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IS CASTOR A SUITABLE ALTERNATE UNDER TANK IRRIGATION? A CASE STUDY IN MAHBUBNAGAR DISTRICT OF ANDHRA PRADESH

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ABSTRACT

The present study was an attempt to analyse the resource use efficiency of castor cultivated under Gunta Cheruvu tank with ayacut area of 121.7 acres in Mahbubnagar district as castor is adopted under the tank. Total cost of cultivation was Rs.21867/ha of which operational costs accounted to Rs. 18573/ha (84.94 per cent). Mean yield was as good as Rs. 9.95 Qt/ha higher than district average which ranged from 730 to 800 Kg/ha. Gross income from one hectare castor was Rs. 35813.30/ha. Farmers were able to secure a net benefit cost ratio of 0.55. The results of Cobb Douglas production function revealed that the farms are under increasing returns to scale (1.326) indicating the scope for improvement in yields. Among the inputs, positive and significant were machine labour, farm yard manure and plant protection chemicals (0.211, 0.363 and 0.34) which can be increased in quantum for increasing the yields. Bullock labour component is excessively used as confirmed by negative production elasticity -0.102. The coefficient of multiple determination is 66.4 i.e., 66.4 per cent of the variation in output is explained by the variables considered. Farmers opined that if good management practices are adopted, with quality of seed, resistant to diseases *viz*., wilt and botrytis and emerging pests like capsule borer yields can be better. So castor can be considered as a suitable alternate under tank areas when ever paddy cannot be grown due to insufficient water.

Key words: Castor, resource use efficiency, economics, Mahbubnagar district *L*

INTRODUCTION

India is the world's largest producer of castor seed and meets the global demand for castor oil. India produces 8 to 8.5 lakh tones of castor seed annually, and accounts to more than 60 per cent of the entire global production. On account of the unlimited industrial applications, castor oil enjoys prime position worldwide. The current consumption of castor oil and its derivatives in the domestic market is estimated at about 3 lakh tones. India is the biggest exporter of castor oil and its derivatives taking 87 per cent share of the international trade in this commodity.

Castor area production and productivity in major states

In India, castor is mainly confined to the states of Andhra Pradesh, Gujarat and Rajasthan. Area under castor was 11.50 lakh hectares during 2011-12 which is more by 34 per cent compared to previous year. Similarly, production of castor exceeded by 30 per cent in India for the year 2011-12. But the average yield for the year 2011-12 was 1417 kg/ha as against 1453 kg/hectare during the year 2010-11 a decrease by 3 per cent. Gujarat recorded 44 per cent and Andhra Pradesh 16 per cent increased area but the reduction in average yields was common in

all states as shown in Table 1. Again during 2012-13 area registered decline and production also followed the same trend. Steep decline in yields may be due to biotic and abiotic factors followed by occurrence of pest and diseases. (Wankhade 2009).

Andhra Pradesh Scenario:
In Andhra Pradesh, the crop is cultivated in the districts of Mahbubnagar, Nalgonda, Kurnool and Prakasam. It is sown during June-July and is harvested during December/January.

Table-1. Area, production & yield of castor among the major states

District	Area ('000 ha.)			Production ('000 tones)			Yield (Kg/ha.)		
	2010-11	2011-12	2012-13	2010-11	2011-12	2012-13	2010-11	2011-12	2012-13
Gujarat	483	697	666	900	1226	806	1863	1760	1210
Rajasthan	127	169	157	180	207	165	1417	1222	1054
Andhra Pradesh	198	230	222	140	156	150	707	677	675
Other States	52	54	51	30	30	22	576	564	424
Total	860	1150	1096	1250	1619	1143	1453	1417	1043

Source : Nielsen India estimates

Table- 2. Area, Yield and Production of Castor Seeds in Andhra Pradesh (2011-12)

District	Area ('000 ha.)			Production ('000 tones)			Yield (Kg/ha.)		
	2010-11	2011-12	2012-13	2010-11	2011-12	2012-13	2010-11	2011-12	2012-13
Anantpur	4.2	18.4	17	3.4	13.7	12	742	687	700
Kurnool	56.3	77.0	68	43.0	53.2	39	764	690	574
Mahbubnagar	90.3	108.5	111	67.0	74.6	82	800	742	736
Prakasam	7.1	9.8	8	4.0	3.8	5	564	386	671
Rangareddy	4.2	3.0	3	3.0	1.6	2	714	529	519
Other Districts	36.0	13.0	15	19.6	8.8	10	707	677	675
Total	198.0	229.7	222	140.0	155.7	150	707	677	675

