



ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; SP-10(7): 499-506
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www.thepharmajournal.com
Received: 19-05-2021
Accepted: 23-06-2021

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Economics of tomato in Yavatmal District

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Abstract

Tomato (*Lycopersicon esculantum* Mill) is the world largest vegetable crop under solanaceae family and known as protective food both because of its special nutritive value and because of its wide spread production. The present study entitled "Economics of Tomato in Yavatmal district" was undertaken to study the economics of tomato production and resource use efficiency in tomato production. The study has been undertaken in Yavatmal district. The data pertains to the year 2016-17. In respect of input use efficiency physically, excess human labour, bullock labour and phosphorus were used by small size group farmers. The excess nitrogen and machine hours were used by medium size group farmers whereas the excess seed, manure and potash were used by large size group farmers. The per hectare cost of cultivation at overall level, at cost 'A₂' was Rs.45738.78, whereas cost 'B₁' was Rs. 46604.23, cost 'B₂' was Rs. 70736.56 and cost 'C₁' was Rs. 50722.28, cost 'C₂' was Rs. 74854.60 whereas cost 'C₃' was Rs. 82340.06. At overall level, the input-output ratio at cost 'C₂' was 1:1.94. At overall level, the regression coefficient of machine hours was significant at five per cent and seed was significant at one per cent level with 81 per cent of variation was explained by variables which were included in function. At overall level, marginal value product to the factor cost ratio of human labour, bullock labour, machine hours, seed, manure, nitrogen, phosphorous and potash was positive, which means there is a scope to increase the level of these inputs in tomato production. Hence, there is scope for increase area under cultivation.

Keywords: Yavatmal, tomato, economics and resource use efficiency

1. Introduction

Tomato (*Lycopersicon esculantum* Mill) is the world largest vegetable crop under solanaceae family and known as protective food both because of its special nutritive value and because of its widespread production. It is native of tropical America. It is the world largest vegetable crop, cultivated for its fleshy fruit. It is considered an important commercial dietary vegetable crop. It is protective supplementary food. As it is short duration crops (180 days) and gives a high yield, it is important from an economic point of view and hence the area under its cultivation is increasing day by day. Tomato is used in the preserved products like ketchup, sauce, chutney, soup, paste and many other ways. It is also used as a salad vegetable. Tomato has very few competitors in the value addition chain of processing.

Tomato is a rich source of minerals, vitamins and organic acids and dietary fibers. Tomato is known as productive as well as protective food. It is a rich source of vitamin 'A' and vitamin 'C'. It also contains minerals like iron, phosphorus.

Vegetables play an important role both in the regional and national economy of the agricultural sector. These crops are generally of short duration hence more than one crops can be raised based on early, medium and late duration varieties. The tomato crop is grown in all the seasons i.e. Kharif, rabi and summer. However, each season has its peculiarities in terms of production, demand and supply, cost and prices, market preferences and comparative advantages. The prosperity of the cultivators depends not only upon the increased rate of production but also on the method and efficiency with which they disposed of their produce to their great advantage. The efforts of large production are unfruitful until the produce is marketed efficiently. The prices are ruled by demand and supply conditions in the market. Price received by the producer mainly depends on proper time and proper stages. Considering the fact, the seasonal nature of tomato also affects the price in the market.

India continues to be the second-largest producer of vegetables in the world next to China (23 per cent) with an estimated production of 99.4 million tonnes, which accounts for 12 per cent of the world's production. However, the horticulture sector has witnessed tremendous growth as a result of investment through the National Horticulture Mission (NHM) and several other programmes.

It has brought the 'Golden Revolution' by rising the vegetable production from 84.8 million tonnes in 2002-03 to 99.4 million tonnes in 2005-06 (Indian Horticulture Database 2005] National Horticulture Board). The per capita availability of vegetables in the country is 210 grams per person per day against a minimum dietary requirement of 300 grams per day. By the end of 2030, the country will need 150 million tonnes of vegetables to meet the requirement. Therefore, it is necessary to increase the production of vegetable crops at a much faster rate mainly by increasing productivity.

Economic point of view total world tomato production is 161.8 million tonnes. China, the largest producer, accounted for about one-quarter of the global output, followed by India and the United States. India continues to be the second-largest producer of tomato in the world next to China with an estimated production of 17.5 lakh MT. (FAOSTAT, 2012). Tomato ranks third in priority after potato and Onion in India. As per the 2nd advance estimate of 2014-15, the area under tomato cultivation was 7.91 lakh hectares, production on 173.98 lakh tonnes.

