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A Comparative Study of Resource Productivities and Resource Use Efficiencies of Traditional and Tissue Culture Banana Cultivation In Parbhani District of Maharashtra State

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Abstract: The regression coefficient obtained from Cobb-Douglas production function represents the elasticities of production. As regards to traditional banana cultivation, regression coefficient of area, FYM and potash were positive and significant at 10 per cent level; thereby indicating scope to increase the level of these inputs so as to step up the productivity of banana. The sum of elasticities of production was equal to unity showing constant returns to scale. In tissue culture banana, the functional analysis revealed that the regression coefficient of plantlet was highly significant thereby indicating scope to increase the level of plantlet so as to step up productivity. The sum of elasticities of production was equal to unity thereby showing constant returns to scale. MVP /MC ratio for the inputs namely sucker, nitrogen and bullock labour was greater than unity there by exhibiting there efficient use in tissue culture banana production.

Introduction

India is an agrarian country. It ranks third after china and USA in fruit production and occupies second rank in banana production. Maharashtra is one of the major banana producing states in India. The Basrai and Ardhapuri varieties are mostly grown in Maharashtra, which are traditionally propagated by sucker or rhizome but recently these are propagated by tissue culture owing to uniformity in crop, earliness and free from disease infection. However, the resource productivity and resource use efficiency in banana production has not been reported so far. Hence it was felt necessary to undertake a study in Parbhani district of Maharashtra state.

Material and Methods

By using multistage sampling design, 60 traditional and 30 tissue culture banana growers were selected from the whole of Parbhani district. Traditional banana growers and tissue culture banana growers were selected from the same villages. With the help of pre-tested schedule, data was collected from both the types of banana growers by using personal interview method.

To determine resource productivity and resource use efficiency in banana production, Cobb-Douglas production function (non-linear) was used on the basis of goodness of fit (r^2) separately for the two methods of banana cultivation. The data was therefore, subjected to functional analysis by using following form of equation.

$$y = ax_1^{b1}. X_2^{b2} \ldots\ldots\ldots\ldots X_{n.}^{bn}.ei$$

Where

Y = dependent variable

X1 = Independent resource variable

a = Constant representing intercept of production function

bi = Regression coefficient of respective resource variable

The regression coefficient obtained from this function directly represents the elasticities

of production, which remain constant throughout the relevant ranges of inputs. The sum of coefficients i.e. Bi indicates the nature of returns to scale. This function can be presented into linear form by making logarithmic transformation -

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

For fitting production function in both traditional and tissue culture banana cultivation methods, nine inputs (variables) were considered as important factors by considering the problem of muticollinearity in estimating production function and the equation fitted was of the following formula.

$$Y = a X_1^{b1}. X_2^{b2}. X_3^{b3}. X_4^{b4}. X_5^{b5}. X_6^{b6}. X_7^{b7}. X_8^{b8}. X_9^{b9}$$

Where,

Y = Yield (qt/ha)

a = Intercept of production function

b_i = Regression coefficient of the respective resource

Variable (i = 1, 2, 3, ……9)

X_1 = Area of banana (ha)

X_2 = Human labour in man days

X_3 = Bullock labour in pair days

X_4 = Suckers in number

X_5 = Manure in quintal

X_6 = Nitrogen in kg

X_7 = Phosphorus in kg

X_8 = Potash in kg

X_9 = Irrigation in number

The marginal value of productivity of resource indicates the addition of gross value of farm production for a unit increase in the 'i'th resource with all other resources fixed at their geometric mean levels. The marginal value of productivity of different input factors is worked out by the following formula.

$$MVP = b \frac{Y}{X} \times PY$$

MVP = Marginal value of productivity

B = Regression coefficient of particular independent variable

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

$\overline{Y}$ = Geometric mean of dependent variable

PY = Price of dependent variable

Results and Discussion

The regression coefficients in Cobb-Douglas production function are the elasticities of production and sum of these regression coefficients indicate return to scale. The regression coefficient can be used to determine the influence of independent variables or inputs on output data collected from banana growers.

