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An economic analysis of turmeric production in Tamil Nadu, India

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Research Paper

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ABSTRACT

The present study revealed that the cost of cultivation of turmeric per hectare was Rs. 119873.75. The gross income realized per hectare was Rs. 247754.92. The net income was Rs. 127881.17 per ha. The Cobb-Douglas production function showed that planting material, nitrogen, potash, harvesting and curing, machine hours and irrigation contributed significant influence on yield of turmeric. The technical efficiency analysis indicated the importance of harvesting and curing, and irrigation in turmeric cultivation. The positive value of NPV, BCR of greater than one and IRR of more than current bank rate revealed the financial feasibility of turmeric processing unit.

Key words: Cobb-Douglas production function, MVP, MIC, NPV, BCR and IRR

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INTRODUCTION

Turmeric is an important commercial spice crop grown in India and it is named as “Indian saffron”. Some famous varieties of turmeric are Local Haldi, China scented, Thodopuza, Red streaked and Alleppey and among which, Alleppey is more popular in American Markets. India shares around 78 per cent of the global turmeric production. India has 182.04 thousand hectares under turmeric cultivation with a total production of 829.30 thousand tonnes and a yield of 4555 kg/ha (Madan, 2008).

Tamil Nadu occupies second position with 16.60 per cent of national area and 20.48 per cent of Indian production. Dharmapuri is one of the major turmeric growing districts in Tamil Nadu. Turmeric produced in Dharmapuri is sent throughout the country.It ranks third in area and production in the state after Erode and Salem districts. The area under turmeric in Dharmapuri district is 12.37 per cent of total state area and total production is 7.05 per cent of total state production with productivity of 3049 kg per hectare Eswaran (1985) in his study on marketing of turmeric in Erode block of Periyar district, identified that the price spread for turmeric was 53.42 percent of consumer’s rupee. Hence, the present study aims to analyze the production of turmeric focusing on resource use efficiency , technical efficiency and economic feasibility of establishment of turmeric processing unit to overcome the marketing problems.

OBJECTIVES OF THE STUDY

(i)To estimate the costs and returns of turmeric cultivation
(ii)To find out the resource use efficiency and technical efficiency of turmeric farms
(iii)To assess the financial feasibility of starting a turmeric processing industry
(iv)To identify the constraints in production and suggest measures for improvement.

DESIGN OF THE STUDY

Choice of the study area

Dharmapuri district of Tamil Nadu, India was purposively selected for the present study in the first stage since it occupied the third position in area under turmeric in the state of Tamil Nadu In the second stage, among the blocks in Dharmapuri district based on area under turmeric Harur, Pappireddipatty and Morappur blocks were selected purposively for the present study. These three blocks accounted for more than 50 per cent of area under turmeric in this district. The villages of the selected three blocks were listed and two villages were selected at random from each block.

Finally six villages were selected for the study. From

each selected village fifteen turmeric growers were selected at random. Thus the total sample size arrived was 90 and two stage random sampling technique was adopted for the study.

Tools of analysis

Functional analysis

Cobb- Douglas production function was selected for the study.
The form of regression model used was

$Y = a\ X_1^{b1}\ X_2^{b2}\ X_3^{b3}\ X_4^{b4}\ X_5^{b5}\ X_6^{b6}\ X_7^{b7}\ X_8^{b8}\ X_9^{b9}\ X_{10}^{b10}\ U_t$

Where,
Y=Yield of turmeric (kgs /ha)
X_1 =Quantity of planting material (Kgs /ha.)
X_2 =Quantity of farmyard manure (tonnes/ha)
X_3 =Quantity of nitrogen (Kgs /ha.)
X_4=Quantity of phosphorous (Kgs /ha.)
X_5=Quantity of potash (Kgs /ha.)
X_6 = Cost of plant protection (Rs/ha.)
X_7=Cost of harvesting and curing (Rs/ha.)
X_8= Human labour (man days/ha.)
X_9= Machine hours (hrs. /ha.)
X_{10}= Irrigation (numbers/ Crop season)
U_t = Error term
a, b_1, b_2, …….. b_{10} = Parameters to be estimated

Economic efficiency

Estimate of the parameters $\beta_{1.....}\beta_{10}$ were elasticities of Y with respect of j^{th} input. The marginal products of the resources were derived from these elasticity coefficients. The marginal productivities of significant inputs were worked out at its geometric mean level. The economic efficiency of resource use and the Marginal Value products of each input were compared with its MIC in order to estimate the efficiency. Equality of MVP_j to the MIC of input 'j' indicates the optimum resource use of a particular input. Ratio of MVP_j to the MIC of input 'j' indicated the degree of resource use efficiency.