The leading vegetable growing districts in Maharashtra are Pune, Nashik, Ahmednagar, etc. As per the 2nd advance estimate of 2014-15 in Maharashtra, the area under tomato cultivation was 44 thousand ha with production at about 10.5 lakh MT. The area and production of tomato are increasing day by day due to their popularity. But it is facing severe losses due to post-harvest handling. (Source: Horticultural Statistics at a Glance 2015) In Yavatmal district during 2014-15 area and production of tomato is 447.65 ha and 6723.80 MT., respectively with the productivity of 15.02 MT/ha. (SAO, Yavatmal).

It is a common belief among the farmers, that tomato is a profitable crop. The demand for tomato is increasing day by day and also it contributing a sizable share in the total earning of the cultivators but it is a very perishable crop. It is a very sensitive crop, negligence of any particular operation or change in climatic condition may cause several losses in yield and ultimately a loss to the farmer as the cost of cultivation of these crops is higher than the other crops. Therefore, the study of the economics of tomato production and resource use efficiency in tomato production is analysed and studied in this paper.

2. Methodology

The study was undertaken in the Yavatmal district of the Vidharbha region. The district was selected by considering the potentiality of the tomato production area. The data pertained to the year 2016-17. The total number of tehsils in Yavatmal district are 16. Tehsils were selected on the basis of the potential area in the year 2015-16. The Mahagaon, Wani and Pusad have the highest area under cultivation of tomato i.e. 100 hectares, 60 hectares and 50 hectares, respectively. Hence Mahagaon, Wani and Pusad tehsils were selected for the present study. The four villages were selected purposely from each tehsil thus overall 12 villages were selected. From each village 8, respondent farmers were selected randomly a total of 96 tomato farmers were selected for the present study. The required data were collected by personal interview method by using pre-tested schedules from selected farmers. The data pertained to the year 2016-17. The collected data then tabulated and a simple tabular analysis was carried out and a standard cost concept was used. The data were analysed by using the level of input utilization and cost of production

of tomato, the resource use efficiency was estimated by using the Cobb-Douglas production function.

2.1 Cost concepts

The data collected were presented in tabular form to facilitate easy comparison. This technique of tabular presentation has employed the cost and return structure using the standard cost concept. The data were summarized with aid of statistical tools like average, percentage etc. to obtain meaningful results.

Cost concepts: These include cost A_1 , A_2 , B_1 , B_2 , C_1 , C_2 and C_3

Cost A_1 = All actual expenses in cash and kind incurred in production by the producer.

Cost A_2 = Cost A_1 + Rent paid for leased in land

Cost B_1 = Cost A_2 + Interest on fixed capital @ 10 per cent

Cost B_2 = Cost B_1 + Rental value of land.

Cost C_1 = Cost B_1 + Imputed value of family labour.

Cost C_2 = Cost B_2 + Imputed value of family labour.

Cost C_3 = Cost C_2 +10 per cent of Cost C_2 on account of managerial functions performed by farmers.

In the present study, the rent paid for leased land was zero, as none of sample farmers took land on lease basis. Hence cost ' A_1 ' and cost ' A_2 ' are similar and simply called cost ' C '. As cost ' A ' and only cost ' C_2 ' was estimated and presented as cost of cultivation in the result.

- Gross return per rupee of investment = $\frac{\text{Gross return}}{\text{Total cost}}$
- Cost of production (quintal) = $\frac{\text{Total cost (Rs/Ha)}}{\text{Yield (Qt/Ha)}}$
- Gross return per quintal = $\frac{\text{Gross return (Rs.Ha)}}{\text{Yield (Qt/Ha)}}$

The Cobb-Douglas type of production was used specify as follows.

$$Y = ax_1^{b_1} \times x_2^{b_2} \times x_3^{b_3} \times x_4^{b_4} \times x_5^{b_5} \times x_6^{b_6} \times x_7^{b_7} \times x_8^{b_8}$$

Where,

Y = Yield in quintals per hectare

a = Intercept

$b_1, b_2, b_3, b_4, b_5, b_6, b_7, b_8$ =Regression coefficient of respective factor as follows.

X_1 = Human labour in days

X_2 = Bullock pair in days/ha

X_3 = Machinery in Hrs/ha

X_4 = Seed in grams/ha

X_5 = Manure in tonnes/ha

X_6 = Nitrogen in kg/ha

X_7 = Phosphorus kg/ha

X_8 = Potash in kg/ha

Cobb-Douglas production function as given above was estimated for input- output data to study the combination of variables and resource productivity.