Source: Nielsen India estimates, Hyderabad

Table- 3. Area of Castor Crop Irrigated, District-Wise, 2011-12 (ha)

District	Irrigated Area of Castor	Total Area
Mahbubnagar	1573 (1.44)	108500
Kurnool	1864 (2.42)	77000
Anantapur	1105 (6.01)	18400
Prakasam	733 (7.88)	9800
Andhra Pradesh	5590 (2.43)	229700

Source: www.ap.gov.in
Note: Figures in parenthesis indicated percent to respective row total

The cultivation of castor in Andhra Pradesh is primarily done in Mahbubnagar district with highest area and production. i.e., as per the past trends and production in 2011-12 were increasing. It is estimated that during 2012-13, Mahbubnagar district alone would account for 50 % (111 ha) and 54 % (82000 tonnes) of the states' area and production respectively Table 2. Castor plants grow as shrubs or small trees and finds a place of importance in the cropping systems of dry land farming in semi-arid zones. Estimates showed that 85 per cent of castor is cultivated in Mahbubnagar and Nalgonda for seed and the leaf has no utility as it cannot be used as fodder. While cultivation of castor for oil seed became more popular, Eri culture utilizing castor leaf, is relatively a new venture, is gaining popularity (Lakshmi 2012). Even though the area under castor declined in the state during 2012-13, in Mahbubnagar there is increase in area indicating the expansion of castor in new areas.

Emphasizing the need for resource management and timeliness of operations the study found that 25 per cent to 65 per cent saving on cost of cultivation was achieved by adopting mechanization (Srinivas *et al*. 2009). Very minimum area of 1.44 per cent in Mahbubnagar castor crop is irrigated as shown in Table 3.

MATERIALS AND METHODS

Mahbubnagar district was selected purposively based on the increasing area under castor (from 0.84 lakh ha in 2009-10 to 1.08 lakh ha in 2011-12). Owing to the prevalence of drought conditions and dwindling of water resources in the district, there was distress among the farming community growing commercial crops, rain fed crop producers and small and marginal farmers. In this context utilization of the depleting water resources for cultivating paddy will worsen situation. Never the less, in recent years farmers adopted castor as an alternate to paddy and other irrigated crops in tank areas.

Even though castor is grown as rainfed crop as discussed slowly castor is being adopted in pockets of tank areas. Therefore, to study the economics and resource use efficiency of castor under tanks as suggested by officials of Community Based Tank Management Project of Gunta cheruvu tank which has an ayacut area of 121.7 acres, was selected for the study. As this tank cannot irrigate total paddy area under the tank, farmers started cultivating castor in this area. Accordingly, utkoor mandal falling under the purview of tank was purposively selected and Avasalanipalli, Bijwar, Peddajatram, Magdampur villages of this mandal were selected at random. A random sample of 60 castor farmers, who are mainly dependent on the tank for irrigation from these villages were selected and data was collected using schedules, through survey method for the agricultural year 2011-12.

Tools of analysis:

The Cobb-Douglas function / log linear production was fitted with seven independent variables namely machine labour (X_1), bullock labour (X_2), human labour (X_3) seed cost (X_4), FYM (X_5), fertilizers (X_6), and plant protection chemicals (X_7). The model adopted was as follows.

$$\ln Y = \ln a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + b_6 \ln X_6 + b_7 \ln X_7 + \ln \mu$$

Y = Returns per hectare in rupees
a = Intercept
X_1 = Machine labour charges in rupees
X_2 = Bullock labour charges in rupees
X_3 = Human labour charges in rupees
X_4 = Seed cost in rupees
X_5 = FYM cost in rupees
X_6 = Fertilizers charges in rupees
X_7 = Plant protection chemicals in rupees
b_1 to b_7 = Respective elasticity co-efficients

For testing the regression co-efficients or production elasticities 't' value was calculated using the formula.

$$t = \frac{b_i}{\text{S.E of } b_i}$$

Where

b_i = Regression co-efficient or production elasticity of input x_i

S.E of b_i = Standard error of b_i

Returns to scale was calculated by summing production elasticities of all the inputs (Σb_i).
If ,$\Sigma b_i : 1$, $\Sigma b_i : > 1$ and $\Sigma b_i : < 1$ it indicates constant, increasing and decreasing returns to scale

Marginal value productivity indicates the expected increase in gross returns forthcoming from the use of an additional unit of relevant input, while the level of other inputs remaining unchanged.

A resource or input factor is considered to be used most efficiently if its marginal value product is just sufficient to affect its cost. Equality of marginal value product to factor cost is the basic condition that must be satisfied to obtain efficient resource use. In Cobb Douglas production function, marginal value product (MVP) of Xi, the i^{th} input factor is given by the following formula.

