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RESEARCH ARTICLE :

Resource productivity and resource use efficiency in *Rabi* jowar production

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SUMMARY : Investigation was carried out during the year 2013-14. In all 48 *Rabi* jowar growers were randomly selected from sixteen villages of two tehsils in Parbhani of Maharashtra. Cross sectional data were collected from *Rabi* jowar growers with the help of pretested schedule by personal interview method. Data were related to *Rabi* jowar outputs and inputs like hired human labour, bullock labour, machine labour, seed, fertilizer and family human labour as resources. Cobb Douglas production function was fitted to the data. The results revealed that, regression co-efficient of area under *Rabi* jowar was 0.267 followed by that of bullock labour (0.222), partial regression co-efficient of family human labour was 0.128. Regression co-efficient family human labour and seed were positive but non-significant. Marginal product of area under *Rabi* jowar was 3.923 quintals followed by that of bullock labour (0.558 q), family human labour (0.167q) and hired human labour (0.067q) and so on. MVP to price ratio with respect to bullock labour was 1.51 followed by family human labour (1.50), area under *Rabi* jowar (1.13) and seed (1.08). Hence, preference might be given to increase hired human labour, family human labour and nitrogen on priority basis in *Rabi* jowar cultivation. Optimum resource use of area under *Rabi* jowar was 093 hectare and that of nitrogen was 36.70 kg.

KEY WORDS :
Rabi jowar, Geometric mean, Resource productivity, Marginal productivity, Optimum resources

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BACKGROUND AND OBJECTIVES

The Jowar [*Sorghum bicolor* (L.) Moench] belongs to family Gramineace. It is the fifth most important cereal crop followed rice, wheat, maize and barley in the world. It is often refereed as 'coarse grain'. It is commonly known as the great millet, due to large size of grains among the millets and vast area under it. It is the one of the main staple foods for the world's poorest food for insecure people in dry parts of tropical Africa, India and China because of its drought resistant nature. It is adoptable in wide variation in regional, climatic conditions and sowing as well as harvesting period. Though it is traditional subsistence crop but now changes its role from traditional to commercial crop. The demand for jowar as feed purpose is the main driving force in rising the global production and international trade.

In India, areas under jowar during 2013-14 was 6.12 million hectares with annual production 2.57 million tonnes and productivity of jowar in the year 2013-14 was 850 kg / ha.

In Maharashtra, jowar is mainly grown as rainfed crop. *Rabi* jowar plays an important role in dry land economy. Maharashtra rank first in Jowar production. Area under *Rabi* Jowar in 2013-14 was 26.46 lakh hectares and production 18.25 lakh tonnes with an productivity 690 kg / ha. In Solapur district area under *Rabi* jowar in the year 2013-14 was 5.5 lakh ha, with production 3.20 lakh tonnes and having productivity of 579 kg per.

RESOURCES AND METHODS

Sampling design :

Multistage sampling design was adopted for selection of district, tehsils, villages and non-residential farms. In the first stage, the Parbhani district was purposively selected of non-residential farms. In the second stage, Parbhani and Punra tehsils were selected on the basis of higher area under non-residential farm. In the third stage eight villages were selected from the each tehsils on the basis of higher area under non-residential farms. From Parbhani tehsil villages were namely Mirkhel, Pandhari, Paralgavan, Pingli, Porjawala, Raipur, Shirshi Bk., Tadlimbla and Aherwadi, Deolgaon, Dhanora, Khadala, Khujada, Makhani, Navki and Phulkalas were selected from Purna tahsil. In the fourth stage, from each village, the list of non-residential farmers along with their holding sizes was obtained. Three non-residential farmers were randomly selected from each of the villages. In this way, from sixteen villages, 48 farmers were selected for the present study. The data were related to area under *Rabi* jowar, hired human labour, bullock labour, machine labour, seed, nitrogen, and family human labour. Cobb-Douglas production function was fitted to the data to estimate resource use efficiency with respect to each of the explanatory variables. The fitted equation was as follows.

$$Y = aX_1^{b1} .... X_n^{bn} . e^u$$

In this functional form 'Y' is independent variable, X_i are independent resource variables, 'a' is the constant representing intercept of the production function and 'bi' are the regression co-efficients of the respective resource variables. The regression co-efficients obtained from this function directly represent the elasticities of production, which remain constant throughout the relevant ranges of inputs. The sum of co-efficients that is 'bi' indicates the nature of returns to scale. This function can easily be transformed into a linear form by logarithmic transformation. After logarithmic transformation, this function is,

$$\text{Log } Y = \log a + b_1 \log x_1 + b_2 \log x_2 + \text{-------} b_n \log x_n + u \log e$$

For fitting the production function in major crops, twelve inputs variables were considering the problem of multicolinearity in estimating production function. Multicolinearity refers to situation where because of storing interrelationship among the independent variables, it becomes difficult to their separate effects on the dependent variables. Some of the independent variables are not important just because the standard errors are high. It might be due to the presence of multicoliniarity are (a) the sampling variances of the estimate co-efficients increases as the degree of collinearity increases between the explanatory variables (b) estimated co-efficients may become very sensitive to small changes in data that is addition or deletion of a few observations produce a drastic changes in some of the estimates of the co-efficients. The equation fitted was of the following form.

$$\hat{Y} = aX_1^{b1} . X_2^{b2} . X_3^{b3} . X_4^{b4} . X_5^{b5} . X_6^{b6} . X_7^{b7} .$$

where, $\hat{Y}$ Estimated yield of the crop (q/farm), a= Intercept of production function, bi=Partial regression co-efficients of the respective variables (i=1,2,3...10), X_1=Area of the crop (ha/farm), X_2=Hired human labour (manday/farm), X_3=Bullock pair (pairday / farm), X_4=Machine labour (hour/farm), X_5=Seed (kg/farm), X_6=Nitrogen (kg/farm) and X_7= Family human labour (manday/farm).