Marginal value product of particular resources represented the expected addition of one unit of that resource while other inputs are held constant to the marginal factor cost.

$$MVP = b_1 \frac{GM(Y_i)}{GM(X_i)}$$

Where,

b_1 = The elasticity of output with respect to X_1

$GM(X_i)$ = Geometric mean of input X_i

$GM(Y_i)$ = Geometric mean of output Y_i

3. Result & Discussion

Economics of tomato production

3.1 Per hectare input utilization for Tomato crop

The degree of management of the resources can be judged for the utilization of resources, the choice and the decision making. Beside this, it also indicates the level of technology adopted by the farmers. The farmers required to spend on various inputs like seed, manure, fertilizers, human labour, bullock labour and machine labour. Therefore, it is necessary to know the pattern of expenditure on various inputs on per hectare basis. The per hectare input utilization pattern of selected farmers is presented in Table 3.1

It is observed from Table 3.1 that, on the overall basis per hectare utilization of inputs i.e. seed 122.95 grams per

hectare, fertilizer 93.23 kg nitrogen, 52.09 kg phosphorus and 45.97 kg potash per hectare respectively. Whereas it is found that, manures 8.57 tonnes, human labour 97.26 human days, machine hours 6.87 and bullock labour 8.49 days per hectare. Per hectare human labour utilized in small size group was 103.19 human days and in medium and large size group it was 94.83 human days and 99.06 human days. As regards seed utilized it was 106.47 grams by small size group, 123.31 grams by medium size group and 125.98 grams by large size group. Highest human labour, bullock labour and phosphorus were used by small size group. The Highest nitrogen and machine hours were used by medium size group whereas the highest seed, manure and potash were used by large size group.

Table 3.1: Per hectare input utilization pattern of selected farmers

Particulars	Unit	Small		Medium		Large		Overall		
		Physical Unit	Monitory Unit (Rs.)	Physical Unit	Monitory Unit (Rs.)	Physical Unit	Monitory Unit (Rs.)	Physical Unit	Monitory Unit (Rs.)	
Seed	Grams	106.47	3194.41	123.31	3512.08	125.98	3842.82	122.95	3959.59	
Manure	Tonnes	7.65	8385.76	8.53	9685.82	8.91	10081.52	8.57	9614.87	
Fertilizer	N	Kgs.	92.13	2737.20	96.43	2892.79	94.35	2949.45	93.23	2796.02
	P	Kgs.	57.33	1689.26	54.30	1740.93	57.21	1792.50	52.09	1631.93
	K	Kgs.	46.98	1415.82	47.32	1482.82	48.23	1546.17	45.97	1473.95
Human labour	Days	103.19	14399.29	94.83	13248.93	99.06	13732.22	97.26	13329.59	
Bullock labour	Days	9.01	5704.41	5.15	3259.49	4.57	2890.33	8.49	5377.71	
Machine (hrs.)	Hours	7.35	4624.49	8.32	5131.29	7.93	5847.83	6.87	4421.54	
Irrigation	Rs.		618.09		613.77		601.09		608.48	
Total	Rs.		42768.73		41567.92		43283.93		43213.68	

3.2 Per hectare cost of cultivation of Tomato

The share of each item in the total cost provides necessary to economizing costs. Here an attempt has been made to estimate the figures of cost of tomato crop in the study area and presented in succeeding tables.

3.2.1 Per hectare cost of cultivation of tomato (Small size group)

The per hectare cost of cultivation of tomato grown by the small farmers is presented in Table 3.2 (a)

It is revealed from the Table 3.2 (a) that, the per hectare cost of cultivation at cost 'A₂' was Rs.44759.66, whereas cost 'B₁' was Rs.45659.25, cost 'B₂' was Rs. 68703.84 and cost 'C₁' was Rs.50657.95, cost 'C₂' was Rs. 73702.53 whereas cost 'C₃' was Rs.81072.79. Which include the 10 per cent as a managerial cost. The major share of cost of cultivation goes towards cost 'A₂' (60.73 per cent). The share of hired human labour was the highest i.e. 12.75 per cent followed by manure 11.38 per cent, fertilizers 7.93 per cent, bullock labour 7.74 per cent, machine hours 6.27 per cent, seed 4.33 per cent and plant protection 4.13 per cent. All the above inputs were the cash inputs for which farmers required to pay immediately from his pocket. The cost 'B₁' contributed to 61.95 per cent, cost 'B₂' contributed 93.22 per cent to the total cost i.e. cost 'C₂'. The share of family labour was 6.78 per cent. Per hectare yield obtained by small farmers was 116.18 quintal with gross returns of Rs. 138475.69. In case of small size group per quintal cost of production was Rs.697.82.

