Economic analysis of watermelon production in manavgat county of Antalya Province

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Abstract

This study aimed to reveal the economic structure of watermelon production in Manavgat county of Antalya province. Manavgat county accounts for 2.81% of Türkiye's watermelon production according to 2021 data. Study data were obtained from 70 watermelon producer farmers by face-to-face survey method and refer to the 2021 production season. According to the research findings, of the watermelon producers interviewed, 34.3% produced watermelon in the open, 41.4% in the low tunnel and 24.3% in the high tunnel. The interviewed producers in the region mainly used F1, Odipus F1, Santa Matilde and Üstün watermelon varieties. The share of variable costs was 66.14% within the production costs, and the share of fixed costs was 33.86%. Seedling, fertilisation, land rent and greenhouse depreciation had the highest share among cost elements. The total production cost in watermelon cultivation per hectare amounted to be as 4208.41 USD $ on the average of the farms. It was determined that the kilogram sale price of watermelon was 0.14 USD $. The GPV obtained in watermelon production per hectare was determined as 8262.12 USD $. The relative profit in watermelon cultivation was calculated as 1.96 while was determined as 1.75 on the average of the farms producing watermelon in the open, 2.02 on the average of the farms in the low-tunnel watermelon production and 2.07 on the average of the farms in the high-tunnel watermelon production. As a result of the research, because the high tunnel (greenhouse) watermelon

producing farms put their products on the market early, their profitability indicators were higher than other production models. Because it is important to shape foreign trade policies by taking into account the watermelon harvest times. Watermelon production is now more and more subject to foreign trade.

Keywords*:* Watermelon. Production cost. Profitability. Türkiye.

1. Introduction

Watermelon is one of the most produced vegetables in the world and Türkiye. Watermelon is an annual, warm and temperate climate plant. Although watermelon is grown outdoors, it is also produced undercover. A large proportion of watermelon is water and has a cooling feature in summer. Watermelon is also used in the food industry. Since watermelon is a sensitive plant, it is difficult to export fresh.

According to the data of FAOSTAT (2022), world watermelon cultivation areas increased from 2.1 million hectares in 1990 to 3.05 million hectares in 2020. Türkiye ranks seventh in terms of world watermelon cultivation area. World watermelon production was 34.87 million tons in 1990. This value increased to 101.62 million tons in 2020. China ranks first in watermelon production in the world with 60 million tons in 2020. While the share of China in world watermelon production was 30.69% in 1990, it increased to 59.13% in 2020. Türkiye takes second place with a share of 3.44% and watermelon production is 3.49 million tons. While the amount of watermelon production in Türkiye was 3.8 million tons in 2004, it decreased to 3.47 million tons in 2021 (TURKSAT, 2022). The most watermelon production in Türkiye is Adana. The share of this province is 19.9%. The second city is Antalya and its share is 11.98%. In each province, there has been a decrease in the cultivation area over the years. This is due to the high volatility in prices.

Watermelon production in Antalya Manavgat has shown an increasing trend (Figure 1). The efficiency of developing tools, machinery, seeds, fertilisers, greenhouse technology, and irrigation system has increased. Between 2011 and 2013, production remained stable, with the increase in costs in recent years, cultivation areas have decreased and production has decreased.

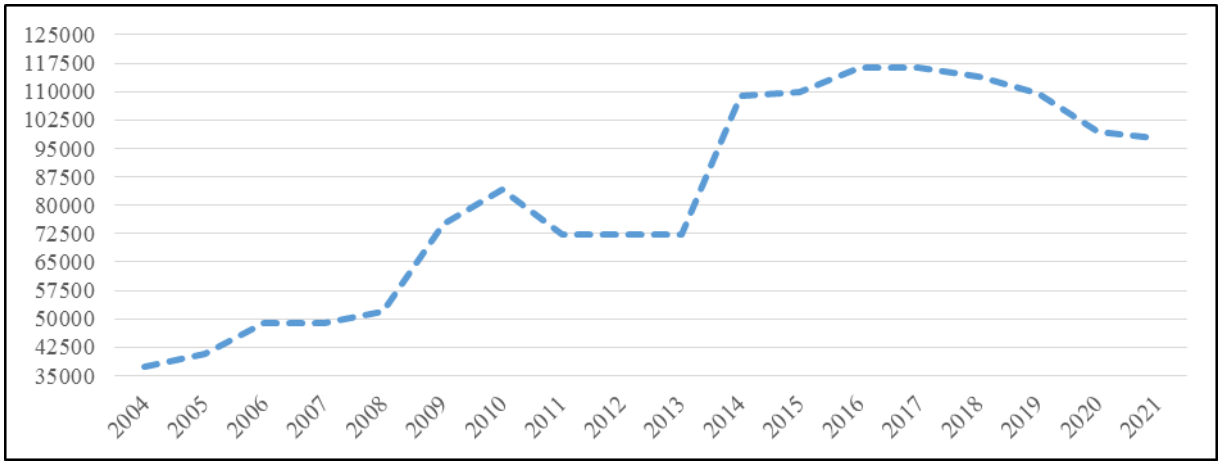

Figure 1: Development of watermelon production (tonnes) in Manavgat district
Source: TURKSAT, 2022

