Asian Journal of Agricultural Extension, Economics & Sociology

39(10): 1-10, 2021; Article no.AJAEES.72339
ISSN: 2320-7027

Comparative Economic Analysis and Profitability of Tomato ((*Lycopersicon esculentum*) Production in Selected Districts of Punjab State

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Authors' contributions

This work was carried out in collaboration between bothauthors. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJAEES/2021/v39i1030659
Editor(s):
(1) Dr. Wang Guangjun, Pearl River Fisheries Research Institute, Chinese Academy of Fishery Sciences, China.
Reviewers:
(1) Arup Barman, Assam University, India.
(2) Navin Pradhan, India.
Complete Peer review History: https://www.sdiarticle4.com/review-history/72339

Original Research Article

Received 15 June 2021
Accepted 23 August 2021
Published 03 September 2021

ABSTRACT

The study was conducted to analyse the comparative economic analysis and profitability of tomato production in selected districts of Punjab state. A primary data was collected in the year 2019-20 by using multistage stratified random sampling technique. Two top ranking districts namely Amritsar and Patiala on the basis of highest area under tomato crop were purposively selected in the Punjab state. A sample of 200 tomato growers were selected, 100 each from both the districts from 21 producing villages selected from Patiala and Amritsar district of Punjab state. The results of the study indicated that the average area under tomato crop was highest in case of Amritsar district i.e. 10.90 acres as compared to 2.98 acres in Patiala district. Majority of the farmers in both the districts were using hybrid varities. 575 variety is basically demanded by the factories or tomato companies and mostly preferred by processing firms. The total variable cost was estimated highest in case of Patiala district (Rs.59262.63/acre) as compared to Amritsar district (Rs.47779.15/acre) due to the difference in their cultivation methods (Bamboo staking vs open field cultivation), varietal difference, nursery preparation methods, seasonal and geographical difference. The returns over variable cost was found higher in case of Patiala district i.e. Rs. 85142.42 than Amritsar district (Rs.61882.74). The study concluded that the tomato cultivation in Patiala district was found more profitable than

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Amritsar district. It was recommended that the primary agricultural credit cooperative societies and other funding agencies should be persuaded to provide adequate short term credit facilities to cover the higher operational cost. Government should ensure the supply of hybrid seeds to tomato growers at subsidized rates and ensure better minimum support price to tomato growers so that farmers received price at least cost equal to the cost of production.

Keywords: Cultivation; credit; district; Punjab; tomato; variety.

1. INTRODUCTION

The vegetable production in India has touched a new height in recent years. Vegetables contributed an estimated area of 10.35 million hectares with a production of 191.77 million tonnes and productivity of 19 metric tonnes per hectare [1]. In India more than 40 kinds of vegetables belonging to different groups being cultivated under different families viz, solanaceae, cucurbitaceous, leguminous, cruciferous (cole crop), root crop and leafy vegetables. Vegetable hybrids and technological interventions have given tremendous boost to vegetable production. The eight major vegetables i.e. Potato (26.75%), onion (13.94%), tomato (10.72%), brinjal (6.66%), cabbage (4.80%), cauliflower (4.61%), okra (3.32%) and pea (2.97%) bestowing 74 percent of the total production in the country [1]. India ranks first in production of okra in the world (62% of world production) followed by brinjal (24.5%), cabbage and other brassicas (12.3%), cauliflower & broccoli (32.5%), onion (21%), potato (11.6%) and tomato (18.4%) (Anonymous 2018). The leading vegetables producing states in India are West Bengal (15.08%), Uttar Pradesh (14.62%), Madhya Pradesh (9.97%), Bihar (9%), Gujarat (6.71%) and Maharashtra (6.47%) contributing about 55 percent of the total production of vegetables in the country [1]. The absolute growth in vegetable production will lead to considerable emergence of processing and export sector generating different employment opportunities in the country. Tomato (*Lycopersicon esculentum)* is a popular, nutrition rich vegetable which is an excellent source of vitamin c and also called as poor's man orange. It is one of the most alimentary vegetable having many end uses. It is used as preserved products like soup, paste, sauce or as well as in fresh forms. Tomato comprises all the essential amino acids, dietary fibers, vitamins, minerals and organic acids. It also has medicinal value. Tomato is a major commercial vegetable and can increase the earnings of rural people with the provision of employment and improvement in living standard.

