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Research Note

Economic Analysis of Tissue-cultured Banana and Sucker-propagated Banana

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Abstract

An economic analysis of tissue-cultured banana (TCB) and sucker-propagated banana (SPB) has been presented through studying their costs and returns. The factors influencing the costs of their production have been identified and resource-use efficiency has been studied. The risks in cultivation of tissue-cultured banana have been highlighted. The study has been conducted in the Theni district of Tamil Nadu using personal interview method. Probit model has been employed to find out the factor influencing the adoption of tissue culture. The study has revealed that tissue-cultured banana is more profitable to farmers than sucker-propagated banana. The resources could be utilized efficiently in TCB. Gross income and bunch weight are the major factors influencing the adoption of TCB. Also, the risk is lower in TCB than in SPB. The study has suggested that farmers should be encouraged to adopt TCB to get higher yield and profits.

Introduction

Banana is one of the oldest fruits known to mankind. It is an important fruit crop in India and has great socio-economic significance. The area under banana was 3.9 lakh hectares and the production was 15.50 million tonnes in the country during 2000-2001. It ranks second, next only to mango in area and production. Tamil Nadu has the largest area under banana where it is cultivated in about 83,800 ha with annual production of 27.82 lakh tonnes. Because of its high returns, it is called as *kalpatharu* (a plant of virtues).

The changes in the life-style of people have shifted their consumption pattern towards nutritious foods like fruits. The production of fruits through conventional methods is not sufficient to meet the growing demand. Hence,

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there is a need of using modern technologies like tissue culture to fill-up the gap between the demand and supply of banana seedlings. Such plants are being cultivated at select places in the state of Tamil Nadu. It is being promoted mainly by the private companies through supplying of seed materials. At this juncture, it is important to study the performance of tissue-cultured banana over that of sucker-propagated banana. Hence, the present study was conducted with the following objectives:

(i) To estimate the costs and returns of tissue-cultured banana (TCB) and sucker-propagated banana (SPB)

(ii) To identity the factors influencing the cost of production

(iii) To assess the resource-use efficiency in tissue-cultured-banana and sucker-propagated banana

(iv) To identify the factors determining the adoption of tissue-cultured banana, and

(v) To find out the risk in cultivation of tissue-cultured banana.

Methodology

The study was conducted in the Theni district of Tamil Nadu state. The data were collected from the farmers who raised banana using suckers and tissue-cultured plantlets. The proportionate random sampling technique was adopted to select 60 sample farmers who raised banana through suckers and 30 farmers who used tissue-cultured plantlets. Thus, the total sample size was 90. Personal interview method was followed to collect data from sample farmers. From the survey data, input-wise costs on suckers, plantlets, manures, fertilizers, labour, etc. and the value of output were calculated. The market prices prevailing during the period of survey for various items were considered for estimation of costs and returns.

The Cobb-Douglas type production function was used to establish the input-output relations with gross returns as dependent variables and inputs as independent variables. The functional relationship is expressed by Equation (1):

$$Y = aX_1^{b1} X_2^{b2} X_3^{b3} X_4^{b4} X_5^{b5} X_6^{b6} e^{U} \quad \ldots(1)$$

where,

Y = Gross return from TCB or SPC (Rs/ha)
X_1 = Sucker/plantlet cost (Rs/ha
X_2 = Cost of manures (Rs/ha)
X_3 = Fertilizer cost (Rs/ha)
X_4 = Labour cost (Rs/ha)

X_5 = Land area under TCB/SPB (ha)

X_6 = Dummy variable (1 for planting during August-September season, 0 otherwise.

b_1 to b_6 = Elasticity coefficients corresponding to each X_i's.

The probit model was employed to find out the factors influencing the adoption of tissue culture. The dependent variable in the model was adoption of TCB. Its value was taken as 0 for non-adoption and 1 for adoption. Adoption of TCB was dependent on both economic and non-economic factors, as shown in the Equation (2):

$$Ii = B_1 + B_2 (EDN) + B_3 (GINCOME) + B_4 (BUNCHWT) + B_5 (AREA) + e \quad \ldots(2)$$

where,

Ii = 1, if farmers adopted TCB

0, if farmers adopted SPB

EDN = Educational status of the farmer
(Illiterate – 1, Primary – 2 , Middle – 3, High school – 4, Higher secondary – 5, College – 6)

GINCOME = Gross income from TCB/SPB (in Rs/ha)

BUNCHWT = Average bunch weight of TCB/SPG (kg)

B_2 to B_6 = Co-efficients

B_1 = Intercept

Ashok Kumar *et al*. (2002) have evaluated different types of risk in terms of coefficient of variation in different crops. In this paper also C.V. was employed to find out the risk in tissue-cultured banana. The formula used is given by Equation (3):

$$C.V. = \frac{S.E.}{\text{Mean yield}} \times 100 \quad \ldots(3)$$

where S.E. = Standard error of the yield

Results and Discussion

Total Costs

The total costs included both total variable cost and total fixed cost incurred in the production of banana. It was estimated for TCB and SPB and the estimates are furnished in Table 1 .

