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Resource productivity of tomato in different seasons in western Maharashtra

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ABSTRACT

The tomato crop is grown in all the seasons *i.e. kharif, rabi* and summer. However, each season has its own peculiarities in terms of production, demand and supply, costs and prices, market preferences and comparative advantages. Considering all this, study on costs and returns of tomato crop grown in different seasons is very important and with this view in mind, the investigation, resource productivity of tomatoes in *kharif, rabi* and summer season was carried out during the years 2005-06 at Sangamner tehsil of Ahemadnagar district. The data was collected from 90 tomato growers by personal interview method with the help of pretested schedule on inputs utilization in tomato production. The results revealed that the regression coefficient of plant protection, nitrogen, phosphorus were positive but non-significant coefficient of multiple determination (R^2) was 0.829 which indicated that 82.90 per cent variation in all independent variables. 'F' value was highly significant (154.00) in *kharif* season. In *rabi* season, N, P and K were positive but non-significant coefficient of multiple determination (R^2) was 0.979 which indicated 97.90 per cent in *rabi* tomato production. In summer season R^2 was 0.986 which indicated that 98.60 per cent variation in tomato production explained due to variation in all independent variables.

Key words : Tomato fruits, Production function, Resource productivity

INTRODUCTION

Tomato (*Lycopersicon esculentum*) is one of the most popular and widely grown vegetables in the world ranking second in importance after potato in many countries. Tomato is grown on an area of 4.8 million hectares with the production of 74.62 million tones. The fruits are eaten raw or cooked. Tomato in large quantities is used to produce soup, juice, ketchup, puree, paste and powder. It supplies vitamin-C and adds variety of colours and flavours to the food. Green tomatoes are also used for pickles and preserves. Its many forms are adapted to wide range of soil and climates extending from the tropics to almost the Aretic circle. It has many other uses, tomato seeds contain 24 per cent oil used as salad oil and in the manufacture of margarines.

Tomato is also rich in medicinal value. The pulp and juice are digestible, mild aperients, promotes gastric secretion and blood purifier. It has antiseptic properties in intestinal infections. It is one of the best vegetables which keeps our stomach and intestine in good order.

Vegetables have proved to be important supplementary food crops which form an essential part of human diet of them tomato ranks first among processed vegetables and is next to potato in area and production in the world. In recent years, farm economists are taking a good deal of interest in production function analysis as it serves as fine tool for developing the economic aspects of agriculture production on a pattern that would guide cultivators to operate at the least cost and the maximum profit combinations. If there is no way add to land, adjustments in variable inputs such as irrigation water, fertilizers, improved seeds, implements, etc. are always possible. The crux of the problem is to know what amount of capital as an available input is needed to obtain a given net return. If this is made known, the farmer can strike at a better combination of reduced input factors for relatively high profits. The present investigation determine resource productivity and resource use efficiency in tomato crop production.

MATERIALS AND METHODS

Multistage sampling technique was used to select district, tehsil, villages and tomato growers. Sangamner tehsil of Ahemadnagar district was purposively selected because of its predominance in area of tomato. Production and having infrastructural facilities like irrigation, transport and marketing are well developed and hence the cultivation of tomato is done on large scale. From Sangamner tehsil 10 villages were selected, the list of tomato grower was stratified into three groups *i.e. kharif, rabi* and summer from each categories, three tomato growers were selected from each village. Thus, from 10 villages 90 tomato growers were selected. Cross sectional data were collected from 90 tomato growers by personal interview method with the help of pretested schedule. Data pertained to production of tomato for the year 2005-06. Tabular analysis, logarithmic linear multiple regression analysis were used to analyse the data. The Cobb-Douglas production function used to know either constant, increasing or decreasing marginal productivity. The marginal product equation is as follows :

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$$MP = \frac{dy}{dx} = \frac{y}{x}$$

Cobb-douglas production function was used to determine the resource productivity and resource use efficiency in tomato production. The data were, therefore, subjected to functional analysis by using the following form of equation.

$$Y = a\, x_1^{b1} . x_2^{b2} . x_3^{b3} . x_4^{b4} . x_5^{b5} . x_6^{b6} ..... x_n^{bn}$$

The equation fitted was at the following formula.

$$Y = a x_1^{b1}. x_2^{b2}. x_3^{b3}. x_4^{b4}. x_5^{b5}. x_6^{b6}. x_7^{b7}. e^u$$

where,

Y = yield of tomato in quintal
a = intercept
bi = regression coefficients of the respective resource variable (i = 1, 2, 3, ... 9)
x_1 = area of tomato in hectare
x_2 = human labour in man day
x_3 = plant protection (ml)
x_4 = manures (q)
x_5 = nitrogen (kg)
x_6 = phosphorus (kg)
x_7 = potash (kg)