Globally, more than 180.76 million tonnes of tomatoes (nearly 16 percent of the total worldwide vegetable production) were produced in 2019 [2]. China is leading producer of tomato with production of 62.86 million tonnes and it contributes 34.77 percent share in total tomato production [3]. After China, India is at the second position in tomato production with 21.95 million tonnes (12.13% of world's production) with the productivity of 26.07 tonnes/hectare and the country is second largest in terms of acreage accounting for 15.52 percent of area under tomato in the world [1]. In India, tomato has wider coverage in comparison to other vegetables as it is one of the most popular and widely grown vegetable after potato and onion as reflected in tonnage produced. India exports mainly 33.38, 20.07, 8.84 and 27.38 tonnes of tomato to Bangladesh, UAE, Qatar and Nepal respectively in the form of whole fruit, paste or in canned form (APEDA 2020). Tomato is perishable in nature and excess of its production has either to be processed or cold stored for further consumption which otherwise would lead to the problems in marketing of the produce. Tomato is more labour intensive as compared to cereals as employment opportunities for hired and family labour is higher in this crop [4]. In Punjab, tomato is grown on 9.01 thousand hectares with the production of 2.31 lakh tonnes [5]. In this context the present study has been taken to evaluate the comparative economic analysis and profitability of tomato production in selected districts of Punjab state.

2. DATA AND METHODOLOGY

The primary data were collected for the year 2019-20 by using multistage stratified random sampling technique. In the first stage, two top ranking districts namely Amritsar and Patiala on the basis of probability proportional to area under tomato crop in the Punjab state were purposively selected. In the second stage, two blocks from each district i.e. Jandiala and Raiyya from Amritsar district and from Patiala district, Sanaur and Patiala were selected where the density of tomato growers was higher. In third stage, the

villages/ cluster of villages with highest concentration of tomato growers from each block were selected in consultation with the officials of Horticulture/Agriculture Department. In next stage, a complete list of tomato growing farmers was prepared from the selected villages/cluster of villages with the help of *Sarpanch* of the village or societies in the villages and from each cluster of villages 50 tomato growers were selected randomly, 100 each from both the districts. Thus, a total sample of 200 tomato growers from 21 producing villages was selected for detailed investigation. Based on cost of cultivation categorization farmers were categorized as marginal (below 1 ha), small (1-2 ha), semi-medium (2-4 ha), medium (4-6 ha) and large (above 6 ha). The farm size categories were clubbed into 3 categories i.e. small (0-5 acres), medium (5-15 acres) and large (15 and above acres) to facilitate the comparison on the basis of operational holdings. The selection of farms was done on the basis of probability proportion to the number of farmers in each category. Consequently, 27 small, 58 medium and 15 large farmers were selected from Patiala district and 13 small, 23 medium and 64 large farmers were selected from Amritsar district. Overall 40 small, 81 medium and 79 large farmers were selected randomly making a total sample of 200 farmers.

3. CONCEPTS USED

3.1 Dependency Ratio

It is the ratio of the economically dependent part of the population to the productive part. The economically dependent part is recognized as children who are too young to work, and individuals who are too old. That is, it includes individuals under the age of 15 and over the age of 64. The productive population comprises the age group of 15 to 64 years. The dependency ratio is important for analysis from the fact that as the ratio increases, there is increased strain on the productive part of the population to support the economically dependents. There are also direct impacts on financial elements like social security.

$$\text{Dependency ratio} = \frac{\text{No.of peeple below 15 years age and above 64 years}}{\text{No.of people aged 15–64}} \times 100$$

3.2 Cost Components

The various components in the cost of cultivation of crops under study were estimated in the line with the methods provided in the manual of cost of cultivation surveys (2008). The cost of cultivation is the total expenses incurred in obtaining the produce. It includes both variable costs (hired human labour, family human labour, hired machine labour, owned machine labour, seeds, fertilizers, insecticides, pesticides, irrigation, interest on working capital) and fixed cost (rental value of owned land, rental value of leased-in land , depreciation of fixed farm assets and interest on fixed capital). A brief description of the evaluation of these components is as follows:

3.3 Human Labour

The hired labour includes both attached and casual labour. While casual labour was paid wage according to prevailing market rate and number hours worked on the specified crops the attached labour, which is a joint cost, was apportioned according to the number of hours worked on each crop in a year. The value of family labour was imputed based on the prevailing market rate or statutory wage rate whichever is higher.

