

## Economic Analysis of Thyme Production: A Case Study of Denizli Province, Turkey

Bahri Karlı<sup>1\*</sup>, Zehra Demir<sup>1</sup>, Mevlüt Gül<sup>1</sup> and Bektaş Kadakoğlu<sup>1</sup>

<sup>1</sup>Isparta University of Applied Sciences, Faculty of Agriculture, Department of Agricultural Economics, Isparta, Turkey

\*Corresponding author e-mail: [bahrikarli@isparta.edu.tr](mailto:bahrikarli@isparta.edu.tr)

### Abstract

This study aims to determine the production costs and profitability of the enterprises producing thyme in Denizli province. Denizli province was chosen as the research area because Turkey was an important region for the production of thyme. The study's data were determined by the stratified random sampling method and obtained by the survey method from 58 enterprises producing thyme in Pamukkale district of Denizli province. The production data set includes data for 2019. According to the research findings, the average production cost per decare was calculated to be 577.66 TRY. The share of variable costs was 59.67% within the production costs, and the share of fixed costs was 40.33%. It was determined that the yield per decare was 144.48 kg, and the unit sale price of thyme was 7.04 TRY. The gross production value (GPV) of thyme in the region was calculated as 686.45 TRY/da, gross profit 353.69 TRY/da, and net profit 128.79 TRY/da. The unit cost of thyme in the region was 3.86 TRY and its net profit was 3.18 TRY. The relative profit was determined as 1.23 unit. As a result of the research, as the enterprises' size increases, the yield per decare, fixed, and variable costs decreased. The profitability ratios decreased by the size groups of the enterprises.

**Keywords:** Thyme, Economic analysis, Production cost, Profitability, Denizli

### INTRODUCTION

Turkey has many types of medicinal and aromatic plants from the Lamiaceae family known as thyme. However, the types containing thymol and carvacrol type essential oil were accepted as thyme. Primarily "Thymus, Origanum, Satureja, Thymbra and Coridothymus" species were commercially produced from this family (Başer, 1994). The thyme plant usage areas were quite wide; It was used in medicine and pharmacy, food preservation, control of bee diseases and pests, perfumery and cosmetics industry, landscape decoration, and spice in meals (Bahtiyarca Bağdat, 2006). Thyme was ranked first in the production of medicinal and aromatic plants were produced in Turkey. In 2019, thyme cultivation was carried out on approximately 157 thousand decares, and 18 thousand tons of thyme were produced. Denizli province constitutes

92.49% of the total thyme production areas and 87.55% of the total production. Pamukkale district constitutes 34.42% of the thyme production area and 31.79% of the thyme production quantity Denizli province. Pamukkale was the most important thyme producing district in this region. The same year, Turkey has made about 17 thousand tons of export thyme and has obtained 58 million dollars in revenue from these exports (TURKSAT 2020a, TURKSAT 2020b).

While tobacco production was common in the research area before 2000, it has been replaced by thyme production in recent years. Because less labour was used in thyme production, it was also more profitable. Çanakkale and İzmir (Balled thyme) thyme belong to the commercially important Origanum Onites (*O. smyrnaeum* or *Majorana onites*) species grown in the region.

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### ORCID and Mail:

B. KARLI: ORCID: 0000-0001-9734-1781 ([bahrikarli@isparta.edu.tr](mailto:bahrikarli@isparta.edu.tr))

Z. DEMİR: ORCID: 0000-0002-8888-2161 ([zehrad342@gmail.com](mailto:zehrad342@gmail.com))

M. GÜL: ORCID: 0000-0002-0147-7228 ([mevlutgul@isparta.edu.tr](mailto:mevlutgul@isparta.edu.tr))

B. KADAKOĞLU: ORCID: 0000-0002-3810-1718 ([bektaskadakoğlu@isparta.edu.tr](mailto:bektaskadakoğlu@isparta.edu.tr))

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Previous studies were generally on the usage areas and cultivation of thyme in medicinal-aromatic plants (Bahtiyarca Bağdat, 2006; Fakılı, 2010; Baydar and Arabacı, 2013; Acıbuca and Bostan Budak, 2018; Bozdemir, 2019). The studies on economic aspects were insufficient (Okan and Şafak, 2004; Gül et al., 2014; Aslan and Gül, 2017; Karlı et al., 2020; Pakdemirli, 2020).

This study aims to determine the production costs and profitability of enterprises that produce thyme, which was an important product for the region's economy and the country. It was thought that the study would be a guide for future studies.