MVP of Yi = $\bar{Y} / \overline{Xi} * bi$

Where,

$\bar{Y}$ = Geometric mean of output Y

$\overline{Xi}$ = Geometric mean of input X_i

bi = Regression co-efficient of X_j

After computation of marginal value product of a variable, it is to be compared with its acquisition cost or opportunity cost. If the variable in the production function is taken in rupee terms, then the acquisition cost of unit of that input will be one rupee. When the input is expressed in physical units, then the marginal value product must be compared with the actual acquisition cost of one physical unit of that input.

Resource-use efficiency is worked out by computing the ratio of marginal value product to opportunity cost. If the ratio is less than one, it indicates that too much of the particular resource is being used under the existing price conditions and vice versa. If MVP to factor cost ratio is equal to one, it indicates efficient resource use.

Cost concepts and farm income measures are calculated.

RESULTS AND DISCUSSIONS

In the study area castor hybrid is grown and the hybrid seed i.e., Navabharath seed and Mahyco seed were used. It is noteworthy that the seed cost of Mahyco is almost double the cost of Navabharath seed i.e., Rs 400/ kg. Farmers purchase seed from external agency every year as hybrid seed cannot be used for sowing. Farmers obtained seed from private seed dealers of Narayanpet and Maktal villages which are situated at 10.7 km and 16.2 km away. Average seed used was 10 kg/ha. The farmers revealed that they were influenced by the advertisements and demonstrations organized by the seed companies in the villages and also followed the neighbor's recommendations. Seed is generally available in 2 kg packs. Castor crop in the study area is the major source of income, but the scientific cultivation techniques, promising cultivars are not employed. (Queiroga 2011)

Results of functional analysis:

Elasticity coefficients of yield (log-linear) and marginal value product of castor in Mahbubnagar district

Functional analysis using log linear form (Cobb-Douglas) for the sample farms and results are presented in Table 4. Costs of human labour, bullock labour, machine labour, seed, farm yard manure, fertilizers and pesticides were the explanatory variables included. It was observed that the production elasticities of machine labour was 0.262 positive and significant at ten per cent level, FYM was 0.363, plant protection chemicals was 0.34 and found to be positive and significant at five per cent level of significance.

This meant that unit increase in machine labour, FYM, Plant protection increases 0.262, 0.363 and 0.34 units of gross returns. Bullock labour is excessively used as indicated by the negative production elasticity -0.102 significant at 10 per

Table- 4. Elasticity coefficients of yield (log-linear) and marginal value product of castor in Mahbubnagar district

Variable	Elasticity	Standard Error
Constant	1.28	2.664
Human labour charges (Rs), X_1	0.211	0.253
Bullock labour charges(Rs), X_2	-0.102*	0.05
Machine labour charges (Rs), X_3	0.262*	0.146
Seed cost (Rs), X_4	0.149	0.128
FYM cost (Rs), X_5	0.363**	0.158
Fertilizers cost (Rs), X_6	0.103	0.091
Plant protection chemicals cost (Rs), X_7	0.34**	0.154
R^2	0.664	
Returns to scale	1.326	

*Note: ** Significant at 5 per cent level and * Significant at 10 per cent level.*

Table- 5. Marginal value products, opportunity costs and ratios of MVP to opportunity costs of castor in Mahbubnagar district

Sl.No	Particulars	Marginal value products (Rs.)	Opportunity costs	Ratio of MVP to opportunity costs
1	X1= Machine labour charges	0.91	1	0.91
2	X2 = Bullock labour charges	-1.27	1	-1.27
3	X3 = Human labour charges	7.27	1	7.27
4	X4 = Seed cost	3.61	1	3.61
5	X5 = FYM cost	19.25	1	19.25
6	X6 = Fertilizers charges	1.36	1	1.36
7	X7= Plant protection chemicals	14.34	1	14.34

Table- 6. Cost of cultivation of castor

S. No.	Particulars	Costs	Percentage
	Operational costs	18039.75	84.56
1.	Human labour	7645.38	35.84
2.	Bullock labour	2845.13	13.34
3.	Machine labour	1201.25	5.63
4.	Seed	1375.5	6.45
5.	Farm yard manure	626.13	2.93
6.	Fertilizers	2535.5	11.88
7.	Pesticides	789.75	3.70
8.	Interest on working capital	1021.12	4.79
	Fixed costs	3294.0	15.44
1.	Rental value of owned land	2500.0	11.72
2.	Depreciation	550.0	2.58
3.	Interest on fixed capital	244.0	1.14
	Total cost (Rs)	21333.75	100.00

Table- 7. Farm Income measures of castor producers on per hectare basis (Rs/ha)

S.No	Particulars	Costs (Rs/ha)
1.	Cost A1/ A2	17089.75
2.	Cost B	19833.75
3.	Cost C	21333.75
4.	Gross income	33114.6
5.	Farm business income	16024.85
6.	Family labour income	13280.85
7	Net income	11780.85
8.	Farm investment income	14524.85
9.	Total Cost of cultivation	21333.75
10.	Net benefit cost ratio	0.55

cent. This implies increase in bullock labour by one unit decreases gross returns by 0.112 units.

