Cost and profitability analysis of tomato production in the greenhouse in highland conditions: a case study of Burdur Province, Turkey

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Abstract

This study aims to determine the production costs and profitability of the farmers' greenhouses tomato production in highland conditions in Burdur province. Burdur province was chosen as the research area because Turkey was an important region for the widely carried out greenhouse tomato production highland conditions. The study's data were determined by the stratified random sampling method obtained by the survey method from 77 farms producing tomato in the Gölhisar and Çavdır district of Burdur province. The production data set includes data for 2019. According to the research findings, the average production cost per decare was calculated to be 17170.56 TRY. The share of variable costs was 76.89% within the production costs, and the share of fixed costs was 23.11%. It was determined that the unit sale price of tomato was 0.98 TRY. The gross production value (GPV) of tomato in the region was calculated as 18924.77 TRY/da, gross profit 5721.52 TRY/da, and net profit 1754.20 TRY/da. The unit cost of tomato in the region was 0.89 TRY. The relative profit was determined as 1.12 TRY. As a result of the research, as the greenhouse tomato production areas increase, the fixed costs decreased per decare. Also, it was determined that as the greenhouse tomato production areas increased, the profitability rates per decare and the tomato kilogram sales prices increased.

Keywords*:* Tomato. Greenhouse. Economic analysis. Production cost. Profitability.

1. Introduction

Greenhouse production activity is important because of the high amount of product obtained from the unit area, the production even outside the production season, and a high value-added production method.

Turkey began greenhouse vegetable cultivation in the province of Antalya in the 1940s. However, until 1970 it showed a slow development trend. After the 1970s, plastic began to be used in greenhouse material, and there was a significant development in greenhouse vegetable production (Aktaş Çimen, 2003).

Greenhouse areas show the distribution in the Marmara coastal areas, the Aegean and the Mediterranean area in Turkey has been intense. Greenhouse production activities are carried out in the north of Turkey in Yalova. Its surrounding microclimate, around Mugla and Izmir in the west, in the southern Antalya, Burdur, are held in Mersin and Hatay (Emekli et al., 2008).

Greenhouse tomato cultivation areas in Turkey in 2019 was reported as 29026 hectares. Of the total greenhouse areas, 73.12% was a plastic greenhouse, 16.98% was a glass greenhouse, 5.11% was a high tunnel, and 4.79% was a low tunnel greenhouse. Tomato production in a greenhouse was reported as 4083681 tons. Total production; 75.77% was in plastic greenhouses, 16.98% in glass greenhouses, 5.11% in the high tunnel and 4.79% in low tunnel greenhouses (TURKSAT, 2021).

The productions in the highland regions have become essential in meeting the consumers' demands during the summer season. In this context, greenhouse production activities have started to become widespread in the highland regions. For this reason, a large number of greenhouse areas were established in Çavdır (Söğüt) and Gölhisar districts of Burdur to produce during the summer period. Tomatoes planted in March-April and harvested in June-July in the region enter the market.

This study aimed to carry out costs and profitability analysis for greenhouses tomato production in highland conditions located in Burdur province. Also, socio-economic and technical information such as age, education level, household size, experience, average farms size, use of fertiliser and bumblebee, and soil and leaf analysis applications were interpreted for tomato producers according to farms groups.

2. Literature Review

Many studies in the literature on economic analysis of tomato production, but the study on economic analysis of tomato production in greenhouses in highland conditions is limited. In this section, literature reviews on the cost and profitability of tomato production in greenhouses is summarised.

Rad and Yarşı (2005) conducted a study entitled "Economic Performance and Unit Production Cost in Greenhouse Farms Producing Tomatoes in Silifke". They determined the economic performance and production costs of farms that produce tomatoes in plastic greenhouses in Mersin. The study's data were obtained from 37 farmers who grow tomatoes in single and double crops in greenhouses. According to the research results, family labour cost, temporary labour cost, agrochemical and fertiliser cost were determined as the most critical costs in tomato production costs.

