indicated highest MVP to price ratio (3.38) followed by bullock labour (2.21). The MVP to price ratio of nitrogen was 4.04 which could be greatly use for increased production of pigeonpea.

In case of optimum resource use, it was observed that area was optimum as 2.60 hectares followed by bullock pair 26.06 pair day.

Estimates of Cobb-Douglas production function in green gram production:

Regression coefficient with respect to various explanatory variables were calculated with 't' values and are presented in Table 2. It was observed that regression coefficient of area under green gram production was 1.25 which was positive and highly significant at 1 per cent level. It was inferred that if 1 per cent increase in area, over its geometric mean, it would lead to increase green gram production by 1.25 per cent. Family labour and hired human labour were negatively significant which indicated that there were excessively use of human labour in cultivation of green gram. Seed, bullock labour and phosphorus were positive but non significant. Nitrogen was negative and non significant. Coefficient of multiple regression determination (R^2) was 0.86 which indicated that 86.00 per cent variation in green gram production was explained due to variation in all independent variables. 'F' value was highly significant (27.36). It was clear that each explanatory variable on its own was not very important but together they explained significantly part of variation in green gram production. The sum of regression coefficients was 1.01 which indicated increasing return to scale.

Resource productivity, resource use efficiency and optimum resource use with respect to various independent variables were estimated and are also presented in Table 2. It is obvious from the table that marginal productivity with respect to area of green gram production was 6.24 quintals followed by phosphorus (0.129 q), bullock labour (0.109 q) and seed (0.047 q). It was inferred that if area of green gram production was increased by one hectare over its geometric mean level, it would lead to increase the production of green gram with 6.24 quintals. Similarly, per unit of phosphorus, bullock labour and seed was increased, it would cause to increase the production of green gram 0.12 q, 0.10 q and 0.479 q, respectively.

In regard to resource use efficiency, it was also evident from Table 2 that area under green gram production indicated the highest MVP to price ratio (6.44) followed by phosphorus (4.09), seed (3.35) and bullock labour (1.49) which were greater than unity. MVP to price

Table 1: Estimates of Cobb-Douglas production function for partial regression coefficients in returns to resource productivity, resource use efficiency and optimum resource use in pigeonpea (tur) production

Sr. No.	Independent variable	Partial regression coefficient (bi)	Standard error bi (SE)	't' value	Geometric mean of input (xi)	Marginal product (q)	Marginal value product (Rs.)	Price of input (Rs.)	MVP to price ratio	Optimum resource use
1.	Area of pigeonpea (ha/farm)	0.46	0.147	3.13**	0.77	3.94	8256.10	2437.15	3.38	2.60
2.	Hired human labour (man day/farm)	0.099	0.111	0.89	26.91	0.025	50.84	60.00	0.84	22.80
3.	Bullock labour (pair day/farm)	0.33	0.146	2.28*	11.74	0.194	388.46	175.00	2.21	26.06
4.	Seed(kg/farm)	-0.059	0.089	-0.67	8.51	-0.047	-95.81	40.00	-2.39	--
5.	Nitrogen (kg/farm)	0.063	0.097	0.65	19.05	0.022	45.70	11.30	4.04	77.04
6.	Phosphorus (kg/farm)	-0.005	0.013	-0.37	1.54	-0.022	-44.87	20.00	-2.24	--
7.	Family labour (man day/farm)	-0.058	0.113	-0.515	30.19	-0.013	-26.55	60.00	-0.44	--

Intercept (log a) 0.457
F value 13.23**
R^2 0.70
Return to scale (Σ bi) 0.83

NOTE : Geometric mean ($\overline{Y}$)of pigeon pea production was 6.91 q per farm and price was Rs.2000/q

* and ** indicates significance of values at P=0.05 and 0.01, respectively

Table 2 : Estimates of Cobb-Douglas production function for partial regression coefficients in returns to resource productivity, resource use efficiency and optimum resource use in green gram (mung) production

Sr. No.	Independent variable	Partial regression coefficient (bi)	Standard error bi (SE)	't' value	Geometric mean of input (xi)	Marginal product (q)	Marginal value product (Rs.)	Price of input (Rs.)	MVP to price ratio	Optimum resource use
1.	Area of Mung (ha/farm)	1.25	0.261	4.83**	0.779	6.24	13108.15	2033.35	6.44	5.02
2.	Hired human labour (man day/farm)	-0.326	0.150	-2.17*	14.79	-0.08	-180.06	60.00	-3.00	--
3.	Bullock labour (pair day/farm)	0.262	0.198	1.32	9.54	0.109	224.34	150.00	1.49	14.26
4.	Seed(kg/farm)	0.115	0.234	0.49	9.33	0.047	100.68	30.00	3.35	31.31
5.	Nitrogen (kg/farm)	-0.0016	0.019	-0.86	3.98	-0.0015	-3.28	11.30	-0.29	--
6.	Phosphorus (kg/farm)	0.0075	0.013	0.575	0.24	0.129	81.83	20.00	4.09	3.06
7.	Family labour (man day/farm)	-0.290	0.116	-2.49*	13.45	-0.083	-176.13	60.00	2.93	--

Intercept (log a) 1.07
F value 27.36**
R^2 0.86
Return to scale (Σ bi) 1.01

NOTE : Geometric mean ($\overline{Y}$)of green gram production was 3.89 q per farm and price was Rs.2000/q

* and ** indicates significance of values at P=0.05 and 0.01, respectively

ratio was greater than one that the resource could be increased.

In regard to optimum resource use, it was observed that area was optimum as 5.02 hectares, followed by phosphorus (3.06 kg), seed (31.31 kg) and bullock labour (14.26 days). It was implied that optimum resource use with respect to these variables was less than existing resource level.

Pigeonpea area and bullock labour were positive and significant at 1 per cent and 5 per cent level, respectively. Marginal productivity of area was 3.94 quintals and bullock labour was 0.194 quintals. MVP to price ratio was 3.38 for area and 2.21 for bullock labour which were greater than one which indicated that there was scope to increase

these resources. In case of optimum use, area and bullock labour was optimum as 2.60 hectares and 26.06 pair days during the year. Hired human labour and nitrogen were positive but non significant. Coefficient of multiple determination (R^2) was 0.70 which showed that 70.00 per cent variation in independent variables. The sum of elasticity was 0.83 which indicated decreasing return to scale. 'F' value was highly significant (13.23). Green gram area was positive and highly significant at 1 per cent level. The marginal productivity was 6.24 quintals mean if area increased by one hectare, production would increase by 6.24 quintals. The marginal value product was Rs.13108.15 and price of land was Rs.2033.35. MVP to price ratio was 6.44 which was greater than one means there was scope to increased land resources. Hired human labour and family labour were negatively significant which indicated that there was excessively use of these resources. 'F' value was highly significant (27.36). Coefficient of multiple determination (R^2) was 0.86 which indicated that 86.00 variation in explanatory variables. The sum of elasticity was 1.01 which indicated increasing return to scale.

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