3.2.2 Per hectare cost of cultivation of tomato (Medium size group)

The per hectare cost of cultivation of Tomato grown by the

Medium group farmers is presented in Table 3.2 (b)

It is revealed from the Table 3.2 (b) that, the per hectare cost of cultivation at cost 'A₂' was Rs.45147.27, whereas cost 'B₁' was Rs.45995.18, cost 'B₂' was Rs. 70195.38 and cost 'C₁' was Rs. 49121.71, cost 'C₂' was Rs. 73321.91 whereas cost 'C₃' was Rs.80654.10. The major share of cost of cultivation goes towards cost 'A₂' (61.57 per cent). The share of hired human labour was the highest i.e. 13.81 per cent followed by manure 13.21 per cent, fertilizer was 8.34 per cent, machine hours 7.00 per cent, seed 4.79 per cent, bullock labour 4.45 per cent and plant protection 3.39 per cent. All the above inputs were cash inputs for which farmers required to pay immediately from his pocket. The cost 'B₁' contributed to 62.73 per cent, cost 'B₂' contributed 95.74 per cent to the total cost i.e. cost 'C₂'. The share of family labour was 4.26 per cent. Per hectare yield obtained by medium farmers was 120.08 quintal with gross returns of Rs. 145409.41. In case of medium size group per quintal cost of production was Rs. 671.67.

3.2.3 Per hectare cost of cultivation of tomato (Large size group)

The per hectare cost of cultivation of Tomato grown by the large group farmers is presented in Table 3.2 (c)

It is revealed from the Table 3.2 (c) that, the per hectare cost of cultivation at cost 'A₂' was Rs. 46539.27, whereas cost 'B₁' was Rs. 47414.62, cost 'B₂' was Rs. 72099.54 and cost 'C₁' was Rs. 51101.49, cost 'C₂' was Rs. 75786.42 whereas cost 'C₃' was Rs.83365.06. The major share of cost of cultivation contributed by cost 'A₂' (61.41 per cent). The share of manure was highest i.e. 13.30 per cent followed by hired human labour 13.25 per cent, fertilizer 8.30 per cent, machine hours

7.72 per cent, seed 5.07 per cent, plant protection 3.88 per cent and bullock labour 3.81 per cent. All the above inputs were cash inputs for which farmers required to pay immediately from his pocket. The cost 'B₁' contributed to 62.56 per cent, cost 'B₂' contributed 95.14 per cent to the total cost i.e. cost 'C₂'. The share of family labour was 4.86 per cent. The per hectare yield obtained by large size farmers was 119.17 quintals with gross returns of Rs.148317.74. In case of large size group the per quintal cost of production was Rs. 699.55.

3.2.4 Per hectare cost of cultivation of tomato (Overall)

The per hectare cost of cultivation of Tomato grown by the overall 96 farmers is presented in Table 3.2 (d)

It is revealed from the Table 3.2 (d) that, the per hectare cost of cultivation at cost 'A₂' was Rs.45738.78, whereas cost 'B₁'

was Rs. 46604.23, cost 'B₂' was Rs. 70736.56 and cost 'C₁' was Rs. 50722.28, cost 'C₂' was Rs. 74854.60 whereas cost 'C₃' was Rs. 82340.06. The major share of cost of cultivation goes towards cost 'A₂' (61.10 per cent). The share of manure was highest i.e. 12.84 per cent followed by hired human labour 12.31 per cent, fertilizer 7.88 per cent, bullock labour 7.18 per cent, machine hours 5.91 per cent, seed 5.29 per cent and plant protection 3.31 per cent. All the above inputs were cash inputs for which farmers required to pay immediately from his pocket. The cost 'B₁' contributed to 62.26 per cent, cost 'B₂' contributed 94.50 per cent to the total cost i.e. cost 'C₂'. The share of family labour was 5.50 per cent. The per hectare yield obtained by farmers was 119.39 quintal with gross returns of Rs. 145002.17. In case of large size group the per quintal cost of production was Rs. 689.67.

Table 3.2 (a): Per hectare cost of cultivation of Tomato (Small)