Özkan et al. (2008) carried out research titled "An Analysis of Profit Efficiency for Greenhouse Tomato Production in Antalya Province". They determined the profit efficiency of farms producing tomatoes in Antalya's greenhouses using the stochastic profit frontier model. The research data were obtained from 256 farmers that produce tomatoes in winter, autumn and summer. They found that winter tomato production was more profitable.

Sipahioğlu (2014) carried out a study titled "Cost Analysis of Tomato Production in Different Farming Systems". He determined the cost of tomatoes produced in conventional farming greenhouses and soilless agriculture greenhouses in Antalya. The data of the research were obtained from farmers that produce tomatoes in conventional and soilless cropping systems. According to the research results, he determined that farms that grow tomatoes in the soilless agriculture greenhouses system are more profitable than conventional farming greenhouses.

Başbuğ (2016b) conducted a study entitled "Analysis of Production Cost and Profitability of Greenhouse Growing Enterprises: A Cases of Elmali County of Antalya Province". He determined the production and marketing problems of farmers that produce tomatoes in greenhouses in Antalya. It also calculated the gross profit, absolute profit and relative profitability of the farms. The data of the research were obtained from 90 farmers that greenhouse cultivation in highland conditions. In the weighted farms average, he calculated the gross profit per decare as 7491.60 TRY, 3498.52 TRY net profit, 1.34 TRY relative profit and 0.73 TRY per kilogram tomato cost.

Demirtaş et al. (2016) carried out a research titled "A Comparison of Profitability and Cost Analyses of Tomato Cropping Systems in Greenhouses". They determined the gross profit, absolute profit and relative profitability of tomatoes in greenhouses in Mersin. The research data were obtained from farmers that produce tomatoes in organic, conventional, and soilless cropping systems. According to the research results, the relative profit value per decare was calculated as soilless agriculture greenhouses (1.26 TRY) and conventional farming greenhouses (1.24 TRY). The highest relative profit value per decare was calculated in organic farming farms (1.54 TRY).

Örük and Engindeniz (2019) carried out research titled "Research on the Economic Analysis of Greenhouse Tomato Production in Mugla Province". They determined the socio-economic characteristics and cost of farms growing tomatoes in greenhouses in Mersin province. The data of the research were obtained from 90 farmers that grow tomatoes in the greenhouse. The research results calculated the gross profit per decare as 7141.31 TRY, 4442.58 TRY net profit, 1.36 TRY relative profit, and 0.56 TRY per kilogram tomato cost.

3. Materials and Methods

3.1. Materials

The study's primary material was comprised of original data obtained via face-to-face survey method from 77 greenhouse tomato production farms in highland conditions at the Gölhisar and Çavdır district Burdur province. Burdur province has a 3.34% greenhouses tomato production area and 3.78% in greenhouses tomato production in Turkey. Gölhisar and Çavdır district constitutes 74.99% of the greenhouses tomato production area and 74.59% of greenhouses tomato production quantity of Burdur province. In Burdur, greenhouse tomato production was produced at 99.74% plastic greenhouse and 0.26% in the glasshouse (TURKSAT, 2021). It is an important product for farmers producing in highland conditions. For this reason, producers growing tomatoes in plastic greenhouses in Gölhisar and Çavdır districts were included in the study. In addition to similar studies conducted by the related individuals and institutions, reports and statistics were used. Survey data belongs to the 2019 production period. The research area is given in Figure 1.

