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Economics of production of Kesar mango in Latur District of Maharastra

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ABSTRACT

Latur is an important Kesar mango growing district of Maharastra. The study was under taken on the economics of production of Kesar mango in Latur. Results revealed that on priority basis use of bullock labour, manure, nitrogen and phosphorus can be increased in production of Kesar mango because MVP to price ratio was higher with respect to the variables in Kesar mango production in the Latur district.

Key words : Cropping pattern, Cobb-Douglas production function, Marginal product, Elasticity of production and Geometric mean

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INTRODUCTION

Mango (*Mangifera indica*, L.) belongs to family Anacardiaceae, originated in South – East Asia. It is one of the most important fruit crops grown in India. Mango is indigenous to India. It is as old as Indian civilization and mango has been cultivated in India since antiquity and records show that Huien-Tsang (606 – 647 AD) has testified its cultivation during the time of his visit to India. India occupies a prominent place in the cultivation of mango. Its cultivation is distributed throughout the warmer countries and is confined in regions between 30 N and 30 S of the equator.

In India, mango is popularly known as "king of fruits". Amir Khusrau (1330AD) has stated: 'The mango is the pride of the garden the choicest fruit of Hindustan, other fruits we are content to eat when ripe, but the mango is good in all stages of growth'.

It is used as a raw material in industries for the preparation of mango juice, mango pulp, mango chutney and mango pickles etc. Mango fruits are used at various stages as young and unripe fruits due to their acidic taste are utilized for culinary purposes. Mango fruits are utilized in preparing squash, nectar, jam, toffee, baby food etc. Bark of trees used for tanning production, which is used for leather industries.

The ripe mango fruit contains 90.00 per cent moisture, 8.8 per cent carbohydrate, 1.00 per cent protein, 0.1 per cent fat, 1.1 per cent fibre, 0.8 per cent lipid, 0.01 per cent calcium, 0.02 per cent phosphorus, 4.5 mg per 100 g iron, carotene (as vitamin A – 150 i.u.), 30 mg per 100 g ascorbic acid.

Often per capita fruit consumption is taken as an index of standard of living of a country. The Indian Council of Medical Research (ICMR) has recommended consumption of 120 g of fruits per capita per day and as many variety as season permits, but the per capita consumption of fruit in India is only 40 g. In view of the ever-increasing facilities and improved technology of handling, processing, storing and transportation of fruits, the potential is likely to grow at a faster rate. Looking into these factors it is not only necessary to step up production, but also, to see that fruits are made available during off-season.

Marathwada is one of the important mango growing regions of Maharashtra and Latur is an important Kesar mango growing district. This district accounts about 15 per cent of total area of Marathwada region under Kesar mango. It envisages suggesting possible corrective measures to bring about the desired improvement in production of Kesar mango. The study was under taken to know the socio-economic characteristics of Kesar mango grower, to estimate cost and returns of Kesar mango garden and to examine the input-output relationship and resource use efficiency in Kesar mango.

METHODOLOGY

Location of Latur district is at the South-East of Marathwada region. Its Latur district is situated between $17^0 52'$ to $18^0 50'$ North latitude and $16^0 12'$ to $77^0 18'$ East longitude. The counter of district is irregular. It is situated on North on North East fringes of Maharashtra. It is one of the districts of Marathawada region which lies in the Manjara basin.

Multistage sampling design was adopted for selection of district, tehsil, villages and Kesar mango growers. In the first stage, Latur district was purposely selected for present study because of favourable climate to grow the Kesar mango crop and because of under export zone for Kesar mango. At second stage three Tehsils of Latur district were selected on the basis of the highest area under Kesar mango. In the third stage from each selected Tehsil, two villages were selected on the basis of the highest area under Kesar mango. The selected villages were namely, Sonvati, Bori, Savargaon, Chakur, Vaijapur and Belkund. At the fourth stage, 10 Kesar mango growers were selected at random from each village. Thus, in all 60 Kesar mango growers were selected randomly.