## MATERIALS AND METHODS

### Study Area

Denizli province has an area of 11868 km<sup>2</sup>. It was located between 37° 12' and 38° 12' north latitudes and 28° 30' and 29° 30' east longitudes, southwest of the Anatolian peninsula, east of the Aegean Region, at the intersection point of the Aegean-Central Anatolia and Mediterranean Regions (Anonymous, 2020). The research area was given in Figure 1.

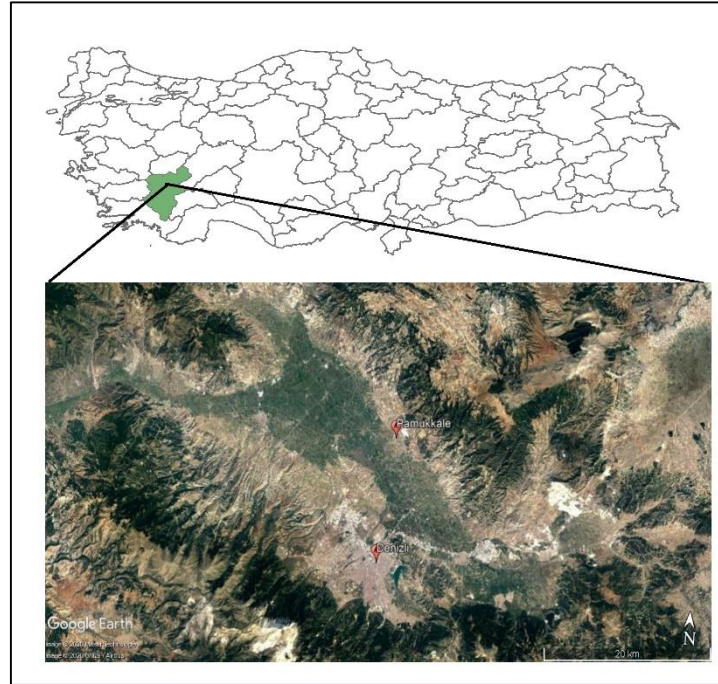


Figure 1. Location map of the study areas

### Materials

This study's main material was obtained through face-to-face questionnaires from 58 enterprises producing thyme. Pamukkale district of Denizli province was selected as the research area. Because in 2019 production year, Denizli province has 92.49% thyme production area and 87.55% thyme production of Turkey. Pamukkale district constitutes 34.42% of thyme production area and 31.79% of thyme production quantity of Denizli province (TURKSAT, 2020a). The fieldwork of the research was conducted in 2019.

### Methods

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.

$$n = \frac{(\sum NhSh)^2}{N^2D^2 + \sum NhSh^2}$$

n; Sample size, N; Total number of units in the population, Nh; Number of units in group h, Sh; Standard deviation of group h, Sh<sup>2</sup>; Variance of group h, D<sup>2</sup>; d<sup>2</sup>/z<sup>2</sup>, d<sup>2</sup>; Allowed error from population average, z<sup>2</sup>; Value of the allowed safety limit in the distribution table.

The producers participating in the research were divided into groups according to their thyme production areas. According to this, the enterprises were divided into 3 groups as "I. group (35 decares and less; 24 enterprises), II. group (35.01-65.00 decares; 18 enterprises) and III. group (> 65.01 decares; 16 enterprises)" (Table 1). The data obtained from the identified enterprises through questionnaires were uploaded to the computer environment and evaluated in tables by making calculations in Microsoft Excel and SPSS software.

**Table 1.** Sample size

Group	Thyme production area (decare*)	Number of enterprises	Percent
I	<35.00	24	41.38
II	35.01-65.00	18	31.03
III	65.01<	16	27.59
<b>Total</b>		<b>58</b>	<b>100.00</b>

\*1 decares = 0.1 hectares

The unique product budget analysis method was used to calculate the production costs of the enterprises producing thyme. In this context, production costs were examined as variable and fixed costs. The net profit was calculated in the enterprises examined by subtracting the changing costs from the thyme production value and subtracting the gross profit and the total production costs. Relative profit was calculated by dividing thyme production value by production costs. The quantity of thyme produced was multiplied by the sales price, and the production value of thyme 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 4.50%) within the scope of changing costs. Fixed costs were calculated as general administrative expenses (3.00% of variable costs), interest on the bare land value (5.00% of the bare land value), facility costs depreciation share (by dividing the total establishment costs during the production period to the economic life of the establishment (11 years)) and facility capital interest (5.00% interest was applied on the total establishment costs half value) (Açıl, 1977; Kiral et al., 1999). The exchange rate for 2019 was 1 (\$) US dollar = 5.67 (TRY) Turkish Lira.