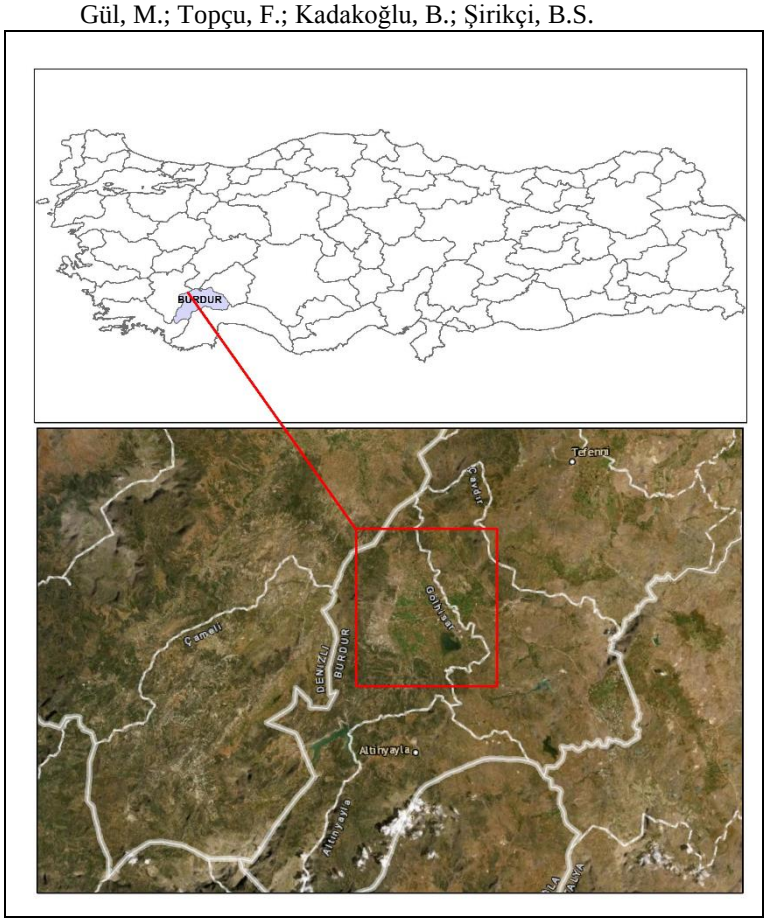

Figure 1: Research area

3.2. Methods

The total number, size and addresses of farms involved in greenhouses tomato production in highland conditions were obtained from the Burdur Directorate of Provincial Agriculture and Forestry. Neyman Method was used to determine the sample volume of the survey (Yamane, 2001). The number of samples was calculated with the formula given below.

$$n = \frac{(\sum N_h S_h)^2}{N_2 D_2 + \sum N_h S_h^2} \quad (1)$$

n; Sample size, N; Total number of units in the population, Nh; Number of units in group h, Sh; Standard deviation of group h, Sh2; Variance of group h, D2; d2/z2, d2; Allowed error from population average, z2; Value of the allowed safety limit in the distribution table.

The producers participating in the research were divided into groups according to their greenhouse area. According to this, the farms were divided into three groups as “I group (4 less than 4.00 decares; 26 farms), II group (4.00-6.99 decares; 29 farms) and III group (>6.99

decares; 22 farms)". The average greenhouse area of the farms in the groups was determined as 2.00 decares for I group farms, 4.88 decares for II group farms, 13.14 decares for III group farms and 6.27 decares for all farms (Table 1). The data obtained from the identified farms through questionnaires were uploaded to the computer environment and evaluated in tables by making statistical software calculations.

Table 1: Sample size

Groups	Greenhouse area (decare)*	Number of farms	Percent	Average decare
I	<4.00	26	33.77	2.00
II	4.00-6.99	29	37.66	4.88
III	6.99<	22	28.57	13.14
Total		77	100.00	6.27

*1 decares = 0.1 hectares

The production costs of tomato producing farms were examined as variable and fixed costs. The unique product budget analysis method was used to calculate costs. The net profit was calculated in the farms examined by subtracting the changing costs from the tomato production value and subtracting the gross profit and the total production costs. Relative profit was calculated by dividing tomato production value by production costs. The quantity of tomato produced was multiplied by the sales price, and the production value was calculated. Fertilisation, labour, machine rent, other changing costs and interest of working capital (half of the interest rate applied by Ziraat Bank for plant production was 4%) within the scope of changing costs. Fixed costs were calculated total of general administrative expenses (3% of variable costs), land rent (5% of the bare land value), depreciation of establishment capital (calculated by dividing the establishment cost by the economic life), and establishment cost interest (8.5% interest was applied on the total establishment costs half value) (Açıl, 1977; Erkuş et al., 1995; Kıral et al., 1999).

