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Resource productivity, resource use efficiency and optimum resource use in rainfed JKCH-666 cotton production

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ABSTRACT
Cotton (*Gossypium hirsutum* L.) has the important characters of high lint production and long staple length. JKCH-666 cotton is one of the intra-hirsutum hybrids. It is suitable to grow under rainfed condition. Investigation was carried out for the year 2003-04 in order to study the marginal productivity, economic efficiency and optimum resource use in JKCH-666 cotton production in Parbhani district of Maharashtra. Results revealed that regression coefficients of manure (0.141) and hired human labour (0.172) were highly significant at 1 per cent level while regression coefficients of phosphorus (0.062), area of JKCH-666 cotton (0.184) and bullock labour (0.142) were positive and statistically significant at 5 per cent level. Thus, it was inferred that these resources were under utilized and there was scope to increase them in the cotton production. The ratios of MVP to price with respect to above resources were higher than unity. Optimum use of resource, where value of the additional product would be equal to the cost of additional resource. So long as the specific return is more than the added cost, one should go on pushing up production till marginal cost become equal to marginal return.

Key words : JKCH-666 cotton, Rainfed farm, Marginal product, Resource use efficiency, Optimum resource.

INTRODUCTION

Cotton (*Gossypium hirsutum* L.) has the important characters of high lint production and long staple length. *Hirsutum* species is popularly known as American cotton. In the species, many intra-hirusutm hybrids are evolved. JKCH-666 cotton is one of the intra-hirsutum hybrids which has been evolved by Agri-Genetic Limited, Begmpet, Hyderabad. It is suitable to grow under rainfed condition. Plant type is compact, dwarf medium and leaf colour is dull green. Boll size is medium round to oval with boll weight of 5 g. The fibre length is 30 mm and proportionate lint is 36 per cent. In India, hirsutum hybrids are grown on an area of 2.80 million hectares which is 31.11 per cent to total area under cotton crop (Raje 1999). Hirsutum hybrids are mostly cultivated in Punjab, Haryana, Rajstan, Gujrat, Maharashtra, Madhya Pradesh, Tamilnadu and Karnataka. Parbhani district of Maharashtra has favourable climate for cultivation of hirsutum hybrids under rainfed condition. The district comes under assured rainfall zone with annual rainfall of 827 mm. Generally, pickings of seed cotton start in November and end in January. Since, no serious attempts has been made to identify key inputs and their contribution in JKCH-666 cotton production. The present investigation, therefore has been devoted to determine resource productivity, resource use efficiency and optimum resource allocation in JKCH-66 cotton production.

MATERIALS AND METHODS

Multistage sampling technique was used to select district, tehsil, villages and JKCH-666 cotton farms. In the first stage, Parbhani district was selected because of its predominance in area of cotton. The district contributes about 25.90 per cent of cotton area to its net cultivated area of 5.20 lakh hectares. In the second stage, on the basis of highest area under hirsutum hybrid cotton, Parbhani tehsil was selected for the present study. In the third stage, 8 villages were selected from Parbhani tehsil on the basis of the highest area under JKCH-666 cotton. In the fourth stage, from each of the selected villages the list of JKCH-666 cotton growers with area under JKCH-666 cotton was obtained. Obviously, six JKCH-666 cotton farms were selected randomly from each of the villages. Thus, forty-eight JKCH-666 cotton farms were selected for the investigation. Cross sectional data were collected from forty-eight JKCH-666 cotton growers by personal interview method with the help of pretested schedule. Data pertained to production of JKCH-666 cotton on each farm and use of resources namely area under JKCH-666 cotton, seed, hired human labour, family human labour, bullock labour, pesticides, nitrogen, phosphorus, potash and manure for the year 2003-04. With the help of correlation matrix of the above variables, independent variables which were significant with respect to dependant variable were taken into consideration. Thus, these independent variables were included in both the linear and Cobb-Douglas 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 optimum resource allocation (Ahuja, 1995), (Kumaresen *et al*., 2005) and (Singh, 1986). The fitted equation was in the following manner,

$$Y = aX_1^{b1} . X_2^{b2} . X_3^{b3} . X_4^{b4} . X_5^{b5} . X_6^{b6} . X_7^{b7} . X_8^{b8} . e^u$$