The data were collected from the sample Kesar mango growers by personal interview method with the help of pre-tested schedule. The information on various items like Kesar mango yields, price of Kesar mango, quantity of inputs and values were collected for the year 2008-09.

Tabular analysis

The first objective like socio-economic characteristics of Kesar mango growers was achieved by application of tabular analysis as well as linear functional analysis.

$$Y = f(x_1, x_2, x_3 \text{———} x_n)$$
$$Y = a + b_1x_1 + b_2x_2 + b_3x_3 + \text{————} + b_nx_n$$

Tabular analysis comprised to arithmetic means, percentages and ratios. This method was also used to determine the cost and returns of Kesar mango cultivation.

Cobb-Douglas production function analysis

On the basis of goodness of fit (R^2), Cobb-Douglas type of production function was used to determine the resource productivity in Kesar mango production. The data were, therefore, subjected to functional analysis by using the following form of equation:

$$Y = ax^{b1}_1 \times X_2^{b2} \times X_3^{b3} \text{ —— } X_n^{bn}\, e^u$$

In this functional form 'Y' is dependent variable, 'X'i shows independent resource variable, 'a' is the constant representing intercept of the production function and 'b'i indicates the regression coefficients of the respective resource variables. The regression coefficients obtained from this function directly represent the elasticities of production which remain constant throughout the relevant range of inputs. The sum of coefficients *i.e.* 'bi' indicates the nature of returns to scale. This function can easily be transformed into a linear form by working logarithmic transformation. After logarithmic transformation, this function is:

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

The main consequences of multicolinearity area (a) the sampling variances of the estimate coefficients increases as the degree of collinearity increases between the explanatory variables (b) estimated coefficients may become very sensitive to small charges in data i.e. addition or deletion of a few observations produce a drastic change in some of the estimates of the coefficients. Sometimes it so happens that more of the regression coefficients are significant but the value of R^2 is very high. The equation fitted was of the following formula:

$$Y = aX_1^{bi}.\, X_2^{b2}.\, X_3^{b3}.\, X_4^{b4}.\, X_5^{b5}.\, X_6^{b6}.\, X_7^{b7}.\, X_8^{b8}.\, X_9^{b9}.\, X_{10}^{b10}$$

where,

$\hat{Y}$ = estimated yield of the crop in q per farm
a = intercept of production function
b_i = partial regression coefficients of the respective resource variable (i = 1, 2, 3, ... 5)
X_1 = area under Kesar mango garden (ha/garden)
X_2 = hired human labour (man day/garden)
X_3 = bullock labour (pair days/garden)
X_4 = machine labour (hours/garden)
X_5 = manures (q/garden)
X_6 = nitrogen (kg/garden)
X_7 = phosphorus (kg/garden)
X_8 = potash (kg/garden)
X9 = insecticide (kg or lit /garden)
X10 = irrigation (m^3/garden)

R^2 is coefficient of multiple determinations. 't' value for R^2 was tested at (n-1) degree of freedom. Intercept (a) is the mean of Kesar mango production obtained in the absence of selected variables and regression coefficients were tested for significance by applying't' test at n-k-1 degree of freedom where 'k' are explanatory or independent variable and 'n' be number of observations

or number of Kesar mango growers.

$$t_{(t-k-1)} = \frac{b_i}{SE(b_i)}$$

where,

b_i = Regression coefficient of i^{th} independent variable.

SE (b_i) = Standard error of i^{th} independent variables

Measures of productivity and resource use efficiency:

Marginal product (MP) :

Cobb-Douglas production function allows constant, increasing or decreasing marginal productivity. The marginal product equation is as:

$$MP = \frac{dy}{dx} = bax^{(b-1)} = \frac{bax^{b}}{X} = b\frac{Y}{X}$$

Marginal value of productivity resource indicates the addition of gross value of farm production for a unit increase in the i^{th} resource with all other resources fixes at their geometric mean levels. The MVP of different input factors is worked out by the following formula:

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

where,

b = Regression coefficient of particular independent variable.