4. Results and Discussion

Some socio-demographic indicators of tomato producers in highland greenhouses such as age, education, household, experience in greenhouse tomato production, training and record-keeping were provided in Table 2. The average age of the interviewed farmers was 40.83 years. The average age of farmers was 39.50 years in the I farm group, 41.10 in the II farm group and 42.05 years in the III farm group. It was determined that as the farms' greenhouse size increased, the farmers' average age also increased. The average education

level of the farmers was 11.66 years. The average education level of farmers was 11.65 years in the I farm group, 11.90 in the II farm group and 11.36 years in the III farm group. The lowest education level was at the II farm group. The average household size of the farmers was 3.55 person. The average household size of farmers was calculated as 3.38 years in the I farm group, 3.59 in the II farm group and 3.68 years in the III farm group. The smallest household size was at the I farm group, and the largest household size was at the III farm group. The experience time of the farmers in greenhouse production was found to be 6.49 years. The farmers' average greenhouse production experience was calculated as 6.85 years in the I farm group, 5.76 in the II farm group and 7.05 years in the III farm group. The highest experience time of the farmers in greenhouse production was at the III farm group. The experience time of the farmers in tomato production was found to be 5.43 years. The farmers' average experience in tomato production was calculated as 5.88 years in the I farm group, 5.00 in the II farm group and 5.45 years in the III farm group.

The farmers' lowest experience time in tomato production was at the II farm group, and the highest experience of the farmers in tomato production time was at the I farm group. It was found that 20.78% of the farmers received training in greenhouse cultivation. The farmers in greenhouse cultivation training were calculated as 30.77% in the I farm group, 17.24% in the II farm group, and 13.64% in the III farm groups. Keeping records of farms reveals the physical performance and success of farms. It was determined that 14.29% of the farms kept records. Keeping records in greenhouse cultivation was calculated as 11.54% in the I farm group, 17.24% in the II farm group and 13.64% in the III farm group. Accordingly, 85.71% of farms were found to be no record-keeping.

Başbuğ and Gül (2016a) determined that the farmers' age averages were 44.00 years, the duration of education 7.71 years, the household size averages of the farmers 5.20 person, the average greenhouse area was 3.30 decare and level of experience in greenhouse production 7.21 years. Yalçın and Boz (2007) determined that the farmers' age averages were 42.70 years, the duration of education 6.64 years, the level of experience in agriculture production 13.00 years and the average greenhouse area was 6.11 decare. Örük and Engindeniz (2019) determined that the farmers' age averages were 44.95 years, the duration of education 7.18 years and the time of experience in greenhouse production 20.81 years.

Table 2: Some characteristics of the farms

Some socio-demographic indicators of tomato growing in the greenhouse	Farm groups (da)			Farms Average
	Group I	Group II	Group III	
Age (year)	39.50	41.10	42.05	40.83

Education level (year)	11.65	11.90	11.36	11.66
Household (person)	3.38	3.59	3.68	3.55
Experience in greenhouse production (year)	6.85	5.76	7.05	6.49
Experience in tomato production (year)	5.88	5.00	5.45	5.43
Training in greenhouse cultivation (%)	30.77	17.24	13.64	20.78
Record-keeping (%)	11.54	17.24	13.64	14.29

Table 3 presents the use of foliar fertiliser, animal manure and bumblebee in farms. It also demonstrates the applications of soil and leaf analysis of farms. It was determined that all farms used foliar fertilisers. It was determined that all farms used foliar fertilisers, 22.73% of the only III group used animal manure, and 85.71% of the farms use bumblebee. Bumblebee was used in all farms in group II and III, while animal manure was not used in groups I and II. Foliar fertiliser application times of farms varied. 77.92% of the farms applied foliar fertiliser in June-July-August-September (6-7-8-9). 20.78% of the farms applied foliar fertiliser in June-July-August-September-October (6-7-8-9-10). With soil analysis, the power of soils to provide nutrients to plants is determined, and deficiencies can be overcome by fertilisation. However, since soil analysis is not sufficient, plant analysis is also used to reveal plants' level of nutrition and make the necessary applications (Orman and Kaplan, 2004). The average of farms applying soil analysis farmers was 19.23% in the I farm group, 13.79% in the II farm group, 31.82% in the III farm group and 20.78% in all farms. The lowest soil analysis application was at the II farm group, and the highest soil analysis application was at the III farm group. The average of farms applying leaf analysis farmers was determined as 30.77% in the I farm group, 6.90% in the II farm group, 13.64% in the III farm group and 16.88% in all farms. The lowest leaf analysis application was at the II farm group, and the highest leaf analysis application was at the I farm group. Although the highest education level was in II group farms, leaf and soil analysis applications are the lowest. This situation could be explained as the greenhouse cultivation experience and tomato production experience of II group farms were less than the other groups.