3.4 Chemical Fertilizers

Chemical fertilizers were evaluated as per the purchased price.

3.5 Farmyard Manure

The farm produced manure was evaluated as per the prevailing locality rates. In case it was purchased, then it was evaluated on the basis of the purchase price.

3.6 Plant Protection Chemicals

The cost of plant protection chemicals like insecticide, herbicide and pesticide were estimated on the basis of actual purchase.

3.7 Farm Produced and Purchased Seed

The cost of farm-produced seed was obtained as per the prevailing market prices in the local area. In case it is purchased, then evaluation was done on the basis of the purchase price.

3.8 Owned/hired Machinery Charges

Owned machinery charges were calculated on the basis of the cost of maintenance of farm machinery which included diesel, power, lubricants, depreciation, repair and other

expenses. A hired machinery charge for each crop was the actual amount paid for the hired service of machinery.

3.9 Interest on Working and Fixed Capital

The interest on working capital is charged at the rate of 7 per cent for half of the crop period covered under tomato crop. Farmers were getting loans by the banks at this rate for their variable expenses. The interest on the present value of fixed assets was charged at the rate of 10 per cent.

3.10 Rental Value of Land

The rental value of owned land was estimated on the basis of prevailing rents for a similar type of land in the given area or as reported by the sample farmers, subject to the ceiling of fair rent given in the legislation. For each specific crop rent was apportioned to its gross value of output and after estimating with fair rent, the lower one from these two was imputed as the rental value of owned land. The rent paid for leased-in land was evaluated the actual rent paid.

3.11 Depreciation

The depreciation cost has been calculated for owned fixed assets such as farm sheds, submersible pump, electric and oil engine, tractors, seed- drill machine, improved plough, harrow, combine harvester, combine thresher, spray pumps etc. Depreciation of farm assets has been calculated using straight line method.

$$\text{Straight line method} = \frac{\text{Original value of farm assets} - \text{Salvage value}}{\text{Expected life years}}$$

3.12 Gross Returns

Gross returns were worked out by multiplying the average yield of the crop and average price received by the farmers.

4. RESULTS AND DISCUSSION

4.1 Cost and Returns Structure in the Production of Tomato

4.1.1 Area under tomato

The perusal of Table 1 represents the average area under tomato crop in the selected districts of Punjab. In case of Patiala district, the average operational holding with the respondent farmers was 9.82 acres in which only 2.98 acres were under tomato crop which was about 30.34 percent to the average operational holding. In case of Amritsar district, the average operational holding with the respondent farmers was 20.68 acres in which 10.90 acres were under tomato crop which was about 52.70 percent to the average operational holding. Overall, average operational holding with the respondent farmers was 15.25 acres in which only 6.94 acres were under tomato crop, which was estimated to be 45.51 percent of the average operational holding.

4.1.2 Varieties

The persual of the Table 2 represents the different hybrid varieties used by the respondent farmers in selected districts of Punjab. None of the farmer used local varieties of tomato. The table indicates that, in case of Patiala district, majority of the farmers were using Himshikhar (24 percent), Abhilash (16 percent) and Namdhari 11 variety (11 percent). Mostly the farmers were using these varieties of tomato because these varieties were survive for a long time, the size of tomato, shape, color, quality , high yield, early marketing variety, temperature bearable variety. The other varieties were used by the respondent farmers in Patiala district were Yuvraj (9 percent), Banaca (6 percent), 1080 (6 percent), Uphar (2 percent), Shiva (2 percent), 4266 (5 percent), 5013 (7 percent), Angel (3 percent), Tarshool (5 percent), 6922 (2 percent) and 575 variety (2 percent). The farmers were using these varieties due to its shape, darker in color, good yield, backend safety etc. The varieties were used by the respondent farmers in Amritsar district was Rani (50 percent) and 575 (50 percent). The farmers were using Rani variety due to its quality, yield and early harvesting variety and 575 variety is basically demanded by the factories or tomato companies and mostly preferred by processing firms.