## RESULTS AND DISCUSSIONS

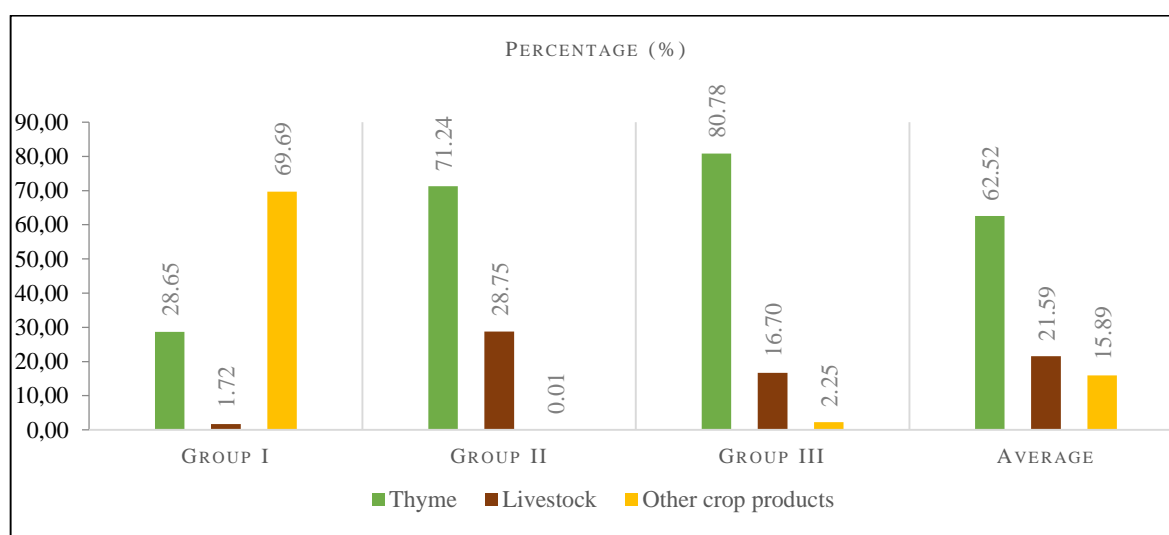
Thyme enterprises were divided into 3 groups according to thyme production areas. The average production area of the enterprises in the groups was determined as 23.96 decares for

I. group enterprises, 48.39 decares for II. group enterprises, 105.13 decares for III. group enterprises and 53.93 decares for all enterprises. Of the 58 enterprises interviewed in the region; 24 enterprises were in I. group, 18 enterprises were in II. group and 16 enterprises were in III. group.

GPV refers to the sum of the values of plant and animal products obtained at the end of the relevant production season and the production increases in plant-animal capital (Açıl and Demirci, 1984). In the research region, the average of GPV enterprises in 2019 was 59215.58 TRY. This value varies between 49800.42 TRY, and 82104.95 TRY among enterprise size groups.

The GPV of the enterprises, according to the production branches, were shown in Figure 2. It was calculated that 62.52% of the GPV of the enterprises' average was obtained from the thyme production activity. The group with the lowest thyme production value in GPV was I group enterprises with 28.65%. They were the highest III group enterprises with a share of 80.78%. This rate was 71.24% in II group enterprises. It was calculated that 21.59% of the enterprises GPV on the obtained from livestock activities and 15.89% obtained from other herbal products other than thyme, an average of the enterprises. As thyme production areas increase, the share of thyme production value in GPV also increases.

Gül et al. (2014) in their study determined that 42.20% of the GPV in the thyme enterprises in Denizli province was the thyme production.



**Figure 2.** Gross Production Value of the farm enterprises according to their production activities

Variable and fixed costs in thyme production were calculated separately. Labour, fertilisation, machinery rents, other variable costs and working capital interest constituted the variable costs elements. Enterprises average variable costs per decare calculated as 332.76 TRY. This value varied between

306.20 TRY and 364.02 TRY in the groups. The share of variable costs was 59.67% of total production costs. This value was calculated as 62.18% in I group, 61.29% in II group, and 57.31% in III group. As the production area increases, the share of variable costs in the total costs decreases. Machine

rent (24.63%) has the highest share among the variable costs. This was followed by labour costs (17.67%) and fertiliser costs (13.63%).

Gül et al. (2014), with the 2011 production period's data, determined the rate of variable costs within the total costs as 56.70%. They determined that the most important cost item among the changing costs was labour (29.40%) and machine rent (15.20%). In ten years, the use of machinery in thyme farming has increased, and labour has decreased. This difference in the two studies conducted in the same region can be explained in this way.