Table 3: Some variables applications in farms

Use of some variables in farms	Farm groups (da)			Farms Average
	Group I	Group II	Group III	
	Rate (%)			
Foliar fertilizer	100.00	100.00	100.00	100.00
Animal manure	0.00	0.00	22.73	6.49
Bumble bee	57.69	100.00	100.00	85.71
Soil analysis (%)	19.23	13.79	31.82	20.78
Leaf analysis (%)	30.77	6.90	13.64	16.88

Fertiliser usage amounts of the farmers were calculated as 46.91 kg N, 18.79 kg P and 15.39 kg K per decare pure substance in tomato greenhouses. The pure N, P, K usage were most in the III group. Başbuğ and Gül (2016a) found average pure N usage was 47.04 kg, pure P usage was 25.94 kg, and pure K usage was 32.42 kg in Antalya province. Engindeniz et al. (2010) calculated pure N was 68.71 kg, pure K was 58.69 kg, and pure P was 57.99 kg average per decare, in Antalya, Mersin, Muğla and İzmir provinces. According to the study results, the levels of N, P, K were lower than the findings of other studies. The primary cause of this may be that the production areas and production periods are different.

The amount of pesticide use of the farmers was calculated. It was determined that 1324.47 g of pesticides were used per unit area in the farms. The farms used 644.17 g fungicide, 396.93 g insecticide, 214.66 g acaricide and 68.70 g herbicide per unit area. Başbuğ and Gül (2016a) found out in their study that the average pesticide usage as per unit area 2688.9 g.

Production costs of farms producing tomatoes in a greenhouse were examined under two separate items. These are fixed and variable costs. Fixed costs are not dependent on the volume of production but are available in farms. In other words, it does not change according to the production volume. Variable costs are the costs that increase or decrease according to the production volume. This cost depends on whether the product is made or not (Rehber and Çetin 1998). Seedlings, pesticides, fertilisers, temporary labour costs, irrigation, machinery rents, other variable costs and working capital interest constituted the variable costs elements.

The average variable costs of the farms engaged in greenhouse production calculated as 82734.66 TRY. This value varied between 25147.26 TRY and 181500.52 TRY in the groups. Seedling cost (42880.26 TRY) has the highest share among the variable costs. This was followed by pesticide cost (16089.61 TRY), fertiliser costs (10039.16 TRY), shipping-marketing cost (4188.92 TRY), temporary labour costs (2912.66 TRY), irrigation cost (2009.57 TRY), other costs (1795.00 TRY), the interest of working capital (1594.15 TRY) and machine rental cost (1225.32 TRY). The farms' fixed costs involved in producing greenhouse tomato, permanent and family labour, establishment capital interest, land rent, establishment depreciation value, and general administrative expenses. The average fixed costs of the farms engaged in greenhouse production calculated as 24860.11 TRY. This value varied between 9696.77 TRY and 47438.74 TRY in the groups. Establishment depreciation cost (7383.08 TRY) has the highest share among the fixed costs. This was followed by establishment capital interest cost (6275.62 TRY), permanent-family labour cost (4500.45 TRY), land rents (4218.91 TRY) and general administration expenses (2482.04 TRY).

According to the farms size groups, total production costs were calculated as an average of 107594.76 TRY. This value was calculated as an average of 34844.03 TRY in the I group, 80765.11 TRY in the II group, and 228939.26 TRY in the III group.