Stochastic Frontier Production Function

Stochastic frontier production function was attempted to measure the technical efficiency in the turmeric production. Maximum Likelihood Estimation (MLE) procedure was adopted for the estimation of the parameters involved. The specification procedure for stochastic frontier production function is given below.The stochastic frontier production function with a composed error term is more suitable to estimate the technical efficiency. The general form of the stochastic frontier production function is

$Y_i = X_i \alpha + v_i - u_i$ …… (1)

where,
Y_i is the dependent variable, X_i s are the independent variables and α is the regression coefficient. In this model the dependent variable is bounded by the stochastic variable $v_i - u_i$. The random error, v_i can be positive or negative. It captures the effects of random shocks outside the farmers control, observation and measurement error on dependent variable and statistical noise.

The other independent error term u_i is a non- negative term representing farm specific technical inefficiency in the sense that it measures short fall output (Y_i) from its maximum possible value given by stochastic frontier. When the model (1) is estimated, one can measure the mean technical efficiency of a farm. The following functional form was used to estimate the individual technical efficiencies and to examine the factors affecting them. The analysis is done (1) in a single step procedure by combining the following models (2) and (3) using a computer program FRONTIER version 4.1.

$\mathbf{L}n\ (\mathbf{Y}_i) = \alpha_0 + \sum_n\ \alpha_k\ \mathbf{L}_n\ (\mathbf{X}_{ki}) + v_i - u_i$…….. (2). (Cobb-Douglas production function)

$\mu_i = \delta_0 \sum^{K=1}{}^{n} \delta_m . Z_m$……(3) (Linear Equation).
where,
Y_i = output of i^{th} crop (kg / ha)
X_{ki} = use of k^{th} input
V_i = random error to be identically and independently distributed N (0, $\sigma^2 V$)
u_i = farm specific inefficiency effect
Z_m = factors affecting technical inefficiency.
α's and δ's = regression coefficients to be estimated.

The stochastic frontier production function model specified for turmeric crop is given below

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$Ln\ (Y) = \alpha_0 + \alpha_1\ ln(X_1) + \alpha_2\ ln(X_2) + \alpha_3\ ln(X_3) + \alpha_4\ ln(X_4) + \alpha_5\ ln(X_5) + \alpha_6\ ln(X_6) + \alpha_7\ ln(X_7) + \alpha_8\ ln(X_8) + \alpha_9\ ln(X_9) + \alpha_{10}\ ln(X_{10}) + v_i - u_i$ (Cobb- Douglas type)
$\mu = \delta_0 + \delta_1 z_1 + \delta_2 z_2 + \delta_3 z_3$ (Linear type)

Where
Y = Yield of turmeric (kgs /ha)
X_1=Quantity of planting material (Kgs /ha.)
X_2 = Quantity of farmyard manure (tonnes/ha)
X_3 = Quantity of nitrogen (Kgs /ha.)
X_4 = Quantity of phosphorous (Kgs /ha.)
X_5 =Quantity of potash (Kgs /ha.)
X_6 =Cost of plant protection (Rs/ha.)
X_7 =Cost of harvesting and curing (Rs/ha.)
X_8 =Human labour (man days/ha.)
X_9 =Machine hours (hrs. /ha.)
X_{10} =Irrigation (numbers/ Crop season)
Z_1 =Experience in turmeric farming (in years)
Z_2=Education of the farmer (in years)
Z_3 =Farm size (in hectares)

Financial feasibility analysis

For financial feasibility analysis two assumptions are made
(a) Growth rate of turmeric rhizome price and turmeric powder price was worked out and it was found to be 8 per cent and 10 per cent respectively.
(b) The price of turmeric rhizome and turmeric powder remains the same for fifteen years (constant price).

Using this cash outflow and cash inflow for the life period of 15 years was worked out. Cash inflow is the value of the turmeric powder produced per year. The capacity of the unit is 2 tonnes per day and the processing unit is working for 200 days per year.