Sr. No.	Items	Units	Units required	Price per unit	Cost Rs.	Per cent	
1	Hired human labour	Male	Days	8.55	217.61	1859.82	2.52
		Female	Days	64.15	117.55	7540.77	10.23
		Total	Days	72.70	129.31	9400.59	12.75
2	Bullock labour	Hired	Days	5.19	633.12	3283.66	4.46
		Owned	Days	3.82	633.12	2420.75	3.28
		Total	Days	9.01	633.12	5704.41	7.74
3	Machine	Hired	Hrs.	7.35	628.93	4624.49	6.27
		Owned	Hrs.	0.00	0.00	0.00	0.00
		Total	Hrs.	7.35	628.93	4624.49	6.27
4	Seed (Hybrid)	Grams	106.47	30.00	3194.41	4.33	
5	Manure	Tonnes	7.65	1096.60	8385.76	11.38	
6	Fertilizer	N	Kgs.	92.13	29.71	2737.20	3.71
		P	Kgs.	57.33	29.47	1689.26	2.29
		K	Kgs.	46.98	30.14	1415.82	1.92
		Total				5842.28	7.93
7	Irrigation	Rs.			618.09	0.84	
8	Incidental	Rs.			367.23	0.50	
9	Plant protection	Rs.			3047.43	4.13	
10	Repairs	Rs.			279.81	0.38	
11	Depreciation	Rs.			578.79	0.79	
12	Land revenue	Rs.			34.70	0.05	
13	Int. on wor. cap. @ 6%	Rs.			2681.68	3.64	
14	Cost A ₁	Rs.			44759.66	60.73	
15	Rent paid for leased land	Rs.	0.00	0.00	0.00	0.00	
16	Cost A ₂	Rs.			44759.66	60.73	
17	Int. on fixed capital @ 10%	Rs.			899.59	1.22	
18	Cost B ₁	Rs.			45659.25	61.95	
19	Rental value of land	Rs.			23044.58	31.27	
	(1/6 of GP- Land revenue)						
20	Cost B ₂	Rs.			68703.84	93.22	
21	Family labour charges	Male	Days	14.14	217.61	3076.41	4.17
		Female	Days	16.35	117.55	1922.29	2.61
		Total	Days	30.49	163.94	4998.70	6.78
22	Cost C ₁	Rs.			50657.95	68.73	
23	Cost C ₂	Rs.			73702.53	100.00	
24	Cost C ₃	Rs.			81072.79		
25	Yield main	Qtl.	116.18	1191.91	138475.69		
26	Cost of production /qtl.	Rs.			697.82		

Table 3.2(b): Per hectare cost of cultivation of Tomato (Medium)

Sr. No.	Items	Units	Units required	Price per unit	Cost Rs.	Per cent	
1	Hired human labour	Male	Days	10.95	217.61	2382.03	3.25
		Female	Days	65.85	117.55	7740.37	10.56
		Total	Days	76.79	131.81	10122.40	13.81
2	Bullock labour	Hired	Days	0.00	0.00	0.00	0.00
		Owned	Days	5.15	633.12	3259.49	4.45
		Total	Days	5.15	633.12	3259.49	4.45

3	Machine	Hired	Hrs.	8.32	616.59	5131.29	7.00
		Owned	Hrs.	0.00	0.00	0.00	0.00
		Total	Hrs.	8.32	616.59	5131.29	7.00
4	Seed (Hybrid)		Grams	123.31	28.48	3512.08	4.79
5	Manure		Tonnes	8.53	1136.11	9685.82	13.21
6	Fertilizer	N	Kgs.	96.43	30.00	2892.79	3.95
		P	Kgs.	54.30	32.06	1740.93	2.37
		K	Kgs.	47.32	31.34	1482.82	2.02
		Total				6116.54	8.34
7	Irrigation		Rs.			613.77	0.84
8	Incidental		Rs.			662.83	0.90
9	Plant protection		Rs.			2482.93	3.39
10	Repairs		Rs.			285.21	0.39
11	Depreciation		Rs.			620.73	0.85
12	Land revenue		Rs.			34.70	0.05
13	Int. on wor. cap. @ 6%		Rs.			2619.47	3.57
14	Cost A₁		Rs.			45147.27	61.57
15	Rent paid For leased land		Rs.			0.00	0.00
16	Cost A₂		Rs.			45147.27	61.57
17	Int. on fixed capital @ 10%		Rs.			847.90	1.16
18	Cost B₁		Rs.			45995.18	62.73
19	Rental value of land (1/6 of GP- Land revenue)		Rs.			24200.20	33.01
20	Cost B₂		Rs.			70195.38	95.74
21	Family labour charges	Male	Days	10.05	217.61	2187.63	2.98
		Female	Days	7.99	117.55	938.91	1.28
		Total	Days	18.04	173.31	3126.53	4.26
22	Cost C₁		Rs.			49121.71	66.99
23	Cost C₂		Rs.			73321.91	100.00
24	Cost C₃		Rs.			80654.10	
25	Yield main		Qtl.	120.08	1210.94	145409.41	
26	Cost of production/ qtl.		Rs.			671.67	

Table 3.2(c): Per hectare cost of cultivation of Tomato (Large)