Table 4: Production costs in farms

Production Costs	Farm groups (da)			Farms Average
	Group I	Group II	Group III	
	Cost (TRY*/farms)			
Seedlings	13238.46	31782.07	92540.91	42880.26
Pesticide cost	5375.58	12768.45	33129.55	16089.61
Fertilization cost	2254.42	5411.03	25340.00	10039.16
Shipping-marketing	1804.35	2993.76	8582.50	4188.92
Temporary labour costs	325.00	1196.90	8232.50	2912.66
Irrigation	731.85	1677.93	3956.77	2009.57
Other variable costs	478.46	1560.69	3659.77	1795.00
The interest in working capital	512.22	1132.57	3481.25	1594.15
Machine rental cost	426.92	915.52	2577.27	1225.32
Total variable cost	*25147.26*	*59438.91*	*181500.52*	*82734.66*
Establishment depreciation value	2472.02	5806.03	15265.91	7383.08
Establishment capital interest	2101.22	4935.13	12976.02	6275.62
Permanent-family labour	2956.54	5484.14	5028.41	4500.45
Land rent	1412.58	3317.73	8723.38	4218.91
General administration expenses	754.42	1783.17	5445.02	2482.04
Total fixed cost	*9696.77*	*21326.19*	*47438.74*	*24860.11*
Total production costs	**34844.03**	**80765.11**	**228939.26**	**107594.76**

*1 USD = 5.67 TRY for 2019 year

According to the per decare, total production costs were calculated as an average of 17422.02 TRY for all group. This value varied between 16552.57 TRY and 17427.90 TRY in the groups. The share of fixed costs was 23.11% in total production. This value was calculated as 27.83% in the I group, 26.41% in the II group and 20.72% in the III group. As the production area increases, the share of fixed costs in total costs decreases. The most important cost elements among fixed costs were the establishment depreciation value cost (6.86%), establishment capital interest cost (5.83%) and permanent-family labour cost (4.18%). The share of variable costs was 76.89% in total production. This value was calculated as 72.17% in the I group, 73.59% in the II group and 79.28% in the III group. It was determined that as the greenhouse area increased, the share of variable costs in total costs also increased. The most important cost elements among variable costs were the cost of the seedlings (39.85%), pesticide cost (14.95%) and fertilisation cost (9.33%).

In another study (Özkan et al. 2011) conducted in 2011 in Antalya province Merkez, Serik and Kumluca districts, the total variable cost per decare in plastic greenhouses was found to be 3510.19 TRY (49.36%) and total fixed cost 3601.53 TRY (50.64%). In another

study (Sipahioğlu, 2014) conducted in 2013-2014 in Antalya province, the total variable cost per decare was found as 15810.49 TRY (80.62%) and total fixed cost 3801.31 TRY (19.38%). In another study (Başbuğ and Gül, 2016b) that was carried out in the Antalya province Elmalı district in 2016, the total variable cost per decare was found as 6421.08 TRY (61.66%). Seedlings costs (18.93%), fertilisers costs (18.00%) and pesticides costs (12.51%) were found as the essential costs. In another study (Demirtaş et al., 2016) carried out in the Mersin province in the three years between 2012 and 2014, the share of total variable costs in the total production cost was found to be 80.21%. Seedlings costs (20.23%), labour costs (17.60%) and heating costs (15.72%) were found as the essential costs. In another study (Örük and Engindeniz, 2019) conducted in 2017 in Muğla province Seydikemer, Fethiye and Ortaca districts, the total variable cost per decare in plastic greenhouses was found to be 9682.03 TRY (78.20%) and total fixed cost 2698.73 TRY (21.80%). In another study (Oruç and Gözener, 2020) carried out in the Antalya province Serik district in 2020, the total variable cost per decare was found as 500.03 USD (80.48%). Fertilisers costs (19.30%), seedlings costs (15.08%) and irrigation costs (11.17%) were found as the essential costs.

The studies revealed that variable costs have an essential share in greenhouse tomato cultivation. The seedling, seed, fertiliser-fertilisation and greenhouse facility and the investment in services supporting the greenhouse are the prominent costs of the depreciation. Studies have shown that variable costs have a significant share of total costs. The most important cost factors were seedling, pesticide and fertiliser costs. The shares of fixed and variable costs in total costs vary according to production regions, production systems or production periods.