Table 1. Total cost incurred in production of TCB and SPB

(Rs/hectare)

Particulars	TCB		SPB	
	Value (in Rs)	% to total	Value (in Rs)	% to total
Variable cost	125180	88.76	92225	85.16
Fixed cost	15860	11.24	16069	14.84
Total cost	141040	100.00	108294	100.00

It could be seen from Table 1 that the total costs of cultivation of TCB and SPB were Rs 141040 and Rs108294 per hectare, respectively and it was higher for TCB by 30.24 per cent. In TCB and SPB, the percentage of fixed cost was 11.24 and 14.84, respectively and the remaining was variable cost, i.e. 88.76 per cent for TCB and 85.16 per cent for SPB. The total cost for TCB was higher because of high plantlet cost and other variable cost items.

Returns

The gross income and net income realized per hectare from TCB and SPB are presented in Table 2.

Table 2. Income from tissue-cultured and sucker-propagated bananas

S.No.	Particulars	TCB	SPB
1.	Mean yield (bunches/ha)	2663	2416
2.	Mean price received (Rs/bunch)	94.47	76.42
3.	Value of main product (Rs/ha)	251573	184630
4.	Value of by-product (Rs/ha)	1729	2518
5.	Gross income (Rs/ha)	253302	187149
6.	Total expenses (Rs/ha)	141040	108294
7.	Net income (Rs/ha)	112262	78855
8.	Cost of production per bunch (Rs)	52.31	43.78
9.	Net income per bunch (Rs)	42.16	32.64

Gross income was obtained by adding the value of all banana bunches and value of suckers at harvest prices, without including the marketing cost. The gross income was higher by 35.35 per cent in TCB than SPB, which worked out to Rs 2,53,302 and Rs 1,87,149 per hectare, respectively. The net income was also higher by 42.37 per cent in TCB than in SPB. This indicated the economic advantage of TCB over SPB. The cost of production per bunch was Rs 52.31 and Rs 43.78 in TCB and SPB, respectively.

Resource-use Efficiency

Resource-use efficiency in tissue-cultured banana and sucker-propagated banana was estimated and is discussed below.

Tissue-cultured Banana

It is evident from Table 3 that the co-efficient of multiple determination (R^2) was 0.82 for TCB which indicated that 82 per cent of the total variation in the gross return was explained by the selected six variables for functional analysis. The co-efficients of plantlets (X_1), manure (X_2), and fertilizer (X_3) were positive and significant at 1 per cent level. Labour cost (X_4) had negative and non-significant influence on gross income, while the land and dummy variable used for planting season had positive but non-significant influence.

The returns to scale was obtained by adding elasticities of all resources and it was 1.06 for TCB. It is very close to unity, indicating constant returns to scale.

Sucker-propagated Banana

It could be seen from Table 4 that the coefficient of multiple determination (R^2) for SPB was 0.69 which indicated that 69 per cent of the total variation in the gross return was explained by the selected six variables in the functional analysis.

The co-efficients of sucker cost (X_1) and fertilizer cost (X_2) were positive and significant at 1 per cent levels. These two variables had influenced the gross return in SPB. The sum of elasticities of resources was 0.69 for SPB, which indicated the decreasing returns to scale.

Marginal Productivity Analysis

The efficiency in the use of various resources can be studied more reliably by marginal productivity analysis. Hence MVP, and MIC were estimated and are presented in Tables 5 and 6.

Tissue-cultured Banana

It is observed from the Table 5 that for the cost of plantlets and fertilizers, MVP is less than MIC, indicating the excessive use of these resources. The MVP is higher than MIC for manures, which indicates that the use of manure would increase the gross return.

Table 3. Results of the production function analysis for TCB

Variables	Regression coefficient	Standard error	*t*-statistics	Significance
Intercept	1.0607	0.6909	1.5352	NS
Plantlet cost (Rs/ha) (X_1)	0.6300	0.1031	6.1084	**
Cost of manure (Rs/ha) (X_2)	0.3140	0.0876	3.6523	**
Fertiliser cost (Rs/ha) (X_3)	0.1663	0.0515	3.2307	**
Labour cost (Rs/ha) (X_4)	-	0.1065	-	NS
Land area (ha) (X_5)	0.0483	0.0290	1.6678	NS
Dummy (X_6)	0.0274	0.0189	1.4476	NS

Number of observations = 30; Adjusted R^2 = 0.82; F- value=22.56**
Returns to scale Σb_i =1.06
**Significant at one per cent level, NS = Non-significant

Table 4. Results of the production function analysis for SPB

Variables	Regression coefficient	Standard error	*t*-statistics	Significance
Intercept	2.0981	0.5456	3.8451	**
Sucker cost (Rs/ha) (X_1)	0.1580	0.0487	3.2417	**
Cost of manure (Rs/ha) (X_2)	0.0140	0.0144	0.9760	NS
Fertiliser cost (Rs/ha) (X_3)	0.7173	0.0906	7.9156	**
Labour Cost (Rs/ha) (X_4)	-0.1293	0.0938	-1.3777	NS
Land area (ha) (X_5)	-0.0370	0.0266	-1.3896	NS
Dummy (X_6)	0.0482	0.0178	2.6866	**

Number of observations = 60; Adjusted R^2 = 0.69 F- value = 22.64**;
Returns to scale Σb_i = 0.77
** Significant at one per cent level; NS = Non-significant

Sucker-propagated Banana

A perusal of Table 6 revealed that for the sucker cost, MVP > MIC, which indicated that there was a scope for increasing the use of resources. For fertilizers, MVP < MIC, which indicated excessive use of fertilizers.