The market price of turmeric powder is taken and it is multiplied with quantity produced per year. Normally the recovery is 98 per cent i.e. for 100 kg of rhizome the turmeric powder produced is 98 kg. Cash out flow is the sum of expenses of rhizome, labour charges, electricity, packing material, and salary to permanent staff, maintenance cost of processing unit and building and interest on working capital. It is the difference between the cash inflow and cash outflow.

The major component in processing unit is machinery and the life period is fifteen years. The life period of machinery is taken as the life period of the project.

Investment on processing unit

The initial investment on processing unit includes cost of land and building, processing machines and accessories, office furniture and fixtures. For two tonnes capacity, establishment cost was Rs. 22.54 lakhs. For calculation of net present value and benefit cost ratio 12 per cent discount rate is used which is the normal lending rate for long term projects.

Financial feasibility

Net present value (NPV): It is the difference between the sum of present worth of benefits and sum of present worth of cost for given discount rate. Positive value of NPV obtained when discounted at the opportunity cost of capital, then the investment is considered viable.

Benefit-Cost ratio (B-C Ratio): It shows how much benefits can be generated per rupee of investment. The BCR is the ratio of sum present value of benefit to sum of present value of cost for a given discount rate. If the B-C ratio is more than one hich indicates the viability of investment.

Internal Rate of Return (IRR):IRR is the discount rate which just makes the net present worth of cash flow equal to zero. The investment is considered viable if the calculated IRR is greater than that of the bank interest rate (opportunity cost of capital).

Garrett's Ranking Technique

The respondents were asked to rank the problems in turmeric production, processing and marketing. In the Garrett's ranking technique these ranks were converted into percent position by using the formula

$$\text{Percent position} = \frac{100 \text{ X } (R_{ij} - 0.5)}{N_j}$$

where,

R_{ij} = Ranking given to the i^{th} attribute by the j^{th} individual
N_j = Number of attributes ranked by the j^{th} individual.
By referring to the Garrett's table, the per cent positions estimated were converted into scores. Thus for each factor the scores of the various respondents were added and the mean values were estimated. The mean values thus obtained for each of the attributes were arranged in descending order. The attributes with the highest mean value was considered as the most important one and the others followed in that order.

RESULTS AND DISCUSSION

Cost of production in turmeric cultivation

Fixed cost

The fixed cost incurred by the sample farmers in turmeric cultivation was worked out and the results are given in Table 1. From the Table, it could be observed that total fixed cost incurred by the sample farmer per ha was Rs.17781.65. (Table.1). Rental value for land had major

Table 1. Fixed cost of production of turmeric.

S/N	Particulars	Amount (Rs/ha)	Percentage to total fixed cost
1	Rental value of land	13125.00	73.81
2	Land revenue	306.36	1.72
3	Depreciation on equipment	2445.12	13.75
4	Interest on fixed capital	1905.18	10.72
	Total fixed cost	17781.65	100.00

Table 3. Costs and returns in turmeric cultivation.

S/N	Particulars	Amount (Rs)
1	Total fixed cost/ ha	17781.66 (14.83)
2	Total variable cost/ha	102092.09 (85.17)
3	Total cost of production/ha	119873.75 (100.00)
4	Gross income	247754.92
5	Net income	127881.17
6	Cost of production / kg	31.23
7	Net returns/kg	33.32

share in fixed cost accounting for about 73.81 per cent while depreciation on equipment, interest on fixed capital and land revenue contributed about 13.75 per cent, 10.72 per cent and 1.72 per cent respectively.

Variable Cost

Variable cost includes the cost for preparatory cultivation, seed and sowing, manures and fertilizers, intercultivation, plant protection, irrigation, harvesting and curing and interest on working capital. The variable cost incurred by the sample farmers in turmeric cultivation was worked out and the results are given in Table 2.

It could be observed from the Table 2 that total variable cost of the sample respondents was Rs. 102092.09 per hectare. Of the total variable cost, seed and sowing accounted for highest proportion with 26.80 per cent to the total variable cost followed by manures and fertilizers with 19.00 per cent and harvesting and curing with 17.54 per cent. These three operations together accounted for nearly two third of the total variable cost. Intercultivation, preparatory cultivation and plant protection accounted for a lesser proportion to total variable cost. The results are in line with the findings of Lokesh and Chandrakanth (2004) who in their study stated that the cost of planting material shared higher percentage to the total variable cost in turmeric cultivation.