The marginal value of product or resource indicates the addition of gross value of farm production for a unit increase in the 'i'th resource with all resources fixed at their geometric mean levels. The MVP of various inputs is worked out by the following formula.

$$MVP = \frac{b\bar{y}}{\bar{X}} Py$$

where, b= Regression co-efficient of particular independent variable, $\bar{y}$ = Geometric mean of particular independent variable, $\bar{x}$ = Geometric mean of dependent variable, Py = Price of dependent variable.

OBSERVATIONS AND ANALYSIS

The findings with respect to elasticity of production,

Table 1 : Estimates of Cobb-Douglas production function in *Rabi* jowar production on non-residential farm

Sr. No.	Independent variable	Partial regression co-efficient (bi)	Standard error (SE)	't' value	Geometric mean (Xi)	Marginal product (q)	Marginal value product (Rs.)	Price of input (Rs.)	MVP to price ratio	Optimum resource use (Xi)
1.	Area under *Rabi* jowar (ha/farm)	0.267	0.106	2.518**	0.82	3.923	7061.40	6236.39	1.13	0.93
2.	Hired human labour (manday/farm)	0.053	0.048	1.104	9.44	0.067	120.60	200.00	0.60	5.74
3.	Bullock labour (pairday/farm)	0.222	0.160	1.387	4.79	0.558	1004.40	662.64	1.51	7.26
4.	Machine labour (hour / farm)	-0.217	0.076	-2.855**	3.02	-0.865	-1557.00	500.00	-3.11	---
5.	Seed (kg/farm)	0.025	0.021	1.190	8.32	0.036	64.80	60.00	1.08	9.03
6.	Nitrogen (kg/farm)	0.022	0.008	2.750**	32.94	0.008	14.40	13.00	1.10	36.70
7.	Family human labour (manday)	0.128	0.050	2.560**	9.23	0.167	300.60	200.00	1.50	13.88

Intercept (log a) -------------------------- 0.483
F-value ------------------------------------- 35.855**
R^2--- 0.894
Return to scale (Σb_i) -------------------- 0.640

Note :- Geometric mean of ($\bar{y}$) *Rabi* jowar production was 12.05 q per farm and price was Rs. 1800/q
** indicates significance of value at P=0.01

marginal productivity, resource use efficiency and optimum resource use were obtained and are presented as follows.

Elasticity of *Rabi* jowar production :

Regression co-efficients with respect to various explanatory variables were calculated and are presented in Table 1. It was observed from the table that partial regression co-efficient of area under *Rabi* jowar was 0.267 which was positive and highly significant at one per cent level. It inferred that when one per cent increased in use of area under *Rabi* jowar over its geometric mean, it would lead to increase production of wheat by 0.267 per cent. Partial regression co-efficient of family human labour was also positive and significant. When use of human labour was increased by one per cent, it would lead to increase *Rabi* jowar production by 0.128 per cent. Partial regression co-efficients of bullock labour, seed were positive but non-significant. On the contrary, partial regression co-efficient of machine labour was negative and significant. Co-efficient of multiple determinations (R^2) was 0.894; it means that there was 89.40 per cent effect of all independent variables together on *Rabi* jowar production. Return to scale was found to be 0.640 which indicated that production of *Rabi* jowar was found in decrease returns to scale.

Marginal productivity of *Rabi* jowar :

Resource productivity with respect to various explanatory variables is also presented the in Table 1. It was obvious that the marginal productivity with respect to area under*Rabi* jowar was the highest as 3.923 quintals followed by that of bullock labour (0.558q), family human labour (0.167q) and hired human labour (0.067q). It inferred that if area under *Rabi* jowar production was increased by one hectare at its geometric mean level, it would lead to increase production of *Rabi* jowar with 3.923 quintals. Similarly, per unit of bullock labour, famiy human labour, hired human labour and seed could be increased then it would cause to increase production of *Rabi* jowar by 0.558q, 0.167q, qand 0.067q, respectively.

Resource use efficiency in *Rabi* jowar production :

In regards to resource efficiency, it was also evident from the Table 1 that use of bullock labour in *Rabi* jowar production indicated MVP to price ratio as 1.51 followed by family human labour (1.50),area under *Rabi* jowar (1.13) and seed (1.08) which were greater than unity. It implied that there was scope to increase these resources in *Rabi* jowar production. On the contrary, in regard to machine labour, MVP to price ratio was negative. Use of machine labour in *Rabi* jowar production was excess.

Optimum resource use in *Rabi* jowar production :

In regards to optimum resource use, it was observed that optimum use of area under *Rabi* jowar was 0.93 hectare over its geometric mean followed by that of family human labour (36.70 mandays) and seed (9.03kg).

Asmatoddin *et al.* (2009); Asmatoddin *et al.* (2009); Oluwatayo *et al.* (2008) and Saini (1969) also conducted similar studies.

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