These results showed clearly that some of the resources were not being properly utilized by both TCB and SPB sample farmers. Hence, the resources which were not being used efficiently in the production process need to be reallocated to obtain higher gross returns from TCB and SPB.

Factors Influencing Adoption of Tissue-cultured Banana

The Probit Model was employed to find out the factors influencing the adoption of tissue-cultured banana and the results are presented in Table 7.

Table 5. Marginal productivity of resources in TCB

Variables (Rs/ha)	Geometric mean	Regression coefficient	MVP (Rs)	Factor cost (MIC) (Rs)	Relationship of MVP to factor cost
Gross return	248828.43	-	-	-	-
Plantlet cost	29437.44	0.6300	5.32	10	MVP < MIC
Cost of manure	13427.65	0.3140	5.81	0.81	MVP > MIC
Fertilizers cost	16191.98	0.1663	2.55	16.25	MVP < MIC

Table 6. Marginal productivity of resources in SPB

Variables (Rs/ha)	Geometric mean	Regression coefficient	MVP (Rs)	Factor cost (MIC) (Rs)	Relationship of MVP to factor cost
Gross return	178402.12	-	-	-	-
Sucker cost	7379.04	0.1580	3.81	2.16	MVP > MIC
Fertilizers cost	16618.81	0.7173	7.70	16.25	MVP < MIC

Table 7. Parameter estimates of Probit model

Variables	Regression co-efficients	Standard error	'*t*'-value	Significance
Intercept	-5.2851	0.5521	-9.5723	**
EDN	-0.0003	0.0618	-0.0052	NS
AREA	-0.1159	0.0314	-3.6964	**
GINCOME	0.00001	0.0000	4.8785	**
BUNCHWT	0.0539	0.0180	2.9891	**
Pearson goodness of fit (chi-square)		213.80	**	

** = Significant at one per cent level; NS = Non-significant; $R^2 = 0.74$

The value of R^2 is 0.74 which indicates that 74 per cent of variations on decision to adopt tissue-cultured banana was explained by the variables included in the model. The Pearson Goodness of Fit (chi-square) was 213.80 for the whole function, which was significant at one per cent level of probability. The variable, area under banana (AREA) was found to have a negative and significant influence on the adoption of TCB at one per cent probability level. This implied that increase in farm-size would reduce the probability of adoption of TCB. The coefficient for area was –0.1159 which indicated that increase in area by one hectare would reduce the probability of adoption by 0.12 per cent on an average, i.e. in the study area TCB was cultivated only in small and marginal areas because of the need of special care for TCB cultivation. Gross income from banana (GINCOME) and

Table 8. Production risk in TCB and SPB

Particulars	TCB	SPB
Average bunch weight (kg)	32.40	28.86
Average yield (t/ha)	93.59	64.99
S.E.	15.6184	11.8622
Variance	243.93	140.711
C.V.(%)	16.69	18.25

bunch weight (BUNCHWT) had positive and significant influence of TCB adoption. The coefficient for bunch weight was 0.05. It meant that increase in bunch weight by one kg would increase the probability of adoption of tissue-cultured banana by 0.05 per cent on an average. Based on these results, one could conclude that bunch weight is the most influencing variable for the adoption of tissue-cultured banana.

Production Risk in Tissue-cultured Banana

In order to find out whether there is any risk in tissue-cultured banana cultivation as against the sucker-propagated banana, coefficients of variation in yield were worked out and are presented in Table 8. The average bunch weight was higher in TCB (32.40 kg) than in SCB (28.86 kg). This led to increased productivity of TCB. But the coefficient of variation was only 16.69 per cent in TCB as compared to 18.25 per cent in SPB. It indicates clearly that the risk in cultivation of banana using tissue-cultured plantlets is lower than the sucker-propagated banana. Hence, it could be concluded that farmers may be encouraged to adopt cultivation of tissue-cultured banana.

Constraints in TCB

The sample farmers expressed that the cost of tissue-cultured plantlet was higher and small plants were also seen as against the expectation of uniform height of plants. Hence they opined that if good quality plantlets were supplied, they will be benefited more. A few farmers experienced problems in marketing of big size bunches obtained from TCB.

Conclusions

The study has shown that tissue-cultured banana was more profitable than sucker-propagated banana. Also, the resources could be used more efficiently in TCB. Through Probit model analysis, it has been found that gross income and bunch weight are the major factors influencing the

adoption of tissue-cultured banana. Since the performance of TCB was better than SPB and the risk is lower, farmers may be encouraged to adopt tissue-cultured banana to get higher profits and increased production of banana.

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