4.1.3 Input use pattern

The input use pattern used in tomato crop by the respondent farmers has been presented in the Table 3. Table 3 represents the district-wise analysis of the Punjab state. Overall at district level, the quantity of seed used by the respondent farmers was 52.10 gms/acre whereas the seedlings used were 4826 plants per acre. Fertilizer use was another crucial component in the input use pattern. The per acre quantity of fertilizers viz urea, di- ammonium

phosphate (DAP), muriate of potash (MOP), zinc and other micro nutrients (iron, sulphur, magnesium, gypsum and plant growth hormones) was about 83.02 kgs, 159.75 kgs, 56.12 kgs, 1.67 kgs and 16.80 kgs. used per acre by the farmers for the cultivation of tomato. An important input to manage different activities is human labour and it is an addition of two components i.e. family labour and hired labour. Overall, the total human labour hours per acre used for performing various operations were 826.97 of which family labour and hired labour was used for 181.20 hours and 645.77 hours respectively. The machinery used for performing various operations in tomato cultivation like ploughing, harrowing and leveling of fields etc. Overall, machinery used per acre by respondent farmers for 4.17 hours out of which owned machines used hours was for 3.07 hours while hired machinery used was for 1.08 hours respectively. The number of sprays of plant protection chemicals used by the farmers was 15.02 sprays per acre. The per acre number of irrigations done by the respondent farmers were 14. Harvesting/picking is another vital component in cultivation of tomato. Overall, in both the districts, the number of pickings per acre was about 13.19.

The district wise analysis revealed that, in case of Patiala district, the quantity of seeds used per acre by the respondent farmers were about 54.57 gms while in Amritsar district, it was about 49.64 gms per acre. The number of seedlings used in case of Patiala district was about 4884 plants whereas in Amritsar district, it was about 4767 plants per acre. Mostly the farmers in Patiala district, they used to grow seeds of different varieties in trays for nursery preparation then planted it in a field while majority of the farmers in Amritsar district directly planted the seed in an open field or they directly purchased plants from the fellow farmers. The per acre quantity of fertilizers used in case of Patiala district was Urea (115.65 kgs), DAP (199.25 kgs), MOP (67 kgs), Zinc (2.35 kgs) and other micro nutrients i.e. 30.30 kgs whereas in case of Amritsar district it was about 50.40 kgs of Urea, 120.25 kgs of DAP, 45.25 kgs of MOP, 1 kg of Zinc and other micro nutrients was about 3.31 kg per acre. The total human labour use for accomplishing different operations in tomato cultivation in case of Patiala district was about 850.66 hours/acre while in case of Amritsar district, human labour was used for 803 hours per acre. Out of which, the average hired labour was used for more hours than the family labour in both the districts. In case of Patiala district, the hired labour was used by the respondent farmers for 628.39 hours while in Amritsar district it was for 663.13 hours per acre. The use of family labour per acre in Patiala and Amritsar district was for 222.27 hours and 140.13 hours respectively. The machines were used for performing various operations. In case of Patiala district, the machines were used for 5.49 hours. The owned and hired machines were used for 3.54 and 1.95 hours whereas in case of Amritsar district, the machine use was for 2.85 hours with owned (2.61 hours) and hired machine hours (0.21 hours). The number of sprays of plant protection chemicals carried out in Patiala district 18 sprays while in Amritsar district, it was 12. The number of pickings per acre in tomato cultivation in Patiala district was 11.54 whereas, in case of Amritsar district, the numbers of pickings per acre were 15.

4.1.4 Cost structure of tomato cultivation

The profitability of any operation depends upon costs and returns structure. Generally, costs in any economic study are discussed under two components viz, variable costs and fixed costs. The variable costs incurred by tomato farmers included costs on seed, fertilizer application, irrigation, plant protection chemicals, human labour, machine labour and interest on working capital. The fixed cost comprises of depreciation on implements and farm buildings, rental value of owned land, rental value of leased in land and interest on fixed capital. The particulars of cost of cultivation of tomato crop and share of different operational costs and fixed costs per acre have been presented district-wise and farm category wise in Table 4 and Table 5.