$\bar{X}$ = Geometric mean of particular independent variable.

$\bar{Y}$ = Geometric mean of dependent variable.

Py = Price of dependent variable.

Elasticity of production (EP)

$$E_p = bax^{(b-1)}$$

RESULTS AND DISCUSSION

The findings of the present study as well as relevant discussion have been summarized under following heads:

Socio-economic status of Kesar mango grower:

Socio-economic characteristics of Kesar mango growers were calculated and are presented in Table 1. The result revealed that age of owner was higher as 47.29 years with respect to Kesar mango grower. Education level was slightly higher 2.79 score with respect to Kesar mango grower. Family size (6.92 persons) was also higher of Kesar mango grower. Occupation level of Kesar mango grower was higher as 1.29 scores in Kesar mango garden. It was observed that land holding was 8.81 hectares with respect to Kesar mango garden. It was clear that bullock pair was 1.06 in numbers in Kesar mango garden. Similarly, milch animals were 1.29 in numbers in Kesar mango garden. In regard to investment, commonly used assets and building was Rs.38775.83 in Kesar mango garden and area under Kesar mango was 2.09 hectares.

Table 1: Socio economic characteristics of Kesar mango growers

Particular	Kesar mango garden	
	Mean	C.V. %
Age of farmers (year)	47.29	28.00
Education level in 5 quantum score (Illiterate / Primary / High School / Higher Secondary / College level)	2.79	35.41
Family size (person)	6.92	50.33
Occupation level in 3 quantum score (Agriculture/Industry/Service)	1.29	50.40
Land holding (ha)	8.81	103.05
Bullock pair (No.)	1.06	68.38
Milch animal (No.)	1.29	138.27
Investment on commonly used assets and farm building (Rs.)	38775.83	104.11
Area under Kesar mango (ha)	2.09	142.94

Effect of socio-economic characteristics on productivity of Kesar mango garden:

Effects of socio-economic characteristics on productivity of Kesar mango garden was estimated and are presented in Table 2. The results revealed that when one pair of bullock was increased over mean value of bullock pair (1.06 bullock pair), it would lead to increase Kesar mango productivity of 22.03 quintals in Kesar mango garden. It implied that there was scope to increase bullock pair in Kesar mango garden. On the contrary the regression coefficient with respect to investment on commonly used asset was also found negatively and highly significant that was -0.0004.

It means that when investment on commonly used asset increased by one rupee that would lead to decrease Kesar mango productivity by 0.0004 quintals. In regard to age of garden, it was observed that regression coefficient was 8.862 which was significant at 1 per cent level. It implied that when one year age of garden was increased over a mean value, it would lead to increase Kesar mango productivity of 8.862 quintals in Kesar mango garden.

Table 2: Effect of socio-economics characteristics on productivity of Kesar mango garden

Variable	Regression coefficient	Standard error	t value
Age (year)	-0.324	0.189	1.714
Education level (Five quantum score)	4.613	3.137	1.470
Family size (person)	-1.093	0.798	1.369
Occupation level (three quantum score)	-7.379	5.434	1.358
Land holding (ha)	0.518	0.423	1.224
Bullock pair (No.)	22.030	6.554	3.361**
Milch animal (No.)	-3.212	1.625	1.976
Investment on commonly used assets (Rs.)	-0.0004	0.0002	2.957**
Age of Kesar mango garden (year)	8.862	1.592	5.567**
Area under Kesar mango garden (ha)	15.449	1.947	7.933**

Intercept a = -57.949 R^2 = 0.918 F value = 37.074**

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

Table 3 : Cropping pattern of Kesar mango growers (Area in ha)