Where, Y = production of JKCH-666 cotton (kg/farm), a = intercept, b = partial regression coefficient of specific resource (i = 1, ^{i}2, ..., 8), X_1 = area of JKCH-666 cotton (ha/farm), X_2 = hired labour (man days/farm), X_3 = family human labour (man days/farm), X_4= bullock labour (pair days/farm), X_5= nitrogen (kg/farm), X_6= phosphorus (kg/

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farm), X_7 = potash (kg/farm), X_8 = manure (q/farm) and e = error term. The function was transformed into log-linear form as follows.

$$\text{Log } Y = \log a + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + b_5 \log X_5 + b_6 \log X_6 + b_7 \log X_7 + b_8 \log X_8 + u \log e$$

Concepts which were frequently used in the present study are cleared as follows. Man day refers to measurement of human labour whereas female labour is equal to 0.50 man day in case of both hired and family labour because the prevailing wage rates for hired or family female and hired or family male labour were Rs. 25 and Rs. 50 per day, respectively. Rent refers to price for use of land of one hectare for the crop period. Resource productivity refers to marginal physical product with respect to added unit of input. It is denoted by MP = bY/X_i in Cobb-Douglas production function. Where, b is elasticity of production, Y is geometric mean of JKCH-666 cotton production and X_i is geometric mean of respective input or resource. Marginal value product (MVP) refers to multiplication of MP and Py, whereas, MP is marginal product of JKCH-666 cotton with respect to specific resource and Py is the price of cotton per quintal. Resource use efficiency refers to the ratio of marginal value product to acquisition price of that resource. Optimum level of resource refers to the quantity of specific resource which could result in the highest profit from that resource. It is denoted by $X_i = (b.Y.Py/Px_i)$, where, X_i is optimum resource, b is elasticity of production, Y is geometric mean of cotton production, Py is price of cotton per quintal and Px_i is the price of particular input or resource.

RESULTS AND DISCUSSION

Partial regression coefficient with 't' value, geometric mean of input, marginal product, marginal value product to price and optimum resource allocation with respect to each of specific resources were estimated and are presented in Table 1. It is evident from the table that the value of R^2 was 0.854 which indicated 85.40 per cent of variation JKCH-666 cotton production due to variation in the explanatory variables. Partial regression coefficients with respect to manure and hired human labour were positive and highly significant at 1 per cent level while the regression coefficients with respect phosphorus, area of JKCH-666 cotton and bullock labour were also positively significant at 5 per cent level. It could be inferred that there was scope to increase the use of manure, hired human labour, phosphorus, area of JKCH-666 cotton and bullock labour in JKCH-666 cotton production. If use of manure, hired human labour, phosphorus, area of JKCH-666 cotton and

Table 1 : Estimates of Cobb-Douglas production function for resource productivity, resource use efficiency and optimum resource allocation in JKCH-666 cotton production

	Resource Variable	Partial regression coefficient (b_i)	Standard error of b_i	't' value	Geometric mean of input (X_i)	Marginal product (q)	Marginal value product (Rs)	Price of input (Rs)	MVP to price ratio	Optimum resource use (X_i)
1.	Area of JKCH-666 cotton (ha / farm)	0.184	0.079	2.329*	0.58	2.328	5703.60	2997.16	1.90	1.10
2.	Hired human labour (man day / farm)	0.172	0.064	2.687**	30.68	0.041	100.45	50.00	2.01	61.86
3.	Family human labour (man day / farm)	0.108	0.104	1.038	19.37	0.040	98.00	50.00	1.96	38.84
4.	Bullock labour (pair day / farm)	0.142	0.065	2.184*	12.08	0.046	210.70	150.00	1.40	17.02
5.	Nitrogen (kg / farm)	0.043	0.041	1.048	38.46	0.008	19.60	11.30	1.73	64.43
6.	Phosphorus (kg / farm)	0.062	0.025	2.480*	26.93	0.016	39.20	18.75	2.09	59.46
7.	Potash (kg / farm)	0.014	0.012	1.166	11.72	0.008	14.70	8.00	2.45	31.47
8.	Manure (q / farm)	0.141	0.051	2.764**	16.91	0.061	149.45	50.00	2.98	50.71