Table 5: Production costs per unit area in farms

Production Costs	Farm groups (da)			Farms Average
	Group I	Group II	Group III	
	Cost (TRY/per decare)			
Seedlings	6619.23	6513.64	7044.64	6843.07
Pesticide cost	2687.79	2616.86	2521.97	2567.67
Fertilization cost	1127.21	1108.98	1929.00	1602.10
Shipping-marketing	902.17	613.56	653.34	668.49
Temporary labour costs	162.50	245.30	626.70	464.82
Irrigation	365.92	343.89	301.21	320.70
Machine rental cost	213.46	187.63	196.19	195.54
Other variable costs	239.23	319.86	278.60	286.46
The interest in working capital	256.11	232.12	265.01	254.40
Total variable cost	*12573.63*	*12181.83*	*13816.65*	*13203.25*
Establishment depreciation value	1236.01	1189.93	1162.11	1178.23
Establishment capital interest	1050.61	1011.44	987.79	1001.50
Permanent-family labour	1478.27	1123.96	382.79	718.21

Land rent	706.29	679.96	664.06	673.28
General administration expenses	377.21	365.45	414.50	396.10
Total fixed cost	*4848.39*	*4370.74*	*3611.25*	*3967.31*
Total production costs	**17422.02**	**16552.57**	**17427.90**	**17170.56**
	The share in the production costs (%)			
Seedlings	37.99	39.35	40.42	39.85
Pesticide cost	15.43	15.81	14.47	14.95
Fertilization cost	6.47	6.70	11.07	9.33
Shipping-marketing	5.18	3.71	3.75	3.89
Temporary labour costs	0.93	1.48	3.60	2.71
Irrigation	2.10	2.08	1.73	1.87
Machine rental cost	1.23	1.13	1.13	1.14
Other variable costs	1.37	1.93	1.60	1.67
The interest in working capital	1.47	1.40	1.52	1.48
Total variable cost	*72.17*	*73.59*	*79.28*	*76.89*
Establishment depreciation value	7.09	7.19	6.67	6.86
Establishment capital interest	6.03	6.11	5.67	5.83
Permanent-family labour	8.49	6.79	2.20	4.18
Land rent	4.05	4.11	3.81	3.92
General administration expenses	2.17	2.21	2.38	2.31
Total fixed cost	*27.83*	*26.41*	*20.72*	*23.11*
Total production costs	**100.00**	**100.00**	**100.00**	**100.00**

Success criteria such as production costs, gross product value, gross profit, net profit and relative return of the farms were compared according to the farms' groups. The profitability status of greenhouse tomato production is shown in Table 6. Gross profit, net profit, relative profit, tomato kilogram cost and production cost per kilogram were calculated to reveal the farms' cost and profitability. These indicators enable farms to reveal their success and make their plans. The gross profit calculated by subtracting the variable costs from the tomato production value was calculated as 5721.52 TRY per decare average of farms. This value was calculated as 5097.52 TRY in the I group, 5975.06 TRY in the II group, and 5709.65 TRY in the III group. Net profit was calculated by subtracting the total costs from the tomato production value. The farms' average net profit per decare was amount to be 1754.20 TRY. This value was calculated as 249.14 TRY in the I group, 1604.32 TRY in the II group, and 2098.40 TRY in the III group. It was determined that as the greenhouse tomato production areas increase, the net profit also increases. The average net profit per decare of the group I of farms was low. Because the production and sales price of tomatoes per decare of farms in the first group was low, and the total costs per decare were high. The relative profit calculated by dividing tomato production value by production costs was calculated as 1.10 TRY per decare average of farms. This value was calculated as 1.01 TRY in the I group, 1.10 TRY in the II group, and 1.12 TRY in the III group. Relative profit value refers to the production value of 1.10 TRY in return for 1.00 TRY expenditure for tomato

production. It was determined that as the area of greenhouse areas increased, this value also increased. The kilogram cost of tomato was calculated by dividing the production costs by the yield. Accordingly, the average kilogram cost of the farms was calculated as 0.89 TRY. This value was 0.93 TRY per kilogram in the I group, 0.88 TRY per kilogram in the II group, and 0.89 TRY per kilogram in the III group. Kilogram sales prices were calculated as 0.98 TRY on average of farms. This value was 0.95 TRY per kilogram in the I group, 0.97 TRY per kilogram in the II group and 1.00 TRY per kilogram in the III group. It was determined that as the greenhouse tomato production areas increase, the kilogram sales prices also increase.