Particulars	Kesar mango garden
Kharif	
Mung	0.23 (2.43)
Urd	0.20 (2.12)
Soybean	1.44 (15.24)
Pigeonpea	0.88 (9.31)
Sorghum (*Kharif*)	0.40 (4.23)
Sunflower	0.12 (1.27)
Kesar mango	2.09 (22.12)
Rabi	
R.jowar	0.66 (6.98)
Wheat	0.92 (9.74)
Chickpea	0.46 (4.87)
Groundnut	0.55 (5.82)
Summer	
Vegetables	0.58 (6.14)
Sugarcane	0.92 (9.73)
Gross cropped area	9.45 100.00)
Net sown area	6.28
Cropping intensity (per cent)	150.48

Similarly, area under Kesar mango was observed that regression coefficient was 15.449 which was significant at 1 per cent level. It implied that when one hectare area under Kesar mango garden was increased over a mean value, it would lead to increase Kesar mango productivity of 15.449 quintals in Kesar mango garden. It was also observed that regression coefficients of education level and land holding were found positive but non-significant while regression coefficient of age, family size, occupation level and milch animal were found negative but non-significant.

It was observed that R^2 was 0.918 which indicated that Kesar mango productivity was influenced by all variables together with 91.89 per cent. The effect of Kesar mango productivity was considerable because F value was 37.07 which was highly significant at 1 per cent level.

Cropping pattern of Kesar mango growers:

Cropping patterns of Kesar mango growers were estimated and are presented in Table 3. The results revealed that gross cropped area was 9.45 hectares in Kesar mango garden. It was observed that proportionate share of Kesar mango was the highest as 22.12 per cent in Kesar mango garden. It inferred that the farmers were giving more importance to Kesar mango crop in cropping pattern. Hence, Kesar mango crop would be considered predominant crop in the study area. The proportionate area under soybean was 15.24 per cent in Kesar mango garden. In general, the proportionate area under wheat was 9.74 per cent in Kesar mango garden. Similarly, the proportionate area under *Rabi* sorghum was 6.98 per cent in *Rabi* season. It inferred that *Rabi* sorghum is used for grain and fodder purpose in that area. The proportionate area under vegetables and sugarcane was 6.14 and 9.73 per cent, respectively in Kesar mango garden. It inferred that the farmers also were giving more importance to vegetables and sugarcane as cash crop in cropping pattern. In next order pigeonpea, *Kharif* sorghum, urd, mung, and sunflower were important crops grown in the study area. In regard to cropping intensity, it was observed that, the highest cropping intensity was 150.48 per cent in Kesar mango garden.

Physical inputs and outputs in Kesar mango production:

Per hectare physical inputs and outputs in Kesar mango production were estimated and are presented in Table 4. Use of hired human labour was the higher as127.53 man days in Kesar mango garden. Use of bullock labour was 4.07 pair days. On the contrary, use of machine labour was higher as 3.99 hours in Kesar mango garden. In regard to manure, the higher quantity of 17.05 quintals was used in Kesar mango garden. Use of nitrogen, phosphorus and potash was slightly higher as 73.70, 60.86 and 48.83 kg, respectively in Kesar mango

Table 4 : Per hectare physical inputs and outputs in Kesar mango production (Unit/ha)

Particular	Unit	Kesar mango garden
Input		
Hired human labour	man day	127.53
Bullock labour	pair day	4.07
Machine labour	hour	3.99
Manure	q	17.05
Nitrogen	kg	73.70
Phosphorus	kg	60.86
Potash	kg	48.83
Plant protection	lit	61.73
Irrigation	m^3	11765.85
Family human labour	man day	19.09
Output		
Kesar mango production	q	120.67

garden. Use of plant protection was 61.73 liter and use of irrigation was higher as 11765.85 cubic meters. Use of family human labour was higher (19.09 man) days in Kesar mango garden.

It is also observed from that Table 4 that Kesar mango production was 120.67 quintals in Kesar mango garden.