Watermelon yield per hectare in Türkiye is at the level of 47.5 tons. Watermelon yield per hectare in the Manavgat district has a value of 60 tons, which is above Türkiye's average. Watermelon cultivation in the Manavgat district is mostly done in low tunnels. The high tunnel comes in second place and 6.5 tons of product is obtained per unit area. In terms of efficiency, 7.6 tons of product is taken in the glass greenhouse the most.

In this study, Antalya province Manavgat district was chosen as the research area. In this selection, the criteria for different types of watermelon production in the region and for being able to work economically were taken into consideration.

The aims of this study can be expressed as (i) determining the socio-economic structure of the farms in the region engaged in watermelon production, (ii) determining the economic structure of the watermelon production activity, and (iii) determining the problems and developing solutions proposals.

2. Literature Review

Various economic studies have been carried out in Türkiye on watermelon. For example, Dağıstan and Erkan (1999) analysed the seasonal price fluctuations of watermelon between 1980 and 1998 in Türkiye. Gül et al. (2004) revealed that Adana's production costs and marketing structure of the watermelon product determined that the sale of watermelon was mostly cash (51%) and that the most important channel of the farms in marketing was the merchants. Sarı et al. (2004) determined the physical quantities of the inputs used in watermelon cultivation in Adana. In addition, they determined the problems faced by watermelon producers in production and marketing and developed solutions. Dağıstan et al.

(2005), used 11 rootstocks, 6 of which were open pollinated and 5 of which were hybrid hybrids, and Crimson Tide watermelon cultivars as pencils in their studies conducted in the experimental areas of Çukurova University Faculty of Agriculture, Department of Horticulture between 1999-2001. They found that grafted plants yielded an average of 42% more net profit than ungrafted plants. They determined that economic efficiency can be obtained with 4000 – 5000 plants per hectare in grafted plants. They found the most suitable plant density as 3700 plants per hectare. They calculated the average yield per hectare as 137640 kg, net income 7150.2 USD and profitability 246.8%.

Abdikoğlu and Unakıtan (2014) analysed the relationship between watermelon production amount and price in Türkiye with the Koyck model, one of the distributed lag models. They found that it takes an average of 2.27 years for price changes to cause a change in output. They also predicted that a 10% increase in watermelon price would increase production by 2.24% one year later, 1.55% after two years, and 1.08% after three years. They calculated the short-term price elasticity of watermelon production as 0.224 and the long-term price elasticity as 0.73. Özbay and Çelik (2016) analysed the relationship between the production and price of watermelon between 1994 and 2013 with the Almon approach, one of the distributed models. They reported that the changes in watermelon prices in the current year had a negative effect on production, but the changes in the lagged values from the first period to the eighth period had a positive effect on production.

Buyukkalay (2019) revealed the quantitative and qualitative aspects of watermelon production and marketing structure in Antalya. It obtained its data through a face-to-face survey method with 70 producers. He stated that a monopoly-like market structure, that is, the presence of a single or limited number of buyers and the uncertainty of the producer price level are the problems that are prioritised. The problem of price uncertainty was associated with the fact that the product's retail price mobility has a higher impact on the producer's market due to the fixed marketing margin. He found a statistical relationship between the age and education level of watermelon producers and the cost of production and income from production activity.

Subaşı et al. (2022) determined the technical efficiency of watermelon farms and their factors, using the stochastic production frontier function, in the province of Adana in Türkiye. They collected data from 69 watermelon farmers. They found that the per kilogram production cost of watermelon was $0.10 and that labour costs accounted for the greatest share of the total cost. They determined technical efficiency was 0.82.

Popescu (2012a) evaluated the watermelon and melon market in Romania from 1990-2009. She determined that despite that the cultivated area remained relatively constant, watermelon and melon yield increased by 73.36%. She stated that a continuous increase in yield and production, a diversified offer consisting both of local and imported watermelons and melons, and the appearance of the extra and early fruit of Romanian origin even from June contributed to a better cover of consumer demand during the summer season. She determined that increased competition among suppliers and also a higher income and profit for Romanian producers.