4.1.5 Variable costs

On an overall basis in both the districts, it was found out that the total variable cost was estimated to be Rs. 53520.85 per acre. Out of total variable costs, the expenditure on seed/seedlings was estimated to be 8.14 percent. Fertilizer cost being one of the crucial inputs in tomato cultivation. The total expenditure incurred on fertilizers was about 10.90 percent of the total variable cost out of which percent incurred on urea (0.74%), DAP (7.46%), MOP (1.81%), Zinc (0.25%) and other micro nutrients was about 0.63 percent respectively. The persual of the Table 5 reveals that the percent expenditure on manures was 0.74 percent of the total variable costs. Analyzing the irrigation cost,

it was about 0.22 percent of the total variable cost. The expenditure on total human labour use was Rs. 26920.77 per acre which comprised of family labour and hired labour. The cost incurred on family and hired labour was estimated to be Rs. 2977.40 per acre and Rs. 23943.37 per acre respectively. The share of human labour was highest among all the variable inputs which were 50.29 percent out of which the share of hired labour (44.73%) was higher than family labour (5.56%). The cost incurred on machine use was Rs.1584.64 per acre which was 2.96 percent of the total variable cost. The results brought out that farmers were using their owned machinery (2.27%) rather than hired machinery (0.67%). Overall expenses on plant protection chemicals came out to be Rs. 9030.60 per acre (16.87%). Out of the total variable cost, interest on working capital was to the tune of less than 1 percent. The miscellaneous expenses estimated were 8.99 percent of the total variable cost.

Table 1. Area under tomato across selected districts and farm size categories, 2019-20. (In acres)

S. No.	Particulars	Districts		
		Patiala	Amritsar	Overall
1	Average operational holdings	9.82	20.68	15.25
2	Average area under tomato	2.98	10.90	6.94
3	Percent area under tomato ((2/1)*100)	30.34	52.70	45.51

Table 2. Different hybrid varieties of tomato used by the respondent farmers in selected districts, Punjab, 2019-20 (Number)

S.No.	Particulars	Districts		
		Patiala	Amritsar	Overall
1	Himshikhar	24 (24.00)	-	24 (12.00)
2	Yuvraj	9 (9.00)	-	9 (4.5)
3	Banaca	6 (6.00)	-	6 (3.00)
4	1080	6 (6.00)	-	6 (3.00)
5	Abhilash	16 (16.00)	-	16 (8.00)
6	Uphar	2 (2.00)	-	2 (1.00)
7	Shiva	2 (2.00)	-	2 (1.00)
8	4266	5 (5.00)	-	5 (2.50)
9	5013	7 (7.00)	-	7 (3.50)
10	Namdhari 11	11 (11.00)	-	11 (5.50)
11	Angel	3 (3.00)	-	3 (1.50)
12	Tarshool	5 (5.00)	-	5 (2.50)
13	6922	2 (2.00)	-	2 (1.00)
14	575	2 (2.00)	50 (50.00)	52 (26.00)
15	Rani	-	50 (50.00)	50 (25.00)
Total sample size		100 (100.00)	100 (100.00)	200 (100.00)

Figures in parentheses are the percentages to their respective totals

Table 3. Input use pattern in the production of tomato by the respondent farmers in selected districts, Punjab, 2019-20

Sr. No.	Particulars	Districts		
		Patiala	Amritsar	Overall
1.	Seed (gm/acre)	54.57	49.64	52.10
2.	Seedlings (No./acre)	4884	4767	4826
3.	Fertilizers			
(i)	Urea (kg/acre)	115.65	50.40	83.02
(ii)	DAP (kg/acre)	199.25	120.25	159.75
(iii)	MOP (kg/acre)	67.00	45.25	56.12
(iv)	Zinc (kg/acre)	2.35	1.00	1.67
(v)	Other micro nutrients (kg/acre)	30.30	3.31	16.80