Costs and returns in turmeric cultivation

It could be seen from (Table 3) that the total cost of production of turmeric was Rs. 119873.75 per ha. The share of variable cost and fixed cost to the total cost of cultivation was 85.17 per cent and 14.83 per cent respectively. The similar results were obtained with the findings of Chinnappa, (1998) who in their study shown that variable cost accounted more proportation than fixed cost in total cost of production of sugarcane. Gross income from turmeric cultivation was Rs. 247754.92 per ha. and net income was Rs. 127881.17 per ha. Cost of production per kg was Rs. 31.23 and the net return per kg was Rs. 33.32.

Resource use efficiency in turmeric farms

Results of Cobb-Douglas production function for turmeric in Dharmapuri district is furnished in Table 4. It could be seen from the table that coefficient of multiple determinations (R^2) was 0.58 revealing that the production function model was a good fit. The coefficients of planting material, potash, harvesting and curing, machine hours, and irrigation were positive and significant at one per cent level with the coefficient values of 0.29, 0.15, 0.24, 0.32 and 0.33 respectively which indicated that these were the significant operations in turmeric cultivation. The variable nitrogen was positive and significant at five per cent level with a coefficient value of 0.12. Thakare et al., (2005) used the Cobb-Douglas production function to work out the resource use efficiency in turmeric and concluded that the regression coefficients of area, seed and bullock labour were significant while those of physical labour, manures and

Table 2. Variable cost of production of Turmeric (Rs./ha).

S/No	Particulars	Material Input (Qty/ha)	Material Input (value in Rs)	Machine or Human Labour cost (Rs)	Total Amount (Rs)	Percentage
1	Preparatory cultivation	0.00	0.00	9026.79	9026.79	8.84
2	Seeds and sowing (kgs/ha.)	1950.16	25147.98	2213.14	27361.12	26.80
3	Manures (tonnes/ha.)	10.14	7792.94	1331.93	9124.87	8.94
	Fertilizers (kgs/ha.)					
4	a) Inorganic	1190.27	9247.78	0.00	0.00	
	b) Organic	224.90	426.69	0.00	0.00	
	Total fertilizers (kgs/ha.)	1415.17	9674.47	596.17	10270.64	10.06
5	Intercultivation	180.00	0.00	10798.12	10798.12	10.58
6	Plant protection	0.00	4356.88	902.25	5259.13	5.15
7	Irrigation	25.94	2446.78	3372.78	5819.56	5.70
8	Harvesting and curing	0.00	0.00	17913.01	17913.01	17.54
9	Interest on working capital	0.00	0.00	6518.85	6518.85	6.39
	Total variable cost	0.00	0.00	0.00	102092.09	100

Table 4. Resource use Efficiency in Turmeric Production.

S/N	Variables	Regression coefficient	Standard error	MVP	MIC	MVP-MIC
1	Regression Constant	0.38	0.93			
2	Planting material (kgs/ha.)	0.29**	0.10	38.67	12.84	3.01
3	Nitrogen (kgs/ha.)	0.12*	0.06	182.41	10.87	16.78
4	Phosphorous (kgs/ha.)	-0..01NS	0.05	-	-	-
5	Potash (kgs./ha.)	0.15**	0.06	543.28	7.67	70.83
6	Harvesting and curing (Rs/ha.)	0.24**	0.06	4.24	8.50	0.49
7	Machine hours (hrs/ha.)	0.32**	0.12	4376.29	370	11.82
8	Irrigation (numbers/ crop season)	0.33**	0.12	3670.91	224.35	16.36

R^2 = 0.58** , R^{-2} = 0.54** ,F- ratio = 16.26 ,N = 90 ** Significant at 1 percent level * Significant at 10 percent level NS Non-significant.

fertilizers and irrigation were non significant

Economic efficiency in turmeric farms

To evaluate the economic efficiency of resource use, marginal value productivity (MVPs) for the significant explanatory variables were worked out and compared with the unit cost of the respective resource (MIC). The ratio between MVP and MIC of planting material, nitrogen, potash, machine hours and irrigation was more than one. It indicated that the above resources are at sub optimum level and there exist a possibility for enhancing the yield of turmeric by increasing the respective inputs from the existing level. The reduction in rupees per hectare for harvesting and curing from the existing mean level was required since MVP is less than MIC.

Technical efficiency in turmeric farms

The technical efficiency of the sample farms in the

Table 5. Estimated Stochastic Frontier Production Function for Turmeric.