In the production of thyme, general administrative expenses, interest on the bare land value, facility costs, depreciation share, and facility capital interest constitute fixed costs. Enterprises average fixed costs per decare calculated as 224.90 TRY. This value varied between 221.41 TRY and

228.10 TRY in the groups. The share of fixed costs was 40.33% in total production. This value was calculated as 37.82% in I group, 38.71% in II group, and 42.69% in III group. As the production area increases, the share of fixed costs in the total costs also increases. The most important cost element among fixed costs was the interest in the bare land value (23.46%) and the facility capital interest (11.83%).

Gül et al. (2014) determined that the fixed cost's ratio was 43.30% within the total costs and stated that the most important fixed cost element was the bare land value's interest with 19.40%.

Total production costs were calculated as 557.66 TRY per decare. This value varied between 534.29 TRY and 589.29 TRY. It was determined that the total expenditure per decare was made in at least III groups and mostly in the II group.

**Table 2.** Thyme production costs

Production Costs	Group I		Group II		Group III		Average	
	TRY/da	%	TRY/da	%	TRY/da	%	TRY/da	%
Machine rental cost	135.43	23.13	144.54	24.53	134.30	25.14	137.36	24.63
Labor cost	121.95	20.83	114.69	19.46	82.20	15.38	98.56	17.67
Fertilization cost	82.84	14.15	80.08	13.59	71.53	13.39	75.99	13.63
Interest of working capital	15.68	2.68	15.55	2.64	13.19	2.47	14.33	2.57
Other variable costs	8.12	1.39	6.33	1.07	4.98	0.93	6.52	1.17
<i>Total variable cost</i>	<i>364.02</i>	<i>62.18</i>	<i>361.19</i>	<i>61.29</i>	<i>306.20</i>	<i>57.31</i>	<i>332.76</i>	<i>59.67</i>
Land rent	129.69	22.15	131.94	22.39	131.25	24.57	130.82	23.46
Establishment capital interest	63.37	10.82	66.92	11.36	68.75	12.87	65.96	11.83
Establishment depreciation value	17.43	2.98	18.40	3.12	18.91	3.54	18.14	3.25
General administration expenses	10.92	1.87	10.84	1.84	9.19	1.72	9.98	1.79
<i>Total fixed cost</i>	<i>221.41</i>	<i>37.82</i>	<i>228.10</i>	<i>38.71</i>	<i>228.10</i>	<i>42.69</i>	<i>224.90</i>	<i>40.33</i>
<b>Total production costs</b>	<b>585.43</b>	<b>100.00</b>	<b>589.29</b>	<b>100.00</b>	<b>534.29</b>	<b>100.00</b>	<b>557.66</b>	<b>100.00</b>

Gross profit, net profit, relative profit, kilogram cost, gross profit rate, and net profit rate were calculated to reveal the enterprises' cost and profitability (Table 3). The average thyme production value per decare was calculated as 686.45 TRY and varied between 630.92 TRY and 903.13 TRY. The thyme production value was calculated the highest in I group and lowest in III group enterprises. The gross profit calculated by subtracting the variable costs from the thyme production value was calculated as 353.69 TRY per decare average of enterprises. It was determined that as the thyme production areas increase, the gross profit per decreases. Net profit was calculated by subtracting the total costs from the thyme production value. The enterprise's average net profit per decare was amount to be 128.79 TRY. Net profit was determined per decare as 317.70 TRY in the most in the I group enterprises and 96.63 TRY in the lowest III group enterprises.

Gül et al. (2014) in their study with determined that the average value of thyme production per decare is 324.60 TRY. They calculated the gross profit as 183.20 TRY per decare and the net profit as 75.40 TRY.

The average thyme yield of the enterprises was determined as 144.48 kg per decare. This value varies between 105.41 kg and 182.81 kg. It was determined that the productivity of the enterprises in the I. group was high. The kilogram cost of thyme was calculated by dividing the production costs by the yield. Accordingly, the average kilogram cost of the enterprises was calculated as 3.86 TRY. This value was 3.20 TRY per kilogram in the I group, 4.60 TRY per kilogram in the II group and 5.07 TRY per kilogram in the III group. It was determined that as the thyme production area increased, the kilogram cost also increased. Kilogram sales prices were calculated as 7.04 TRY on average of enterprises. This value varies between 6.67 TRY and 7.50 TRY. It was determined that as the production areas of thyme increase, the sale price per kilogram of thyme decreases.

Gül et al. (2014) In their study, the enterprises determined the average thyme yield per decare as 150.00 kg. They calculated the kilogram cost of thyme as 1.66 TRY and the selling price per kilogram as 2.16 TRY. According to the results of these two studies, it can be said that the kilogram cost of thyme has increased approximately 2.3 times in 8 years

and the sales price per kilogram increased approximately 3.3 times.