Sr. No.	Particulars	Districts		
		Patiala	Amritsar	Overall
Total (kg./acre)		414.55	220.21	317.36
4.	Human Labour			
(i)	Family (Hrs./acre)	222.27	140.13	181.20
(ii)	Hired (Hrs./acre)	628.39	663.13	645.77
Total (Hrs./acre)		850.66	803.26	826.97
5.	Machine use			
(i)	Owned (Hrs./acre)	3.54	2.61	3.07
(ii)	Hired (Hrs./acre)	1.95	0.21	1.08
Total (Hrs./acre)		5.49	2.85	4.17
6.	Plant protection chemicals (No. of sprays/acre)	17.71	12.33	15.02
7.	Irrigations (No./acre)	15.25	12.77	14.01
8.	Harvesting/Picking (No./acre)	11.54	15.00	13.27

The district-wise analysis revealed that, the per acre total variable cost was found Rs.59262.63 in Patiala district whereas it was about Rs.47779.15 in Amritsar district. The expenses incurred on seed/ seedlings were Rs.4191.80 per acre in case of Patiala district while these were Rs. 4523 per acre in case of Amritsar district. The share of seed/seedlings accounted for 7.07 percent in case of Patiala district and 9.46 percent in case of Amritsar district. The total expenses incurred on fertilizers were Rs. 7282.05 per acre and Rs.4392.70 per acre in Patiala and Amritsar district which was 12.28 percent and 9.19 percent of the total variable cost. The percent use of manures was 1.16 percent in Patiala district whereas less than one percent in case of Amritsar district of the total variable cost. The expenses on irrigation were less than one percent in both the districts. Human labour, a vital input to conduct various on-farm activities is generally provided by family members, permanent labour and casual labour. The total human labour used for performing different operations in tomato cultivation, like ploughing of field, sowing of seed, fertilizer application, spraying insecticides etc. The share of total human labour was higher among all the variable inputs which was 43.05 percent in case of Patiala district and 59.28 percent in case of Amritsar district. The hired labour was more used than family labour. The expenses incurred on hired and family labour in case of Patiala district was about Rs. 21570.19 per acre and Rs. 3947.56 per acre while in Amritsar it was about to be Rs. 26316.55 per acre and Rs. 2007.25 per acre. The share of hired labour was 36.39 percent in Patiala district while in Amritsar it was about 55.07 percent. The expenditure incurred on total machine use cost was higher i.e. 3.20 percent in Patiala district and lower i.e. 2.66 percent in Amritsar district. The total machine use comprises of owned machinery and hired machinery. The share of owned machinery use was higher than the hired machinery in both the districts. The percent expenses incurred on use of owned and hired machinery in case of Patiala district was about to be 2.25 and 0.95 percent while 2.32 percent and 0.34 percent in case of Amritsar district. The expenses on total plant protection chemicals were came out to be Rs.9432.60 per acre in Patiala district and Rs.8628.60 per acre in Amritsar district. The share in total variable cost was found out to be 15.92 percent and 18.06 percent. The proportionate share of interest on working capital was less than one percent in both the districts. The miscellaneous expenses were only borne by the farmers in Patiala district for bamboo staking, mulching sheets, nylon threads, fencing wires and these expenses incurred on this were found to be Rs.9628.15 per acre (16.25%). None of the farmer in the Amritsar district incurred miscellaneous expenses. The difference in their cost was due to the difference in their cultivation methods of tomato. Mostly the farmers in Patiala district were following Bamboo staking while all the farmers of the Amritsar district were following the open field cultivation of tomato. The difference in the costs of the districts was due to their varieties, nursery preparation methods, seasonal difference and geographical difference. The farmers of Patiala district used to grow nurseries in trays with ferodon spray and cocopeet to treat them and used to grow different varieties that if one variety got damage they would use another nursery then planted it in a field while in Amritsar district the mostly farmers were used to buy plants from the fellow farmers for the bed cultivation. The farmers of the Patiala district used to grow tomato in Kharif and Rabi season while all the farmers in Amritsar district used to grow tomato in Zaid season. The farmers

in Patiala district were using bamboo cultivation rather than the open field cultivation due to the early and long duration varieties.