Sr. No.	Items	Units	Units required	Price per unit	Cost Rs.	Per cent	
1	Hired human labour	Male	Days	11.27	217.61	2452.05	3.24
		Female	Days	64.60	117.55	7593.29	10.02
		Total	Days	75.86	132.41	10045.35	13.25
2	Bullock labour	Hired	Days	0.00	0.00	0.00	0.00
		Owned	Days	4.57	633.12	2890.33	3.81
		Total	Days	4.57	633.12	2890.33	3.81
3	Machine	Hired	Hrs.	7.93	736.99	5847.83	7.72
		Owned	Hrs.	0.00	0.00	0.00	0.00
		Total	Hrs.	7.93	736.99	5847.83	7.72
4	Seed (Hybrid)		Grams	125.98	30.50	3842.82	5.07
5	Manure		Tonnes	8.91	1131.10	10081.52	13.30
6	Fertilizer	N	Kgs.	94.35	31.26	2949.45	3.89
		P	Kgs.	57.21	31.33	1792.50	2.37
		K	Kgs.	48.23	32.06	1546.17	2.04
		Total				6288.12	8.30
7	Irrigation		Rs.		601.09	0.79	
8	Incidental		Rs.		366.91	0.48	
9	Plant protection		Rs.		2938.86	3.88	
10	Repairs		Rs.		305.76	0.40	
11	Depreciation		Rs.		601.66	0.79	
12	Land revenue		Rs.		34.70	0.05	
13	Int. on wor. cap.@ 6%		Rs.		2694.33	3.56	
14	Cost A₁		Rs.		46539.27	61.41	
15	Rent paid For leased land		Rs.		0.00	0.00	
16	Cost A₂		Rs.		46539.27	61.41	
17	Int. on fixed capital @ 10%		Rs.		875.35	1.16	
18	Cost B₁		Rs.		47414.62	62.56	
19	Rental value of land (1/6 of GP- Land revenue)		Rs.		24684.92	32.57	
20	Cost B₂		Rs.		72099.54	95.14	
21	Family labour charges	Male	Days	9.59	217.61	2086.53	2.75
		Female	Days	13.61	117.55	1600.34	2.11
		Total	Days	23.20	158.90	3686.87	4.86
22	Cost C₁		Rs.		51101.49	67.43	

23	Cost C ₂	Rs.			75786.42	100.00
24	Cost C ₃	Rs.			83365.06	
25	Yield main	Qtl.	119.17	1244.59	148317.74	
26	Cost of production/ qtl.	Rs.			699.55	

Table 3.2(d): Per hectare cost of cultivation of Tomato (Overall)

Sr. No.	Items	Units	Units required	Price per unit	Cost in Rs.	Per cent	
1	Hired human labour	Male	Days	8.49	217.61	1848.37	2.47
		Female	Days	62.64	117.55	7363.16	9.84
		Total	Days	71.13	129.50	9211.54	12.31
2	Bullock labour	Hired	Days	2.19	633.12	1385.74	1.85
		Owned	Days	6.31	633.12	3991.97	5.33
		Total	Days	8.49	633.12	5377.71	7.18
3	Machine	Hired	Hrs.	6.87	643.86	4421.54	5.91
		Owned	Hrs.	0.00	0.00	0.00	0.00
		Total	Hrs.	6.87	643.86	4421.54	5.91
4	Seed (Hybrid)	Grams	122.95	32.20	3959.59	5.29	
5	Manure	Tonnes	8.57	1121.36	9614.87	12.84	
6	Fertilizer	N	Kgs.	93.23	29.99	2796.02	3.74
		P	Kgs.	52.09	31.33	1631.93	2.18
		K	Kgs.	45.97	32.06	1473.95	1.97
		Total				5901.89	7.88
7	Irrigation	Rs.			608.48	0.81	
8	Incidental	Rs.			604.42	0.81	
9	Plant protection	Rs.			2475.56	3.31	
10	Repairs	Rs.			283.97	0.38	
11	Depreciation	Rs.			576.77	0.77	
12	Land revenue	Rs.			34.70	0.05	
13	Int. on wor. cap. @ 6%	Rs.			2667.73	3.56	
14	Cost A ₁	Rs.			45738.78	61.10	
15	Rent paid For leased land	Rs.			0.00	0.00	
16	Cost A ₂	Rs.			45738.78	61.10	
17	Int. on fixed capital @ 10%	Rs.			865.45	1.16	
18	Cost B ₁	Rs.			46604.23	62.26	
19	Rental value of land (1/6 of GP- Land revenue)	Rs.			24132.33	32.24	
20	Cost B ₂	Rs.			70736.56	94.50	
21	Family labour charges	Male	Days	10.46	217.61	2276.31	3.04
		Female	Days	15.67	117.55	1841.73	2.46
		Total	Days	26.13	157.61	4118.05	5.50
22	Cost C ₁	Rs.			50722.28	67.76	
23	Cost C ₂	Rs.			74854.60	100.00	
24	Cost C ₃	Rs.			82340.06		
25	Yield main	Qtl.	119.39	1214.53	145002.17		
26	Cost of production/ qtl.	Rs.			689.67		