Cost of cultivation of Kesar mango production:

Per hectare cost of cultivation of Kesar mango production was calculated and is presented in Table 5.

Table 5: Per hectare cost of cultivation of Kesar mango garden (Rs./ha)

Particular	Kesar mango garden
Hired human labour	10202.40 (11.38)
Bullock labour	610.50 (0.68)
Machine labour	1077.30 (1.20)
Manures	852.50 (0.95)
Fertilizers	2561.27 (2.86)
Plant protection	677.93 (0.76)
Irrigation	11412.87 (12.73)
Land revenue	229.17 (0.26)
Incidental expenditure	30.55 (0.03)
Interest on working capital	2765.45 (3.09)
Depreciation on capital asset	410.33 (0.46)
Cost-A (item 1 to item 11)	30830.27 (34.40)
Rental value of land	50050 (55.85)
Interest on fixed capital	492.39 (0.55)
Amortised cost @ 12 per cent discount per year	6719.98 (7.50)
Cost-B (item 12 + 13 + 14+15)	88092.64 (98.30)
Family human labour	1527.20 (1.70)
Cost-C (item 16+17)	89619.84 (100.00)

(Figures in parentheses indicate percentages to cost-C)

The results revealed that cost-C was higher as Rs.89619.84 in the Kesar mango garden. Among the various items of expenditure, the proportionate share of rental value of land was predominant as 55.85 per cent and irrigation 12.73 per cent in Kesar mango garden. It inferred that due to higher yield the share of rental value of land was higher in the Kesar mango garden while the higher quantity irrigation, the share of expenditure on irrigation was higher. The similar results were found by Deoghare *et al.* (1999) in regard to cost-C as Rs.88174.12 per hectare in Kesar mango garden.

Profitability of Kesar mango production:

Profitability of Kesar mango production was estimated and is presented in Table 6. It was observed that gross return was Rs.301675.00 in the Kesar mango garden. It was clear that farm business income, family labour income and net profit were Rs.270844.73, Rs.213582.36 and Rs.212055.16, respectively, in the Kesar mango garden. It was clear that Output-Input ratio was higher (3.37). Per quintal cost of production was Rs.742.69 in the Kesar mango garden. It implied that cost of production can be reduced due to drip irrigation system. The present findings are in conformity with the results obtained by Deoghare *et al*. (1999). The variables were selected in production function with the help of correlation of matrix with respect to Kesar mango production. The variable of plant protection was dropped because it was not correlated with Kesar mango production. Similarly, problem of multi-colliniarity was also solved in the cases by considering the correlation value more than 0.80, where the regression coefficients were the elasticities of

Table 6: Profitability of Kesar mango production (Rs./ha)

Particular	Kesar mango garden
Gross return	301675.00
By produce	0.00
Cost-A	30830.27
Cost-B	88092.64
Cost-C	89619.84
Farm business income (Gross returns minus cost-A)	270844.73
Family labour income (Gross returns minus cost-B)	213582.36
Net profit (Gross returns minus cost-C)	212055.16
Output - Input ratio (Gross returns divided by cost-C)	3.37
Per quintal cost of production	742.69

production and used to determine return to scale in Kesar mango production.

Use of Cobb-Douglas production function in Kesar mango production:

Linear and Cobb-Douglas production function were used in Kesar mango garden. Regression coefficients with respect to various explanatory variables were calculated and are presented in Table 7. Regression coefficient of hired human labour was 0.25 which was positive and highly significant at 1 per cent level. Regression coefficient of bullock labour was 0.195 which was positive and highly significant at 5 per cent level. Similarly, regression coefficient of irrigation was 0.043 which was positive and highly significant at 5 per cent level. On the contrary, regression coefficient of potash (-0.190) which was negative. Coefficient of multiple determination (R^2) was 0.928 which indicated 92.80 per cent variation in Kesar mango production and was explained due to variation in all independent variables. F value was highly significant (47.797). It was clear that explanatory variable on its own was not very important but together it explained significantly part of variation in Kesar mango production. The sum of regression coefficient was -5.821, which indicate decreasing return to scale.