Cobb-Douglas type of production function was fitted to data of traditional banana enterprise in order to examine the influence of different inputs, on output. Cobb-Douglas type of production function was fitted with nine different inputs (X_1 to X_9) as independent variables and yield of banana crop as dependent variable. The data in table 1 showed that all variables except X_2 (human labour) indicated positive contribution towards yield of banana. The regression coefficient of not a single variable was significant at one and five per cent level of productivity but contribution of area (X_1) under banana was highly significant at 10 per cent level of productivity followed by X_5 (FYM) and X_8 (Potash) variable. This means increase in yield level of traditional banana is directly proportional to increase in use of these inputs above the mean level. The elasticity of production of variable x_1 (area) was 0.518, which means one percent increase in area increased yield of banana by 0.518 per cent. Similarly one

Table 1. Estimates of Cobb-Douglas production function for traditional banana cultivation

Independent variables	Regression coefficients (Bi)	Standard error of bi (SE±)	't' Value
Area (x_1)	0.5188	0.2632	1.9706**
Human labour (x_2)	-0.0857	0.1429	-0.5635^{NS}
Bullock labour (x_3)	0.0105	0.1202	0.0880^{NS}
Suckers (x_4)	0.1567	0.2558	0.6125^{NS}
Fym (x_5)	0.1364	0.0746	1.8289**
Nitrogen (x_6)	0.1574	0.1180	1.3340^{NS}
Phosphorous (x_7)	0.0553	0.0748	0.7392^{NS}
Potash (x_8)	0.0191	0.0107	1.7816**
Irrigation (x_9)	0.0302	0.2459	0.1229^{NS}
F- value	58.230		
R^2	0.913		
Return to scale	0.9991		

** - Significant at 10 per cent level

per cent increase in FYM and Potash increased the banana yield by 0.13 and 0.019 per cent respectively. The negative elasticity of human labour may be due to less utilization of this input and its use might have not attained the saturation level. These findings are in accordance with findings of Bhatia (1999).

The coefficient of multiple determination (R^2) was 0.913 indicates 91.3 per cent variation in traditional banana production was explained by all independent variables. F value was highly significant there by indicating that each explanatory variable on its own was not very important, but together they explained a significant part of variation in traditional banana production. The sum of elasticity of production (0.991) indicated that scale of return was constant to the level of input. The findings are similar to the findings of Pawar (1987) and Bhatia (1999).

The data presented in table 2 indicates that the marginal value product (MVP) of all variables except X_2 (human labour) was positive. The marginal value of product (MVP) of area of traditional banana was higher (Rs. 39680.80) and the price of area in the form of rent was 12640.67. Hence ratio of MVP to price was 3.13. It was inferred that expenditure on rent of land for traditional banana was worthwhile because when banana producer was spending one rupee on rent, it could give return of Rs. 3.13.

The MVP of bullock labour and irrigation was less as compare to MC, which indicates non significant use of these variables in production of banana. The negative MVP of human labour indicates less use of human labour against desired level. MVP of area, sucker, FYM, nitrogen, phosphorous, and potash was higher than MC, which indicates that these inputs were efficiently used for production of traditional banana method. The foregoing analysis revealed that in traditional banana area, suckers, nitrogen, phosphorus, potash and FYM were efficient. The findings are in accordance with findings of Salikram (1977). The Cobb-Douglas function was fitted with different selected inputs as independent

Table 2. Comparison of marginal value products of various inputs with their prices in traditional banana cultivation

Independent variables	Unit	Mean	B(I)	MP= BI Y/X	MVP = MP X PY	MC	MPV/MC
Area (x_1)	Hectare	0.652	0.5188	269.20	39680.08	12640.67	3.13
Human labour (x_2)	Man day	182.72	-0.0805	-0.149	-21.962	50	-0.43
Bullock labour (x_3)	Pair day	33.81	0.0105	0.1050	15.477	100	0.154
Suckers (x_4)	Number	2735.30	0.1567	0.0194	2.859	0.93	3.07
Fym (x_5)	Quintal	149.008	0.1364	0.3096	45.635	22.27	2.04
Nitrogen (x_6)	Kg	242.49	0.1574	0.2196	32.369	9.54	3.39
Phosphorous (x_7)	Kg	133.35	0.0553	0.1403	20.680	13.73	1.50
Potash (x_8)	Kg	103.95	0.0192	0.0624	9.197	6.52	1.41
Irrigation (x_9)	Number	45.19	0.0302	0.2260	33.312	50.55	0.65