S. No.	Variables	Regression coefficient	Standard error	Significance
A	Frontier production function			
1	Constant	-0.065	0.907	NS
2	Planting material (kgs/ha.)	0.321	0.092	**
3	Nitrogen (kgs/ha.)	0.152	0.064	*
4	Phosphorous (kgs/ha.)	-0.032	0.041	NS
5	Potash (kgs./ha)	0.122	0.057	*
6	Harvesting and curing (Rs/ha.)	0.287	0.061	**
7	Machine labour (hrs/ha.)	0.212	0.119	NS
8	Irrigation (numbers/ha.)	0.491	0.104	**
B	Technical inefficiency effects			
	Constant	-0.170	0.461	NS
	Education (years)	-0.121	0.013	NS
	Farm Size (ha)	0.031	0.023	NS
	Farming experience (years)	0.002	0.008	NS
C.	Diagnosis Statistics			
	Sigma-square (σ^2)	0.055	0.019	**
	Gamma (γ)	0.999	0.071	**
	Log- likelihood	45.22		
	Mean technical efficiency (%)	84.13		

N= 90 ** 1 per cent level NS- Non significant * 5 per cent level.

production of turmeric was worked out by adopting Maximum likely-hood Estimation (MLE) method using Stochastic Frontier Production function. The stochastic frontier production function model specified by Battese and Coelli (1995) was used to estimate technical efficiency of turmeric in the sample farms selected for the study.A computer program FRONTIER version 4.1 developed by Tim Coelli, Centre for efficiency and productivity Analysis, University of New England, Austria, was used for the estimation of Stochastic Frontier Production function. The estimated stochastic frontier production for turmeric in Dharmapuri district by using maximum likelihood method is furnished in Table 5.The estimate of gamma (γ) which is the ratio of the variance of farm specific performance of technical efficiency to total variance of output was significant at one per cent level, with a value of 0.99, indicating the presence of one sided error component. This implied that the effect of technical inefficiency was significant. Hence the average production function (OLS) was not an adequate representation of the data. The variance ratio, defined by g = s 2 / (s2u + s2v), was estimated as 0.99, implying that about 99.00 percent of the disparities between the observed output and the frontier output were due to technical inefficiency. In other words, the shortfall in observed output from the frontier output (one percent) was primarily due to the factors, which were within the control of the turmeric growers in the sample under study.

The coefficients (production elasticity) of planting material, harvesting and curing, and irrigation were significant at one per cent with the values 0.321, 0.287 and 0.491 respectively, which implied that one per cent increase in the respective inputs could increase turmeric yield by 0.321, 0.287 and 0.491 per cent, respectively.The coefficient of nitrogen and potash were significant at five per cent with the values 0.152 and 0.122 respectively, which implied that one per cent increase in the respective inputs could increase turmeric yield by 0.152 and 0.122 per cent, respectively. The results indicated the importance of planting material, nitrogen, potash, harvesting and curing, and irrigation in improving per ha yield of turmeric in the Dharmapuri district. The inefficiency variables included in the model such as education, farm size and farming experience were non-significant. The variation in the levels of efficiency of turmeric growers ranged from 54.53 to 97.09 with mean efficiency of 84.13 per cent (Table 6). The mean level of technical efficiency indicates that on an average 15.87 per cent of turmeric growers falling short of the maximum possible frontier level of technology. Therefore it was possible to increase the turmeric yield by 15.87 per cent of turmeric growers on average by adopting the technology used by best performers. About 5.56 per cent of the farmers belonged to the most efficient category (96 to 100) while 1.11 per cent belonged to least efficient category (51 to 55). The

Table 6. Frequency distribution of turmeric farms based on technical efficiency.

S/N	Technical efficiency classes (per cent)	No. of farms	Percentage to total
1	51-55	1	1.11
2	56-60	3	3.33
3	61-65	3	3.33
4	66-70	5	5.56
5	71-75	7	7.78
6	76-80	9	10.00
7	81-85	14	15.56
8	86-90	17	18.89
9	91-95	26	29.89
10	96-100	5	5.56
	Total	90	100.00
	Mean technical efficiency	84.13	

Table 7. Cost and returns from turmeric powdering unit per annum.