3.3 Per hectare cost and returns of Tomato cultivation

The cost and return structure per hectare of agricultural production, helps the farmer in mapping adjustment in the

organization and thereby secure the optimum level of production and income. The per hectare cost and returns from tomato cultivation is presented in the Table 3.3

Table 3.3: Per hectare cost and returns of Tomato cultivation (Rs.)

Sr. No.	Particulars	Size group			
		Small	Medium	Large	Overall
1	Yield (quintal)	116.18	120.08	119.17	119.39
2	Price / quintal	1191.91	1210.94	1244.59	1214.53
3	Value of main produce	138475.69	145409.41	148317.74	145002.17
4	Value of by-produce	0.00	0.00	0.00	0.00
5	Total produce	138475.69	145409.41	148317.74	145002.17
6	Total cost				
a)	Cost 'A2'	44759.66	45147.27	46539.27	45738.78
b)	Cost 'B2'	68703.84	70195.38	72099.54	70736.56
c)	Cost 'C2'	73702.53	73321.91	75786.42	74854.60
d)	Cost 'C3'	81072.79	80654.1	83365.06	82340.06
7	Net return over				
a)	Cost 'A2'	93716.03	100262.14	101778.47	99263.39
b)	Cost 'B2'	69771.85	75214.03	76218.20	74265.61
c)	Cost 'C2'	64773.16	72087.50	72531.32	70147.57
d)	Cost 'C3'	57402.90	64755.31	64952.68	62662.11

8	Input-output ratio at				
a)	Cost 'A2'	3.09	3.22	3.19	3.17
b)	Cost 'B2'	2.02	2.07	2.06	2.05
c)	Cost 'C2'	1.88	1.98	1.96	1.94
d)	Cost 'C3'	1.71	1.80	1.78	1.76

It is revealed that from the table that, at overall level average gross returns was Rs. 145002.17. The net returns obtained at various costs were Rs. 99263.39 at cost 'A₂', Rs. 74265.61 at cost 'B₂', and Rs. 70147.57 at cost 'C₂'. This means tomato crop appeared to be good farm monetary benefits. The highest input- output ratio at cost 'C₂' was recorded in medium size group i.e. 1:1.98 and the lowest input- output ratio at cost 'C₂' was recorded in small size group was 1:1.88. At overall level, the input-output ratio at cost 'C₂' was 1:1.94.

The input output ratio which is an indicator of economic viability in crop production for the crop and other discussion indicated that, tomato registered a good input output ratio 1:1.94 means this is a profitable crop.

3.4 Resource use efficiency of Tomato production

The resource use efficiency of tomato production is presented

Table 3.4: Cobb-Douglas production function for Tomato

Sr. No.	Variable	Small	Medium	Large	Overall
1	Constant (Intercept)	0.2534	0.0477	0.2242	0.2447
2	Coefficient				
A	Human labour (X ₁)	0.0079 (0.1139)	0.2681 (0.1294)	0.3413 (0.3031)	0.0870 (0.0812)
	B	Bullock labour (X ₂)	-0.1741 (0.1429)	0.1377 (0.1449)	-0.4440 (0.4089)
C		Machine hours (X ₃)	0.1391* (0.0671)	0.0004 (0.0694)	0.1454 (0.2232)
	D	Seed (X ₄)	0.3486 (0.1832)	0.5541** (0.1384)	0.5393 (0.5814)
E		Manure (X ₅)	0.3923** (0.0926)	-0.0096 (0.1532)	0.2462 (0.3990)
	F	Nitrogen (X ₆)	0.3249 (0.1729)	0.0882 (0.1510)	0.3063 (0.3612)
G		Phosphorous (X ₇)	0.1851 (0.2281)	0.0186 (0.0604)	-0.1102 (0.5628)
	H	Potash (X ₈)	-0.1145 (0.1188)	0.0732 (0.1177)	-0.3087 (0.3610)
3		Coefficient of Determinant (R ²)	0.9092**	0.7403**	0.7156

(Figure in parentheses indicates the Standard error)

Note: ** significant at 1 per cent level. * significant at 5 per cent level.

In large size group, the regression coefficient was non-significant in large size group. They could not give the desired production from tomato. About 71 per cent variation was explained by the variables included in function.