Popescu (2012b) analysed the economic efficiency of two cultivars (Crisby and Karistan) with different maturation lengths, upon watermelon growing in an experiment at Dolj County, Romania in the year 2011. She found that the extra-early cultivar (Crisby) was more efficient than the other cultivar (Karistan) because of fruit could be delivered earlier in the market

Amao et al. (2014), calculated the profitability of watermelon in Ibarapa Central Local Government Area of Oyo state, Nigeria. They suggested that government should make credit facilities and fertiliser available to the farmer, and improve transportation facilities.

Ajewole (2015), evaluated the income and factor productivity in watermelon production in Ekiti State, Nigeria. He used data from 90 watermelon farmers with a questionnaire. He found that the farmers were relatively young and on smallholder farms. He determined the overall factor productivity index was 1.14 and an increasing return to scale in watermelon farms.

Ogunwande et al. (2015) calculated the technical efficiency as 0.6098 and return the scale as 0.7787 for watermelon farms in Oyo State. They found that 59.13% of farms' efficiency score was higher than 0.70. They mentioned that watermelon farmers use an optimal combination of input and economics in the 2014 production season.

Adedeji et al. (2017), examined the technical efficiency and its determinants in watermelon farming in Yobe State, Nigeria. They used 300 farmers' data. They found watermelon production level was positive and significantly influenced by farm size, seed quantity and agrochemical used.

Makuya et al. (2018) calculated the cost-effectiveness levels of watermelon farms in the Rufiji and Mkuranga districts in Tanzania, determined the cost-effectiveness differences between enterprises of different sizes and capitals, and examined the sources of cost-effectiveness. Using the data from 200 farmers from these two districts, they calculated that the cost efficiency for farms in Mkuranga was 0.73, and the average cost efficiency was 0.90

in Rufiji. They found that farms with small holding sizes and capital sizes had higher average cost-effectiveness than farms with large holding sizes and capital sizes. They determined that the sources of cost inefficiency are education level, business size, capital size and cost of logistics services.

Odebode et al. (2018) conducted a gender assessment of watermelon production among farmers in the Ibarapa region of Oyo state. They randomly selected one hundred and thirty-two watermelon producers. They stated that 93% of males were more involved in weeding than females, but, more females (81.3%) were involved in carting watermelon from the farm than males. Their t-test analysis claimed that there was a significant difference between the roles that male and female farmers play in watermelon production, and between income from watermelon by both male and female farmers.

Balogun et al. (2019) reported in their study that watermelon marketing efficient distribution was needed to maximize economic returns to marketers and consumers. They analysed the watermelon marketing in Lagos state, Nigeria, between January and February 2018. They found watermelon marketing was profitable and a major constraint encountered by marketers was their inability to access credit.

Reis da et al. (2019) determined watermelon production costs, economic, and sensitivity analysis of Sátiro Dias city/Bahia State. They found that variable costs represented 46.76% of total costs and calculated the benefit-cost ratio as 1.92.

Ndanitsa et al. (2021) examined the economic analysis and technical efficiency of watermelon production in the Niger State of Nigeria. Their data was gathered from 150 watermelon farmers. They concluded that the profitability of watermelon production would increase with the improvement of transportation facilities and access to production inputs.

3. Materials and Methods

The material of this research consists of the information obtained through a questionnaire from the farmers who grow watermelon in the research area chosen as the Manavgat district of Antalya province. The survey was conducted in February 2022. The data refer to the 2021 production season. In addition, statistical data from the Turkish Statistical Institute (TURKSAT) and the World Food and Agriculture Organization (FAOSTAT) were used as secondary data in the study.

The database of watermelon enterprises was obtained from the Manavgat District Directorate of Agriculture and Forestry. Stratified Sampling was used to determine the

number of samples for the survey application (Yamane, 2001), and the Neyman Method was used to distribute the sample numbers calculated for farms into strata (Çiçek and Erkan, 1996). Accordingly, it was calculated that 70 farms should be interviewed with a 90% confidence limit and a 10% deviation from the mean.

The necessary data for the analysis were obtained through face-to-face surveys from farms in the field of watermelon cultivation in the villages of the Manavgat district (Figure 2). The questionnaire form, which was created according to the purpose of the research from the determined farms, was filled by the researcher by going to the producers in the villages in the relevant research region through face-to-face interviews. Later, these data were transferred to the computer environment, calculations were made in statistical programs and charts were created. These charts are interpreted using the absolute and relative distributions and simple and weighted averages method.