As was known, agricultural production depends on natural conditions. Arid farming areas were affected more by natural conditions. Thyme was cultivated as dry farming in the region and was affected by the climate factor. The yield difference between the two studies can be explained by the fact that agricultural production depends on natural conditions. The Producer Price Index expresses the change in prices caused by input prices in the agricultural production process. The difference in kilogram cost of thyme between the two studies can be explained by the approximately 2.3 fold increase in the Producer Price Index from 2011 to 2019. (TURKSAT, 2020c).

Relative profit was calculated by dividing thyme production value by production costs. The average relative

profit of the enterprises was determined as 1.23 unit. This value refers to the production value of 1.23 unit in return for 1 unit expenditure for thyme production. The relative profit among enterprise groups ranges between 1.18 unit and 1.54 unit. Gül et al. (2014) determined the relative profit as 1.30 unit in their studies.

The gross profit rate among the thyme production values was 51.52% and varied between 50.74% and 59.69% in the groups. The net profit rate was 18.76% and varied between 15.32% and 35.18% among the groups. There was an inverse relationship between enterprises sizes and gross and net profit rates. These rates decrease as the enterprises' size increases. This situation can be explained by the high yield per decare in small-scale enterprises.

**Table 3.** Cost and profitability in thyme production

Costs and profit	Group I	Group II	Group III	Average
1. GPV (TRY/da)	903.13	733.22	630.92	686.45
2. Variable cost (TRY/da)	364.02	361.19	306.20	332.76
3. Gross margin (TRY/da) (1-2)	539.11	372.03	324.72	353.69
4. Total production costs (TRY)	585.43	589.29	534.29	557.66
5. Net profit (TRY) (1-4)	317.70	143.93	96.63	128.79
6. Yield (kg/da)	182.81	128.11	105.41	144.48
7. Per kilogram cost (TRY) (4/6)	3.20	4.60	5.07	3.86
8. Per kilogram selling price (TRY)	6.67	7.14	7.50	7.04
9. Per kilogram net profit (TRY) (8-7)	3.47	2.54	2.43	3.18
10. Relative profit (1/4)	1.54	1.24	1.18	1.23
11. Gross profit rate (%) (3/1x100)	59.69	50.74	51.47	51.52
12. Net profit rate (%) (5/1x100)	35.18	19.63	15.32	18.76

## CONCLUSION

This study was conducted in Denizli, which was important in Turkey thyme production. Production costs of thyme, which was economically significant in the research area, was calculated. The data was obtained through face-to-face surveys with farmers. Thyme, an important place in medicinal and aromatic plants' production, was intensively produced by farmers in Denizli province. It has also been found to be important in animal production in the region.

It was determined that the enterprises' total production costs 59.67% were variable, and 40.33% were fixed costs. Of the variable costs, 24.63% was machinery rental costs, 17.67% was labour costs, 13.63% was fertiliser costs, and 1.17% was revolving fund interest expense. Of the fixed costs, 23.46% was land rent costs, 11.83% was the facility capital's interest, 3.25% was the depreciation of the facility capital, and 1.79% was general administration expenses.

It was determined that as the enterprises' size increases in the enterprises' groups, the costs that vary per decare decrease, and there was no significant change in fixed costs. However, it was determined that as the enterprise's size increases, gross profit, net profit and relative profit decrease. This differentiation in profitability was due to different thyme yields per decare of enterprise groups. As the enterprises' size increases, the yield per decare decreases and in parallel with this, the production value of thyme decreases. Therefore, the scale of enterprises' size increases the kilogram cost of thyme and large enterprises' profitability decreases.

Thyme has emerged as a highly profitable and vital source of income for producers in Denizli province. Thyme has shown up as an essential source of income and high profitability for producers in Denizli province. It was less expensive than other crop production activities, and its high price per kilogram makes thyme an alternative product. Cooperatives should be developed to ensure the sustainability of thyme production in the region. With the cooperation, producers will quickly supply their inputs in production and market their products more efficiently. Besides, with a tax reduction in input prices, producers will produce lower costs and increase profits.

In future studies, the input usage efficiency of thyme enterprises can be determined by calculating the technical and economic efficiency.

## AUTHOR CONTRIBUTIONS

Karlı B. devised and supervised the project, the main conceptual ideas and proof outline. Demir Z. conducted the survey application. Gül M., and Kadakoğlu B., calculated economic analysis. All authors wrote the manuscript in consultation with.

## CONFLICT AND INTEREST

Authors declare no conflict and interest.

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