S/N	Particulars	Amount (in lakh Rs)	Percentage
I	Establishment of powdering unit		
1	Land and building value	10.29	45.63
2	Cost of processing machines and accessories	11.79	52.32
3	Office furniture and fixtures	0.46	2.05
4	Total establishment expenses	22.54	100.00
I a	Annual share of establishment cost	1.50	0.99
II	Annual processing expenditure		
A	Total annual variable cost		
1	Cost of rhizome	128.21	84.30
2	Labour charges	4.60	3.03
3	Cost of electricity	0.45	0.30
4	Packaging materials	2.09	1.37
5	Interest on working capital at 7 per cent	9.48	6.23
	Total annual variable cost	144.83	95.23
B	Total annual fixed cost		
1	Salary to permanent staff	0.48	0.32
2	Maintenance cost of processing unit and building	0.43	0.28
3	Rental value of building	2.54	1.67
4	Depreciation of machineries at 10 per cent	1.18	0.78
5	Depreciation of building at 5 per cent	0.50	0.33
6	Interest on fixed Investment at12 per cent	0.62	0.40
	Total annual fixed cost	5.75	3.78
III	Total annual processing cost	152.08	100.00
IV	Cost of processing/ tonne	0.38	
V	Gross income/year	548.80	
VI	Profit	396.72	
VII	Profit / tonne	0.99	

majority constituting 29.89 per cent of the turmeric growers belonged to efficiency groups falling between 91 to 95 per cent. The results are similar with the findings of Bhendi (2007) who had shown that mean technical

Table 8. Financial feasibility analysis of turmeric powdering unit (Rs in lakhs) with current market price.

Year	Initial investment	Cash outflow	Cash inflow	Net cash flow	NPV (12 %)	Present worth of cash outflow	Present worth of cash inflow	NPV (60%)
0	22.54	22.54	0.00	-22.54	-22.54	22.54	0.00	-22.54
1		145.74	548.80	403.06	359.88	130.12	490.00	251.91
2		156.71	603.68	446.97	356.32	124.93	481.25	174.59
3		168.57	664.05	495.48	352.67	119.98	472.66	120.97
4		181.37	730.45	549.09	348.95	115.26	464.22	83.78
5		195.19	803.50	608.30	345.17	110.76	455.93	58.01
6		210.12	883.85	673.72	341.33	106.45	447.78	40.16
7		226.25	972.23	745.98	337.46	102.34	439.79	27.79
8		243.67	1069.46	825.79	333.52	98.41	431.94	19.22
9		262.48	1176.40	913.92	329.57	94.65	424.22	13.30
10		267.38	1294.04	1026.66	330.56	86.09	416.65	9.34
11		304.73	1423.46	1118.72	321.61	87.60	409.21	6.36
12		328.42	1565.79	1237.37	317.60	84.29	401.90	4.40
13		354.01	1722.37	1368.35	313.59	81.13	394.72	3.03
14		381.65	1894.61	1512.96	309.58	78.09	387.67	2.10
15		411.50	2084.07	1672.57	305.57	75.19	380.75	1.45
					4980.84	1517.83	6498.69	793.87

DR = Discount Rate, NPV at 12 % Discount rate =4980.84 lakhs , NPV = Net Present Value, B-C Ratio at 12 % Discount rate = 4.28
IRR = Internal Rate of Return , IRR = Greater than 60 per cent.

efficiency of paddy, sorghum, groundnut and cotton were 79 percent, 86 percent, 80 percent and 94 percent.

Economics of turmeric powdering unit

The cost incurred by the sample processor and returns from turmeric powdering unit per annum were worked out and the results are given in Table 7. From the table it could be observed that the total establishment expenditure was Rs. 22.54 lakhs. Of which, cost of processing machines and accessories shared relatively higher proportation (52.32 per cent) followed by land and building value. Annual share of establishment cost was Rs. 1.50 lakhs.

The total variable cost was worked out as 95.23 percent to the total annual processing cost. Here the value of rhizome was arrived by multiplying the annual average price and the total quantity of rhizome used. Of the total variable cost, cost of rhizome alone accounted for highest proportion with 84.30 per cent to total cost.

The total fixed cost required for turmeric powdering industry was Rs. 5.75 lakhs which accounted for 3.78 per cent. The total fixed cost constituted salary to permanent staff, maintenance cost of processing unit and building, rental value of building, depreciation of machineries and building and interest on fixed investment. The results are in line with the findings of Lokesh and Chandrakanth (2004) who in their study shown that total variable cost was more proportion than total fixed cost in total annual processing cost of turmeric powdering unit. The total annual processing cost was Rs. 152.08 lakhs and cost of processing per tonnes was Rs. 0.38 lakhs. The gross income was estimated at Rs. 548.80 lakhs. Finally the profit per tonnes was worked out at Rs. 0.99 lakhs.