The single product budget analysis method was used to determine the operating costs in watermelon farming. According to this method, the income and expense status is calculated not for all products grown in an agricultural enterprise, but only for the watermelon, which is the subject of the research. Production period cost charts were created for watermelon production.

It was calculated by taking into account the foreign labour wages in the research region in the calculation of the family labour wage provision. Since the partial budget analysis was made in the research, although the farms use their machines, the machine rental prices were taken as a basis. 3% of total variable costs are taken as general administrative expenses. Revolving fund interest, as variable costs were calculated as half of the current interest rate applied by Ziraat Bank to crop production loans. Land rent fees for watermelon in the research area were also taken into account in the cost of land rent for watermelon, even if the farm owners use their land.

The gross production value (GPV) was calculated by multiplying the amount of product obtained as a result of watermelon production activity with the sales price.

The following formulas were used to calculate the gross and absolute (net) profits per unit area for watermelon (Açıl and Demirci, 1984; Erkuş et al., 2005; Kıral et al., 1999).

Gross Profit = Gross Production Value – Variable Costs

Absolute (Net) Profit = Gross Production Value – Production Costs

Relative Profit = Gross Production Value / Production Costs

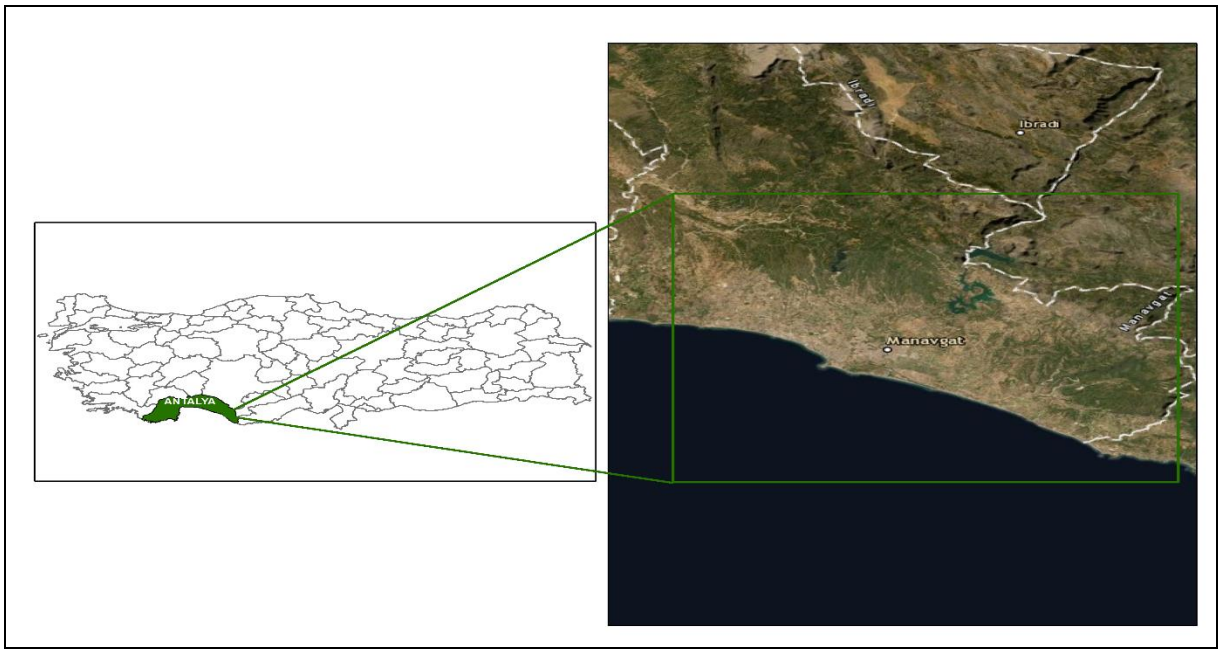

Figure 2: Research area

4. Results and Discussion

Of the watermelon producers interviewed, 34.3% produced watermelon in the open, 41.4% in the low tunnel and 24.3% in the high tunnel (Table 1).

Table 1: Watermelon production model preferences

Production type	Number (N)	Percent (%)
In the open	24	34.3
Low tunnel	29	41.4
High tunnel	17	24.3
Total	70	100.0

There is no illiterate among the watermelon producers surveyed in the Manavgat district of Antalya province. 11.4% of the farmers received education at the primary education level, 4.3% at secondary school, 75.7% at high school, and 8.6% at undergraduate and associate degree levels (Table 2).