The magnitude of coefficient of multiple determination (R^2) was 0.66, indicating that independent variables considered for analysis explained about 66 per cent of variation in the output. The coefficient of bullock labour charges has shown negative association with yield. Therefore the bullock labour has to be judicious

Resource use efficiency

To determine efficiency of resource use, estimation of marginal value products of the resources is required, the general approach for judging the efficiency of resource use has been the comparison of marginal return with marginal cost. In other words, when marginal value products of inputs, considered along with factor acquisition costs, it indicates the efficiency with which resources have been put under use. The value of MVPs, OC and their ratio's is presented in Table 5. The MVP of human labour, bullock labour, machine labour, seed cost, farm yard manure, fertilizers and Pesticides were estimated to be 0.91, -1.27, 7.27, 3.61, 19.25 and 1.36. This has indicated the extent of increase in returns by increasing one rupee of expenditure in case of respective input.

The ratio of MVP to OC for human labour, bullock labour, machine labour, seed cost, farm yard manure, fertilizers and Pesticides were found to be more than one indicating that the utilization of these inputs could be increased sufficiently to reach the optimum level of production.

The Return to Scale (RTS), summing up of the production elasticities of the inputs amount to 1.326 which is more than unity and thus castor farms were characterized by increasing return to scale. This implies that production was in the irrational zone of production (stage 1) which implied that still there is scope to increase the returns by increasing inputs like machine labour, FYM, plant protection chemicals and decreasing bullock labour .therefore, under tanks and tailend areas of tanks castor stands as a suitable crop

Costs and Returns

A perusal of table 6 revealed that the total costs incurred on castor cultivation was around Rs.21333.75/ha of which operational costs accounted to Rs.18039.75 /ha (84.56 per cent) and fixed costs to Rs. 3294 /ha (15.44 per cent). The major components of variable costs were expenditure on human and bullock labour occupying 50 per cent of the total costs.

Cost concepts and farm income measures

The cost concepts and farm income measures viz., gross income, net income, farm business income, family labour income and farm investment income were worked out and presented in Table 7.

Farmers grow castor in their own land. Hence cost A1 and cost A2 are one and the same which is Rs.17089.75/ha. Cost of cultivation of castor (Cost C) was Rs. 21333.75/ha. Cost B was estimated to be Rs. 19833.75/ha.

The estimated average gross income from one hectare castor was Rs. 33114.6. The net income in the surveyed area among the selected farmers was Rs. 11780.85 per hectare. A study in Kanpur district of U.P found that under irrigation castor gave a net income of Rs.22766/ha (Rai *et al.* 2007) The farm business income realization was Rs. 16024.85/ha. Similarly, the family labour earnings and the farm investment income of castor per hectare respectively were Rs. 13280.85 and Rs. 14524.85. Farmers were able to secure a net benefit cost ratio of 0.55 i.e., receiving Rs. 0.55 additionally for every rupee invested in castor cultivation.

CONCLUSION

The study found good yield potential for hybrid castor on account of yields received by sample farmers i.e., 9.95 kg/ha. (Vaz *et al.* 2010) Optimum irrigation at different CPE (Cumulative Pan Evaporation) levels has an ability to increase castor yields upto 2.32 t/ ha (Ramanjaneyulu *et al.* 2013) The use of resources did not reach to the level of optimum production so increase in inputs can increase the yields further. Reduction in cost of cultivation is possible by increasing mechanization. There is good market for castor because of its industrial applicability. Farmers also opined that improved management can reduce costs and reduce pest and disease problems. Establishment of primary processing centres can enhance farmer's remuneration. High dependence on hybrids will enhance the cost of cultivation but development of public hybrids can reduce this problem. Among various constraints that limit the productivity levels, availability of quality seed of the cultivars suited to the local conditions is the most critical constraint faced by the farmers (Reddy *et al*. 1997) Therefore the study is suggestive of castor suitability under tanks with low capacity and gives more efficient resource use than rainfed castor.

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