'F' value was tested at k and n-k-1 degree of freedom *i.e.* explanatory of independent variable (k) and number of observation or number of tomato growers (n) R^2 is coefficient of multiple determination. Intercept (a) is the mean of tomato productivity obtained in the absence of selected variables and regression coefficients (bi) are coefficients of independent variables. Regression coefficients were tested for significance by applying 't' test and n-k-1 degree of freedom as under :

$$t_{n-k-1} = \frac{bi}{SE\,(bi)}$$

RESULTS AND DISCUSSION

Estimate of Cobb-Douglas production function in tomato production:

Linear and Cobb-Douglas production function were used with respect to various independent variable in tomato production. On the basis of goodness of fit (R^2) Cobb-Douglas production function was considered for further analysis. Seven independent variables were considered in the functional analysis of tomato production. In tomato production. Coefficient of variables which were non significant were dropped from the further consideration in the functional analysis. Similarly, the correlation coefficient among independent variables which had the highest value as the coefficient of multiple determination were also dropped in order to solve the problem of multicolinearity. Thus remaining specific independent variables were considered in each of the type of tomato production, Cobb-Douglas type of production function gives elasticity of production function directly. Their regression coefficient are elasticties of production and sum of these regression coefficient can be used to determine the return to scale in the tomato production.

The linear (Cobb-Dougals) production function was estimated to know resource use efficiency of different explanatory variables in *kharif, rabi* and summer seasons.

Estimates of Cobb-Douglas production function in kharif season:

Regression coefficient with relation to various explanatory variables were calculated with 't' values and presented in Table 1. It was observed, that regression coefficient of manures 0.07 which was positive and significant at 5 per cent level. It was inferred that if 1 per cent increase in use of manures over its geometric mean, it would lead to increase tomato production by 0.07 per cent. Similarly regression coefficient with respect to human labour, potash were 0.49 and 0.015 which were positive and significant at 5 per cent level. It was inferred that if 1 per cent increase in use of human labour, potash over its geometric mean it would lead to increase tomato production by 0.49 and 0.015 per cent, respectively. The regression coefficient of plant protection, nitrogen, phosphorus were positive but non significant coefficient of multiple determination (R^2) was 0.829 which indicated that 82.90 per cent variation in *kharif* tomato production explained due to variation in all independent variables. 'F' value was highly significant (154.00).

Resource productivity, resource use efficiency with respect to various explanatory variables were estimated and presented in Table 1 noticed that marginal productivity with respect to area was highest (101.66 q) followed by manures (0.450 q), human labour (0.413 q), potash (0.028q), phosphorus (0.019 q) and nitrogen (0.018q).

In regard to resource use efficiency it was evident that use of manures in *kharif* tomato production indicated highest MVP to price ratio (4.5) followed by area (2.83), human labour (2.06), potash (1.32) which were greater than unity on the contrary MVP to price ratios of nitrogen (0.64), phosphorus (0.38), plant protection. (0.32) were less than unity, whereas the MVP to price ratio was

Table 1 : Estimate of Cobb-Douglas production function in *kharif* tomato production

Sr. No.	Independent variables	Partial regression coefficient (bi)	SE	't' value	GM of input Xi	MP	MVP	Price of input	MVP to price ratio
1.	Area (ha/farm)	0.55*	0.247	2.220	0.347	101.66	40664.00	14376.50	2.83
2.	HL (mandays/farm)	0.49**	0.196	2.504	76.14	0.413	165.20	80.00	2.06
3.	PP (ml/farm)	0.001	0.002	0.408	330.92	0.0002	0.08	0.25	0.32
4.	Manure (q/farm)	0.07*	0.032	2.214	9.97	0.450	180.00	40.00	4.50
5.	N (kg/farm)	0.02	0.541	0.037	69.45	0.018	7.20	11.30	0.64
6.	P (kg/farm)	0.012	0.012	0.961	39.44	0.019	7.60	20.00	0.38
7.	K (kg/farm)	0.015**	0.005	2.779	34.22	0.028	11.20	8.50	1.32

b0 : 2.021 Return to scale : 1.158 Y : 64.14 PY : Rs.400/q
F : 154.060 R^2 : 0.829
* and ** indicates significance of values at P=0.05 and 0.01, respectively

greater than one that resource could be increased in the production.

Estimates of Cobb-Douglas production function in rabi season:

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 manures 0.033 which was positive and significant at 5 per cent level. Similarly, regression coefficient with respect to human labour, plant protection which were positive and significant at 10 per cent level of significance. It was inferred that 1 per cent increase in use of manures over its geometric mean level it would lad to increase tomato production by 0.033 per cent, likewise if 1 per cent, increase in use of human labour, plant protection over its geometric mean, it would lead to increase in tomato production by 0.248 and 0.006 per cent, respectively. The regression coefficient of nitrogen, phosphorus and potash were positive but non-significant coefficient of multiple determination (R^2) was 0.979 which indicate that 97.90 per cent variation in *rabi* tomato production explained due to variation in independent variables.