Financial feasibility analysis of turmeric powdering unit

The financial feasibility analysis for starting a rural turmeric powdering unit for producing turmeric powder per annum was worked out and presented in Table 8 and 9. To evaluate the financial feasibility of investment in turmeric powder processing unit, the project evaluation criteria of Net Present Value (NPV), Benefit Cost Ratio (BCR) and Internal Rate of Return were employed.

The net present value for turmeric powder processing unit was worked out to Rs.4980.84 lakhs with varying prices at 12.00 per cent discount rate and Rs. 2722.68 lakhs at constant prices which indicated the soundness of investment in turmeric powder processing plant. The benefit- cost ratio for turmeric powder processing unit was 4.28 with varying price and 3.68 at constant prices

Table 9. Financial feasibility analysis of turmeric powdering unit (Rs in lakhs) with constant price.

Year	Initial investment	Cash outflow	Cash inflow	Net cash flow	NPV (12 %)	Present worth of cash outflow	Present worth of cash inflow	NPV (60%)
0	22.54	22.54	0.00	-22.54	-22.540	22.54	0	-22.54
1		145.74	548.80	403.06	359.88	130.12	490.00	251.91
2		145.74	548.8	403.06	321.32	116.18	437.50	157.45
3		145.74	548.8	403.06	286.89	103.73	390.63	98.40
4		145.74	548.8	403.06	256.15	92.62	348.77	61.50
5		145.74	548.8	403.06	228.71	82.70	311.40	38.44
6		145.74	548.8	403.06	204.20	73.84	278.04	24.02
7		145.74	548.8	403.06	182.33	65.92	248.25	15.02
8		145.74	548.8	403.06	162.79	58.86	221.65	9.39
9		145.74	548.8	403.06	145.35	52.55	197.90	5.87
10		145.74	548.8	403.06	129.78	46.92	176.70	3.67
11		145.74	548.8	403.06	115.87	41.90	157.77	2.29
12		145.74	548.8	403.06	103.46	37.41	140.86	1.43
13		145.74	548.8	403.06	92.37	33.40	125.77	0.89
14		145.74	548.8	403.06	82.48	29.82	112.30	0.56
15		145.74	548.8	403.06	73.64	26.63	100.26	0.35
					2722.68	1015.14	3737.80	648.65

DR = Discount Rate , NPV at 12 % Discount rate = 2722.68 lakhs, NPV = Net Present Value ,B-C Ratio at 12 % Discount rate = 3.68
IRR = Internal Rate of Return , IRR = Greater than 60 per cent.

Since the BCR is greater than one, the investment on turmeric powder processing plant is financial viable. Internal rate of return was found to be greater than 60 per cent in varying prices and also at constant prices that indicated financially viability of investment in turmeric powdering unit.

Sensitivity analysis

Sensitivity analysis were attempted to know as to how for our estimates of project appraisal remain constant under the changing situation of costs, price and yields. For sensitivity analysis two assumptions were made.
(i)The price of turmeric rhizome and turmeric powder was increased to ten per cent from the existing price level.
(ii)The price of turmeric rhizome and turmeric powder was decreased to ten per cent from the existing price level.

NPV for turmeric processing unit was increased at 10.16 per cent with varying prices and 10.29 per cent with constant prices at ten per cent increase in both turmeric rhizome and turmeric powder prices from existing price level. The NPV was decreased at 10.16 per cent with varying prices and 10.29 per cent with constant prices at ten per cent decreases in both turmeric rhizome and turmeric powder prices from existing price level.
The BCR of turmeric processing unit was increased at 0.41 per cent with varying prices and 0.81 per cent with constant prices at ten per cent increase in both turmeric rhizome and turmeric powder prices from the existing price level. The BCR was decreased at 0.46 per cent with varying prices and 0.81 per cent with constant prices at ten per cent decreases in both turmeric rhizome and turmeric powder prices from existing price level.

IRR was found to be greater than 60 per cent in both varying prices and also at constant prices with both ten per cent increases and ten per cent decreases in turmeric rhizome and turmeric powder prices. This indicated financially viability of investment in turmeric powdering unit under both increased and decreased price scenario.