4.1.6 Fixed costs

Overall, total fixed cost was estimated at Rs.37153.17 as shown in Table 5. Out of this, the depreciation on implements and farm buildings was estimated at Rs. 7321.31 and its relative share in total fixed cost was 19.70 percent. Among fixed costs components, the maximum share was retained by the rental value of leased in land followed by interest on fixed capital and rental value of owned land. The rental value of leased in land estimated to be Rs. 13689 per acre and its proportionate share in total fixed cost was about 36.84 percent. Interest on fixed capital was to the tune of Rs. 10327.59 and the relative share of this component was about to be 27.80 percent in total fixed costs. The rental value of owned land was estimated to be Rs. 5815.27 accounting for 15.65 percent of the total fixed cost.

The district-wise analysis revealed that total fixed cost came out to be Rs. 38489.50 in case of Patiala district whereas, Rs. 35816.85 in case of Amritsar district. The depreciation on implements and farm buildings accounted for 16.17 percent of the total fixed cost in case of Patiala district, whereas its relative share in Amritsar district accounted for 23.50 percent. The rental value of leased in land retained the highest share among all the fixed cost components. The rental value of leased in land estimated about Rs. 14299.87 per acre in Patiala district and Rs. 13078.13 in case of Amritsar district which accounted for 37.15 percent and 36.51 percent of the total fixed cost respectively. The rental value of owned land was accounting for 18.85 percent and 12.22 percent in case of Patiala and Amritsar district respectively. The proportionate share of interest on fixed capital was 27.83 percent in case of Patiala district whereas it was 27.76 percent in case of Amritsar district.

4.1.7 Profitability of tomato

The perusal of the Table 5 depicted that the average price per quintal received by the farmers was Rs. 337.20. The gross returns were estimated to be Rs.126655.70. The returns over variable cost and total cost of cultivation were to the tune of Rs. 73134.84 and Rs. 90674.02 respectively. The per quintal cost of production was Rs. 268.90 and the per quintal profit margin was estimated to be Rs. 106.70.

Table 4. Cost structure of tomato cultivation in selected districts of Punjab, 2019-20 (Rs. /acre)

Sr. No.	Particulars	Districts		
		Patiala	Amritsar	Overall
A.	**Variable costs**			
1.	Seed/Seedlings	4191.80 (7.07)	4523.00 (9.46)	4357.40 (8.14)
2.	Fertilizer			
(i)	Urea	493.90 (0.83)	302.35 (0.63)	398.12 (0.74)
(ii)	DAP	4981.25 (8.40)	3006.25 (6.29)	3993.75 (7.46)
(iii)	MOP	1040.00 (1.75)	903.00 (1.88)	971.50 (1.81)
(iv)	Zinc	188.00 (0.32)	80.00 (0.17)	134.00 (0.25)
(v)	Other micro nutrients cost	578.90 (0.97)	101.10 (0.21)	340.00 (0.63)
Total		7282.05 (12.28)	4392.70 (9.19)	5837.37 (10.90)
3.	Manures	687.75 (1.16)	101.20 (0.21)	394.47 (0.74)
4.	Irrigation charges	110.50 (0.18)	124.09 (0.26)	117.29 (0.22)
5.	Human Labour			
(i)	Family	3947.56 (6.66)	2007.25 (4.20)	2977.40 (5.56)