At overall level, the regression coefficient of machine hours was significant at five per cent and seed was significant at one per cent level whereas other variables found non-significant. They could not influence on tomato production. About 81 per cent of variation was explained by variables included in

in the Table 3.4. It is observed from the table that, the explanatory variable included in the production process has explained almost all the variation in input for small medium and large sample as a whole.

In small size group the regression coefficient of machine hours was significant at five per cent and manure was significant at one per cent level and other variable found non-significant in small size group. They could not give the desired production from tomato. About 90 per cent of variation was explained by variables included in function.

In medium size group, the regression coefficient of seed was significant at one per cent and other variable found non-significant in medium size group. They could not influence on tomato production. About 74 per cent of variation was explained by variables included in function.

function.

3.5: Marginal value product to factor cost

The ratio of marginal value product to factor cost indicates the optimum resource use efficiency of particular inputs. Marginal value of product of each input factor was worked out compared with quantity of inputs in small, medium, large and overall group of farmers. The marginal value product to factor cost of tomato cultivation is presented in the Table 3.5.

Table 3.5: Marginal value product to factor cost

Sr. No.	Particulars	MVP At Factor Cost			
		Small	Medium	Large	Overall
1	Human labour (X ₁)	0.0082	0.2880	0.3619	0.0923
2	Bullock labour (X ₂)	-0.4388	0.5825	-2.1482	0.1274
3	Machine hours (X ₃)	0.2895	0.0009	0.3761	0.3250
4	Seed (X ₄)	0.3617	0.5624	0.5371	0.5454
5	Manure (X ₅)	1.0281	-0.0258	0.6902	0.3327

6	Nitrogen (X_6)	0.3515	0.0952	0.3277	0.1642
7	Phosphorous (X_7)	0.2272	0.0279	-0.1352	0.0247
8	Potash (X_8)	-0.1481	0.0974	-0.4037	0.0033

It is observed from the table that, at overall level, marginal value product to the factor cost ratio of human labour, bullock labour, machine hours, seed, manure, nitrogen, phosphorous and potash was positive and less than unity which means there is a scope to increase the level of these inputs in tomato production.

In small size group the marginal value product to factor cost ratio was positive in case of human labour, machine hours, seed, manure, nitrogen and phosphorous, which means there is a scope to increase the level of these inputs in tomato production and negative in case of bullock labour and potash and this indicated that, the excess use of these inputs. Hence, there should be reduction in use of these inputs for efficient tomato production. In medium size group the marginal value of product to factor cost ratio was positive in case of human labour, bullock labour, machine hours, seed, nitrogen, phosphorous and potash, which means there is a scope to increase the level of these inputs in tomato production and negative in case of manure and this indicated that, the excess use of these inputs. Hence, there should be reduction in use of these inputs for efficient tomato production. In large size group the marginal value of product to factor cost ratio was positive in case of human labour, machine hours, seed, manure and nitrogen, which means there is a scope to increase the level of these inputs in tomato production and negative in case of bullock labour, phosphorous and potash and this indicated that, the excess use of these inputs. Hence, there should be reduction in use of these inputs for efficient tomato production.

4. Conclusion

The results of this study led to the conclusion that, in respect of input use efficiency physically, highest human labour, bullock labour and phosphorus were used by small size group farmers. The Highest nitrogen and machine hours were used by medium size group farmers whereas the highest seed, manure and potash were used by large size group farmers. The per hectare cost of cultivation for overall 96 farmers at cost 'A₂' was Rs.45738.78, whereas cost 'B₁' was Rs. 46604.23, cost 'B₂' was Rs. 70736.56 and cost 'C₁' was Rs. 50722.28, cost 'C₂' was Rs. 74854.60 whereas cost 'C₃' was Rs. 82340.06. At overall level, average gross returns were Rs. 145002.17. The net returns obtained at various costs were Rs. 99263.39 at cost 'A₂', Rs. 74265.61 at cost 'B₂', and Rs. 70147.57 at cost 'C₂'. The input-output ratio at cost 'C₂' was 1:1.94. In small size group 90 per cent of variation was explained by variables included in function. The regression coefficient of machine hours was significant at five per cent and manure was significant at one per cent level. In medium size group 74 per cent of variation was explained by variables included in function. The regression coefficient of seed was significant at one per cent level. In large size group 71 per cent variation was explained by the variables included in function. At overall level 81 per cent of variation was explained by variables included in function. The regression coefficient of machine hours was significant at five per cent and seed was significant at one per cent level. At overall level, marginal value product to the factor cost ratio of human labour, bullock labour, machine hours, seed, manure, nitrogen, phosphorous and potash was positive, which means

there is a scope to increase the level of these inputs in tomato production.

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