Sipahioğlu (2014) calculated the cost of tomato production per decare in conventional greenhouses was 15810.49 TRY, 22820 TRY gross production value, 1.01 TRY per kilogram tomato cost, 3208.8 TRY net profit, 7010.11 TRY gross profit, and 1.16 TRY relative profit. Başbuğ and Gül (2016b) calculated the cost of tomato production per decare in highland conditions greenhouses was 10303.93 TRY, 15761.85 TRY gross production value, 0.69 TRY per kilogram tomato cost, 5457.92 TRY net profit, 9900.91 TRY gross profit, and 1.53 TRY relative profit. Demirtaş et al. (2016) calculated tomato production cost per decare in conventional greenhouses was 23135.32 TRY, 28752.97 TRY gross production value, and 1.25 TRY kilogram tomato cost, 5617.65 TRY net profit, 10042.95 TRY gross profit, and 1.24 TRY relative profit. Örük and Engindeniz (2019) calculated tomato production cost per decare in greenhouses was 12380.76 TRY, 16823.34 GPV, 0.56 TRY per kilogram tomato cost, 4442.58 TRY net profit, 7141.31 TRY gross profit, and 1.36 TRY relative profit. The gross profit value we calculated per decare was found to be similar to the results of Sipahioğlu (2014), Başbuğ and Gül (2016b), Örük and Engindeniz (2019) research results. Besides, the relative profit value coincides with the results of Sipahioğlu (2014). According to the studies of Başbuğ and Gül (2016b), Örük and Engindeniz (2019), the relative profit value was found to low. The reason for this is the high value of production costs in our study.

Table 6: Cost and profitability in greenhouse tomato production

Costs and profit	Farm groups (da)			Farms Average
	Group I	Group II	Group III	
1.Gross production value (TRY/da)	17671.15	18156.89	19526.30	18924.77
2.Variable cost (TRY/da)	13427.48	12181.83	13816.65	13295.27
3.Gross profit (TRY/da) (1-2)	5097.52	5975.06	5709.65	5721.52
4.Total production costs (TRY/da)	17422.02	16552.57	17427.90	17170.56
5.Net profit (TRY/da) (1-4)	249.14	1604.32	2098.40	1754.20
6.Relative profit (1/4)	1.01	1.10	1.12	1.10
7.Production cost per kg (TRY/kg)	0.93	0.88	0.89	0.89
8.Sale price per kg (TRY/kg)	0.95	0.97	1.00	0.98

5. Conclusions and Recommendations

This study was conducted in Burdur was an important region for the widely carried out greenhouse tomato production highland conditions. Production costs and profitability of tomato, which was economically significant in the research area, was calculated. It was determined that the greenhouses' total production costs per decare for all farms average was 17170.56 TRY with the share of 59.67% were variable cost, and 40.33% were fixed costs. Of the variable costs, 39.85% was seedling costs, 14.95% was pesticide costs, 9.33% was fertiliser costs and 3.89% shipping-marketing cost. Of the fixed costs, 6.86% was establishment depreciation value costs, 5.83% was the facility capital's interest, 4.18% was permanent labour, and 3.92% was land rent cost. It was determined that as the tomato production areas increased in the greenhouse, the fixed costs per decare decreased. As the greenhouse tomato production areas increased, the profitability rates per decare and the sales prices per kilogram of tomatoes increased. It is thought that if the size of the farms' increases, their profitability will increase.

Tomato production in the greenhouse is an important activity in the region that increases income and provides employment. For this reason, there is a need for an effective producer organisation that can reduce production costs and improve marketing opportunities in the region.

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