Resource productivity, resource use efficiency with respect to various explanatory variables were estimated and presented in Table 2 revealed that marginal productivity with respect to area was highest as 125.19 quintal followed by human labour (0.213 q), manure (0.194 q), phosphorus (0.031 q), potash (0.018 q) and nitrogen (0.017 q).

In regard to resource use efficiency it was also evident that area indicate highest MVP to price ratio (2.86) followed by manures (2.18), plant protection (1.8) and human labour (1.20) which were greater than unity on the contrary MVP to price ratios of nitrogen (0.953), phosphorus (0.698) and nitrogen (0.68) were less than unity.

Estimates of Cobb-Douglas production function in summer season:

Regression coefficient with respect to various explanatory variables were calculated with 't' values and are presented in Table 3. It was observed that regression coefficient of human labour, plant protection and nitrogen were 0.73, 0.004 and 0.064, respectively which were

Table 2 : Estimate of Cobb-Douglas production function in *rabi* tomato production

Sr. No.	Independent variables	Partial regression coefficient (bi)	SE	't' value	GM of input Xi	MP	MVP	Price of input	MVP to price ratio
1.	Area (ha/farm)	0.51*	0.237	2.151	0.30	125.19	56335.5	19721.45	2.86
2.	HL (mandays/farm)	0.248**	0.051	4.86	85.54	0.213	95.85	80	1.20
3.	PP (ml/farm)	0.006**	0.0023	2.59	329.01	0.001	0.45	0.25	1.8
4.	Manure (q/farm)	0.033*	0.014	2.434	12.53	0.194	87.3	40.00	2.18
5.	N (kg/farm)	0.016	0.615	0.026	68.22	0.017	7.65	11.30	0.68
6.	P (kg/farm)	0.019	0.024	0.79	45.58	0.031	13.95	20.00	0.698
7.	K (kg/farm)	0.009	0.059	0.152	37.21	0.018	8.1	8.50	0.953

b0 : 0.548 Return to scale : 0.841 Y : 73.64 q PY : Rs.450/q
F : 144.98 R^2 : 0.979
* and ** indicates significance of values at P=0.05 and 0.01, respectively

Table 3 : Estimate of Cobb-Douglas production function in summer tomato production

Sr. No.	Independent variables	Partial regression coefficient (bi)	SE	't' value	GM of input Xi	MP	MVP	Price of input	MVP to price ratio
1.	Area (ha/farm)	0.251**	0.102	2.467	0.41	78.01	39008.86	25956.5	1.50
2.	HL (mandays/farm)	0.73**	0.15	4.884	156.12	0.580	290	30	3.63
3.	PP (ml/farm)	0.004**	0.001	2.946	709.4	0.0007	0.35	0.25	1.40
4.	Manure (q/farm)	0.0181	0.016	1.126	22.80	0.099	49.5	40	1.24
5.	N (kg/farm)	0.064**	0.026	2.455	108.25	0.073	36.5	11.30	3.23
6.	P (kg/farm)	0.017	0.023	0.747	74.12	0.028	14	20	0.70
7.	K (kg/farm)	0.006	0.038	0.158	56.87	0.013	6.5	8.5	0.765

b0 : 1.52793 Return to scale : 1.0901 Y : 124.14 PY : Rs.500/q
F : 228.74 R^2 : 0.986
* and ** indicates significance of values at P=0.05 and 0.01, respectively

positive and significant at 1 per cent level. It was inferred that if 1 per cent increase in use of human labour, plant protection, nitrogen over its geometric mean level it would lead to increase tomato production by 0.73, 0.004 and 0.064 per cent, respectively. Coefficient of multiple determination (R^2) was 0.986 which indicated that 98.60 per cent variation in tomato production explained due to variation in all independent variables. The sum of regression coefficient was 1.090.

Resource productivity, resource use efficiency with respect to various explanatory variables were estimated and presented in the Table 3 estimated that marginal productivity with respect to area (78.01 q) was highest followed by human labour (0.580 q), manures (0.099 q), nitrogen (0.073 q), phosphorus (0.028 q) and potash (0.013 q).

In regard to resource use efficiency it was also evident that use of human labour in tomato production indicated the highest MVP to price ratio (3.63) followed by nitrogen (3.23), area (1.50), plant protection (1.40) and manures (1.24) which were greater than unity. On the contrary MVP to price ratios of potash phosphorus (0.70) were less than unity. Where MVP to price ratio was greater than one that resource could be increased in production.

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