Resource productivity with respective various explanatory variables was estimated and is presented in Table 7. It is obvious from table that marginal productivity with respect to area under Kesar mango garden was highest as 3.084 quintals followed by that of bullock labour (1.229 q), manure (0.504 q), machine labour (0.115 q), phosphorus (0.091 q), family human labour (0.033 q), nitrogen (0.028 q), hired human labour (0.012 q) and irrigation (0.000087 q). It inferred that if area under Kesar mango production was increased by one hectare at its geometric mean level, it would lead to increase production of Kesar mango with 3.084 quintals. Similarly, per unit of bullock labour, manure, machine labour, phosphorus, family human labour, nitrogen, hired human labour and irrigation increased, it would cause to increase the production of Kesar mango by 1.229, 0.504, 0.115, 0.091, 0.033, 0.028, 0.012 and 0.000087 quintals, respectively. In regard to resource use efficiency, it was also evident to Table 4.8 that use of manure in Kesar mango production indicated MVP to price ratio (25.205) followed by hired human labour (20.484), phosphorus (10.265), nitrogen (6.674), machine labour (1.073), and family human labour (1.05), which were greater than unity. It implied that there was scope to increase these resources in Kesar mango production. On the contrary in regard to potash MVP to price ratio was negative.

Table 7: Estimate of Cobb-Douglas production function as partial regression coefficients in order to determine resource productivity, resource use efficiency and optimum resource use in Kesar mango production

Independent variables	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
Area of Kesar mango (ha/garden)	0.138	0.121	1.14	1.412	3.084	7710.70	50050.00	0.154	-
Hired human labour (man day/ garden)	0.25	0.011	2.27**	62.012	0.012	31.81	80.00	0.397	24.654
Bullock labour (Pairday/ garden)	0.195	0.091	2.14*	5.007	1.229	3072.60	150.00	20.484	102.563
Machine labour (hours/ garden)	0.021	0.019	1.10	5.714	0.115	289.95	270.00	1.073	5.163
Manure (q/ garden)	0.201	0.134	1.49	12.583	0.504	1260.26	50.00	25.205	317.157
Nitrogen (kg/garden)	0.059	0.149	0.39	64.220	0.028	72.48	10.86	6.674	428.619
Phosphorous(kg/garden)	0.112	0.119	0.94	38.685	0.091	228.42	22.25	10.265	397.134
Potash (kg/garden)	-0.190	0.119	1.59	40.950	0.146	366.15	8.33	43.955	-
Irrigation (m^3/ garden)	0.043	0.020	2.15*	1553.710	0.000087	0.22	0.97	0.225	3497.407
Family human labour (man day/garden)	0.036	0.027	1.33	33.739	0.033	84.18	80.00	1.05	35.502

Intercept (Log a) = -5.82 F – value = 47.797 R^2 = 0.928 Return to scale (Σ bi) = 0.640

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

NOTE : Geometric mean (Y) of Kesar mango production was 31.558 quintals per garden and its price(Py) was Rs.2500 per quintal

In regard to optimum resource use, it was observed that use of optimum hired human labour was 24.654 man days over its geometric mean followed by bullock labour (102.563 pair days), machine labour (6.136 hours), manure (317.157 q), nitrogen (428.619 kg), phosphorus (397.134 kg) and irrigation (3497.407 m^3) and family human labour (35.502 man days). The results were found by Koujalagi and Kunnal (1992) in regard to coefficient of multiple determination (R^2) in production of Kesar mango garden.

Conclusion:

On priority basis use of bullock labour, manure, nitrogen and phosphorus can be increased in production of Kesar mango because MVP to price ratio was higher with respect to these variables in Kesar mango production.

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