Sr. No.	Particulars	Districts		
		Patiala	Amritsar	Overall
(ii)	Hired	21570.19 (36.39)	26316.55 (55.07)	23943.37 (44.73)
Total		25517.75 (43.05)	28323.80 (59.28)	26920.77 (50.29)
6.	Machine use			
(i)	Owned	1333.73 (2.25)	1108.32 (2.32)	1221.02 (2.27)
(ii)	Hired	564.25 (0.95)	163.00 (0.34)	363.62 (0.67)
Total		1897.98 (3.20)	1271.32 (2.66)	1584.64 (2.96)
7.	Plant protection chemicals	9432.60 (15.92)	8628.60 (18.06)	9030.60 (16.87)
8.	Interest on variable cost @7% for half of period	514.05 (0.86)	414.44 (0.87)	464.24 (0.87)
9.	Other miscellaneous charges (bamboo staking ,Mulch sheet, nylon thread, fencing wire)	9628.15 (16.25)	00.00 (00.00)	4814.07 (8.99)
Total variable costs		59262.63 (100.00)	47779.15 (100.00)	53520.85 (100.00)
B.	**Fixed costs**			
1.	Depreciation on implements and farm buildings @10%	6224.63 (16.17)	8417.99 (23.50)	7321.31 (19.70)
2.	Rental value of owned land	7254.06 (18.85)	4376.48 (12.22)	5815.27 (15.65)
3.	Rental value of leased in land	14299.87 (37.15)	13078.13 (36.51)	13689.00 (36.84)
4.	Interest on fixed capital @10%	10710.94 (27.83)	9944.25 (27.76)	10327.59 (27.80)
Total fixed costs		38489.50 (100.00)	35816.85 (100.00)	37153.17 (100.00)
Total cost (A+B)		97752.13	83596.00	90674.02

Figures in parentheses are the percentages to their respective totals

Table 5. Profitability of tomato across selected districts and farm size categories, Punjab, 2019-20

S. No.	Particulars	Districts		
		Patiala	Amritsar	Overall
1	Yield (Qtls.)	374.31	300.09	337.20
2	Average price (Rs /quintal)	385.79	365.43	375.61
3	Gross returns	144405.10	109661.90	126655.70
4	Total variable cost	59262.63	47779.15	53520.85
5	Total cost	97752.13	83596.00	90674.02
6	Returns over variable cost	85142.42	61882.74	73134.84
7	Returns over total cost	46652.92	26065.89	35981.67
8	Per quintal cost of production	261.15	278.56	268.90
9	Profit margin (Rs./quintal)	124.64	86.86	106.70

District-wise analysis revealed that price per quintal of the produce received by the farmers in Patiala district was Rs.374.31 whereas in case of Amritsar district, it was Rs. 300.09. On an average, the gross returns were found higher in case of Patiala district i.e. Rs. 144405.10

whereas in case of Amritsar district, it was to be Rs. 109661.90. The returns over variable cost were estimated in case of Patiala and Amritsar district was Rs. 85142.42 and Rs. 61882.74 respectively. The returns over total cost of cultivation were found to be Rs.46652.92 in Patiala district and Rs. 26065.89 in Amritsar district. On an average, the per quintal cost of production was estimated to be Rs. 261.15 in Patiala district whereas, it was Rs. 278.56 in Amritsar district. The per quintal profit margin was worked out to be Rs. 124.64 in Patiala district and Rs. 86.86 in Amritsar district. It was concluded that tomato cultivation in Patiala district was found more profitable than Amritsar district.

5. CONCLUSIONS AND POLICY IMPLICATIONS

To conclude, it was found that mostly the farmers in Patiala district, they used to grow seeds of different varieties in trays for nursery preparation then planted it in a field while majority of the farmers in Amritsar district directly planted the seed in an open field or they directly purchased plants from the fellow farmers. The share of total human labour was higher among all the variable inputs which was 43.05 percent in case of Patiala district and 59.28 percent in case of Amritsar district. The hired labour was more used than family labour. The total variable cost was estimated highest in case of Patiala district (Rs.59262.63/acre) as compared to Amritsar district (Rs.47779.15/acre) due to the difference in their cultivation methods (Bamboo staking vs open field cultivation), soil type, varietal difference, location specification in terms of access to services and input management methods. On an average, the gross returns were found higher in case of Patiala district i.e. Rs. 144405.10 whereas in case of Amritsar district, it was to be Rs. 109661.90. The returns over total cost of cultivation were found to be Rs.46652.92 in Patiala district and Rs. 26065.89 in Amritsar district. It was concluded that tomato cultivation in Patiala district was found more profitable than Amritsar district. It was recommended that the primary agricultural credit cooperative societies and other funding agencies should be persuaded to provide adequate short term credit facilities to cover the higher operational cost. Government should ensure the supply of hybrid seeds to tomato growers at subsidized rates and ensure better minimum support price to tomato growers so that farmers received price at least cost equal to the cost of production.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle4.com/review-history/72339