Production constraints faced by sample farmers

The producers expressed that the non-availability of labour was the most important problem as most of the labour in the area were more willing to work under Mahatma Gandhi National Rural Employment Guarantee Scheme.(Tables 10 and 11). The Second major constraint in the turmeric production was the attack of pest and diseases like leaf blotch, rhizome rot, shoot borer and rhizome scale. Hence the farmers had to spend a lot to control the attack of pests and diseases in the crop and the cost was Rs. 5259.13 per ha. The next important problem was high wage rate and it was Rs. 130 for men and Rs. 60 for women respectively. High cost of fertilizers was the fourth problem. The fifth important

Table 10. Sensitivity analysis of turmeric powdering unit.

	NPV			BCR			IRR (percentage)		
	X	Y	Z	X	Y	Z	X	Y	Z
Current market price	4980.84	5486.99 (10.16)	4474.67 (-10.16)	4.28	4.30 (0.46)	4.26 (-0.46)	>60	>60	>60
Constant price	*2722.68*	*3002.99 (10.29)*	*2442.31 (-10.29)*	*3.68*	*3.71 (0.81)*	*3.65 (-0.81)*	*>60*	*>60*	*>60*

(Figures in parentheses indicate percentages to respective total), X- Existing price level, Y- 10 per cent increases in both turmeric rhizome and turmeric powder price
Z- 10 per cent increases in both turmeric rhizome and turmeric powder price.

Table 11. Problems faced in turmeric cultivation by sample farmers.

S/N	Problems	Mean Score	Rank
1	Non-availability of labour	63.61	I
2	Pest and disease attack	53.01	II
3	High wage rate	50.27	III
4	High cost of fertilizer and plant protection chemicals	43.83	IV
5	Water scarcity	39.61	V

problem faced by the turmeric producers was water

CONCLUSION

The results indicated that the turmeric cultivation is profitable with total cost of production per hectare of Rs. 119873.75 and gross income realized from turmeric cultivation was Rs. 247754.92 per hectare. The net income was Rs. 127881.17 per hectare. Resource use and technical efficiency in turmeric cultivation is significant. The results indicated that the resources planting material, nitrogen, potash, harvesting and curing, machine hours and irrigation had positive and significant influence on yield of turmeric and there was scope for increasing the planting material, nitrogen, potash, harvesting and curing, machine hours and irrigation could increase the turmeric yield. The results indicated the feasibility of starting rural turmeric processing industry on cooperative basis with positive value of NPV, BCR of greater than one and IRR of more than current bank rate. The results of Garrett's ranking technique on farm level constraints and intermediary level constraints in production of turmeric revealed that non availability of labour and pest and disease attack were the major constraints in production.

Policy implications

Turmeric crop was found to be profitable with gross income of Rs. 247754.92 per hectare and net income of Rs. 127881.17 per hectare. Hence efforts should be taken by Agriculture Department to bring more area under turmeric cultivation in Dharmapuri district.

The results of production function analysis suggested that an increase in quantity of planting material, nitrogen, potash, harvesting and curing, machine hours and irrigation would increase the yield of turmeric. Productivity of Dharmapuri district was 3049 kg/ha which was low compared to the productivity of Erode and Salem districts which accounted 6961kg/ha and 4725 kg/ha.

These two districts accounted major share in area and production to the total state area and production. Hence, the Agriculture Department of the State Government has to arrange for awareness programmes for increased use of inputs.

The results of technical efficiency analysis had showed that 79.90 per cent of the farms have achieved the technical efficiency of more than 75

percent. They have achieved this performance by adopting drip irrigation and control of rhizome rot. Hence training programmes have to be organized by the Agricultural Department for the remaining 20.10 per cent of farms to attain the frontier yield.

The financial feasibility analysis of the turmeric processing unit had shown that it was most profitable venture and hence encouragement should be given by the State Government for this industry and also financial institutions should lend adequate credit for this venture.

It was observed that the turmeric price had been fluctuating from Rs.4000 per quintal to Rs. 12000 per quintal in the study area. Higher price fluctuation was the major constraint in the turmeric marketing. Hence establishing contract farming between turmeric growers and turmeric processing units will reduce price fluctuation and provide remunerative price to the turmeric growers during peak season. The farmers felt that non availability of labour was the most important problem in cultivation of turmeric.Hence, introduction of labour-saving machineries in the study area would increase the area of cultivation of turmeric.

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