Geometric mean (y) of traditional banana was 338.32 quintal and price was Rs. 147.40 per quintal.

variable and yield of banana as dependent variable. Bo, F-value and R^2 values were found to be 4.49, 171.33 and 0.987 respectively showing best fit. The values presented in Table 3 indicated that except variable X_5 (FYM), X_7 (Phosphorus) and X_8 (Potash), all variables positively contributed towards the yield of tissue culture banana. The contribution of X_4 (Plantlet) was highly significant, which means yield level of tissue culture banana increases with increase in use of x_4 (plantlet) above mean level. Among significant variables elasticity of production of variable x_4 (plantlet) was 0.972, which indicates one per cent increase in number of plantlet increases yield by 0.972 per cent. The negative elasticity in respect of FYM, phosphorus and potash may be due to excess utilization of these inputs; their use might have crossed the recommended level. The sum of elasticities of production of banana by tissue culture method was 0.974, it implied constant return to scale. The coefficient of multiple determination i.e. R^2 was 0.987 which indicated that, the variation in output explained by independent variable used in study was more than 98 per cent. The remaining variation in output may be due to those input factors, which have been left out from model. The highly significant F-value indicates proper selection of model and specification of the variables. These findings are in line with the findings of Thomas and Gupta (1987).

The ratio of marginal value product to their prices were calculated and presented in Table 4 indicated that resource use efficiency was highest in plantlet (5.95) followed by nitrogen (3.99) and bullock labour (2.45). These ratios were considerably higher than unity indicates considerable scope to increase banana production by the increasing level of these variables. MVP of FYM, phosphorus and potassium were found negative indicating their excess use. MVP/MC ratio for variables X_1 (area), X_2 (human labour) and X_9 (irrigation) was considerably low. This implied that area, human labour and irrigation were not efficiently used to achieve desired level of production. Similar findings were reported by Bhatia (1999).

Table 3. Estimates of Cobb-Douglas production function for tissue culture banana cultivation

Independent variables	Regression coefficients (bi)	Standard error of bi (se)	'T' Value
Area (x_1)	0.1052	0.2023	0.5202^{NS}
Human labour (x_2)	0.0098	0.1082	0.0849^{NS}
Bullock labour (x_3)	0.0544	0.0341	0.1594^{NS}
Suckers (x_4)	0.9727	0.2291	4.245**
FYM (x_5)	-0.1345	0.0633	-2.219^{NS}
Nitrogen (x_6)	0.1027	0.1008	1.0018^{NS}
Phosphorous (x_7)	-0.0211	0.0469	-0.0451^{NS}
Potash (x_8)	-0.1114	0.0780	-1.427**
Irrigation (x_9)	0.0001	0.1482	0.0054^{NS}
F- value	171.33		
R^2	0.987		
Return to scale	0.9740		

** - Significant At 10 Per Cent Level.

Table 4. Comparison of marginal value products of various inputs with their prices in tissue culture banana cultivation

Independent variables	Unit	Mean	b(i)	MP= bi $\frac{Y}{X}$	MVP = MP x PY	MC	MPV/MC
Area (x_1)	Hectare	0.581	0.1052	109.62	29118.36	44646.91	0.652
Human labour (x_2)	Man day	201.74	0.0091	0.0273	7.251	50	0.14
Bullock labour (x_3)	Pair day	35.34	0.054	0.9251	245.73	100	2.45
Suckers (x_4)	Number	2568.30	0.972	0.229	60.82	10.21	5.95
FYM (x_5)	Quintal	323.11	-0.134	-0.251	-66.67	21.88	-3.04
Nitrogen (x_6)	Kg	400.61	0.102	0.154	40.90	10.23	3.99
Phosphorous (x_7)	Kg	273.42	-0.021	-0.046	-12.35	14.71	-0.83
otash (x_8)	Kg	486.87	-0.114	-0.141	-37.63	6.71	-5.60
Irrigation (x_9)	Number	46.94	0.0008	0.010	2.65	96.38	0.02

Geometric mean (y) of traditional banana was 338.32 quintal and price was Rs. 265.63 per quintal.

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