Intercept (log a) …………1.039
R^2 …………………………... 0.854
'F'- value ………..…….…28.708**
* Significant at 5 per cent level

Note : Geometric mean (Y) of the JKCH-666 cotton production was 7.34 q/farm and its price was Rs. 2450/q.

** Significant at 1 per cent level

bullock labour are increased by 1 per cent each, that will lead to increase the cotton production by 0.141, 0.172, 0.062, 0.184 and 0.142 per cent, respectively. On the contrary, the regression coefficients with respect to potash (0.014), nitrogen (0.043), and family human labour (0.108) were positive but non-significant. The results are in line with the findings of Belsure (1991) and Gulhane (2001) regarding production elasticities of inputs in hybrid cotton production.

Regarding marginal productivity or resource productivity, it is also evident from the table that existing area of JKCH-666 cotton farm was 0.58 hectare. It was inferred that for every one hectare addition to the existing area of the cotton farm, there would be increase in the production by 2.328 q over the existing JKCH-666 cotton production of 7.34 q per farm as its resource productivity, where other resources remained constant. Similarly, if one unit of each of hired human labour (man day), bullock labour (pair day), phosphorus (kg), and manure (q) are added to existing respective resources, there would be increase in the cotton production by 0.041, 0.046, 0.016 and 0.061 quintal, respectively. On the contrary, resource productivities with respect to family human labour, nitrogen and potash were 0.040, 0.008 and 0.008 q, respectively. These results are in concurrence with the findings of Abraham and Bokil (1996) as well as Pawar and Pawar (2003) regarding resource productivities in hybrid cotton production.

In relation to resource use efficiency, the ratio of MVP to price with respect to manure was the highest of 2.98 followed by that with respect to potash (2.45), phosphorus (2.09), hired human labour (2.01), family human labour (1.96), area of JKCH-666 cotton (1.90), nitrogen (1.73) and bullock labour (1.40). Thus, allocation efficiency was higher than unity in above variables. These variables were used at sub-optimal level. Hence, there is a possibility of increasing the use of these inputs to the optimum level, where the efficiency of input use is maximum. These results are in agreement with the results obtained by Singh (1986) and Kata (1990) regarding magnitude of efficiency ratio estimates.

Regarding optimum resource allocation, the use of land under JKCH-666 cotton could be increased up to 1.10 hectors to overcome under utilization of land resource when other resources remained constant. At this land use level, marginal value product came down and equalised to acquisition cost or rent of the land resource (Rs. 2997.16/ha). Similarly, the optimum use of hired human labour and family human labour was 61.86 and 38.84 man days, respectively, whereas marginal value product was equal to price of use of human labour (Rs. 50/man day) in both the cases. Optimum resource allocation in case of bullock labour was 17.02 pair days. At this level, marginal value product was equal to acquisition cost of bullock pair (Rs. 150/pair day). In the same way, use of nitrogen, phosphorus and potash could be increased upto 64.43, 59.46 and 31.47 kg, respectively, whereas respective marginal value product was equal to price of nitrogen (Rs. 11.30/kg), price of phosphorus (Rs. 18.75/kg) and price of potash (Rs. 8.00/kg). Optimum allocation of manure was found to be 50.71 q whereas marginal value product with respect to manure was equal to acquisition cost of it (Rs. 50/q). The results are in conformity with the results obtained by Pawar and Pawar (2005) in case of NCS-145 cotton production.

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