Table 2: Farmers' education status

Education status	Number (N)	Percent (%)
Primary school	8	11.4
Middle school	3	4.3
High school	53	75.7
Undergraduate or Associate Degree	6	8.6
Total	70	100.0

The average age of the reference people who participated in the interviews was found to be 39.70 years. 50% of the respondents were between the ages of 31-45 (Table 3).

Table 3: Age groups of farmers

Age groups	Number (N)	Percent (%)
18-30	14	20.0
31-45	35	50.0
46-60	20	28.6
61 years and more	1	1.4
Total	70	100.0

The average age of the examined watermelon producers was 39.70 years, the average agricultural experience was 17.39 years, and the average experience in watermelon cultivation was 14.06 years. Watermelon experience was a maximum of 15.08 years in the open field farms. The farmers growing watermelons in the low tunnel were younger than the other groups (Table 4).

58.57% of the surveyed farms cultivate watermelon every year. From this point of view, it can be stated that the fact that the farmers have been dealing with watermelon farming for a long time and that they have created their machine parks according to watermelon farming is an effective factor.

The family population consisted of 3.44 people, while this value was 3.88 people in the farmers who grow watermelons in the open, 3 people in the low tunnel, and 3.59 in those who grow watermelon in the high tunnel (greenhouse) (Table 4).

The education level of farmers was more than 10 years. Generally, farmers have an education above the secondary school level (Table 4).

In the average of the examined farms, it was determined that 71.43% of the farmers did not do agricultural income outside of their own business, and 28.57% of them did. While the agricultural income outside of own business level was 183.84 USD on the average of the farmers, the least high tunnel (greenhouse) watermelon grower farmers with 44.28 USD income level. This value was $352.01 on the open watermelon farms and $126.48 on low tunnel watermelon farms (Table 4). The major source of this income was labour income on other farms.

58.57% of the farmers were doing non-agricultural work. On the other hand, while the non-agricultural income level of the interviewed farmers was $248.24, the least exposed watermelon growers were the farmers with an income level of $216.49. This value was $333.59 for high tunnel (greenhouse) watermelon farms and $224.49 for low tunnel

watermelon farms (Table 4). An important source of this income was their work as a labour force in non-agricultural sectors.

The main agricultural activity of the interviewed farmers was plant production. In addition, it was determined that the farms also include large ruminant breeding, small ruminant breeding and beekeeping activities to meet the family needs and to keep them when they need cash. It was determined that 21.43% of the interviewed farmers were engaged in large ruminant production, 17.14% in small ruminants, and 2.86% in beekeeping. The average GPV obtained from livestock was 2569.99 USD $ for the interviewed farmers, with an income of 2330.64 USD $, which was at least among the farmers who grew watermelons in the open. This value was $2864.40 for high tunnel (greenhouse) watermelon farms, and 2595.49 USD $ for low tunnel watermelon farms (Table 4).

It was determined that 68.89% of the watermelon cultivation area was rented land on the average of the farmers considered. 77.13% of the watermelon lands in farmers growing watermelons in low tunnels and 73.06% of the open watermelon farmers were rented land. This value was 40.58% in high tunnel (greenhouse) watermelon farms (Table 4).

The average number of pieces of the watermelon field was 1.16 pieces. The watermelon area in the low tunnel was 1.71 hectares, 1.60 hectares in open watermelon growers, and 1.22 hectares in high tunnel (greenhouse) watermelon farms (Table 4).

In the watermelon field, an average of 4750 grafted seedlings were used by the farmers. 5337.93 grafted seedlings were used in low tunnel farmers, 4825 in open watermelon growers and 3641.18 grafted seedlings in high tunnel (greenhouse) watermelon farms (Table 4).

Table 4: Various indicators related to the interviewed farms

Indicators	Open	Low tunnel	High tunnel	Average
Farmer's age (years)	40.71	38.66	40.06	39.70
Farmer's education (years)	10.67	10.31	10.71	10.53
Farmer's experience in agriculture (years)	16.75	17.72	17.71	17.39
Family size (person)	3.88	3.00	3.59	3.44
Farmer's watermelon production experience period (years)	15.08	13.03	14.35	14.06
Agricultural income from outside the farms (USD $)	352.01	126.48	44.28	183.84
Non-agricultural income (USD $)	216.49	224.49	333.59	248.24
Large ruminant number (head)	0.83	0.59	3.41	1.36
Small ruminant number (head)	4.88	8.62	0.29	5.31
Beehive number (pcs)	0.08	0.00	0.12	0.06
Gross production value from livestock (USD $)	2330.64	2595.49	2864.40	2569.99
Number of watermelon pieces (pcs)	1.17	1.24	1.00	1.16
Watermelon property area (hectare)	0.43	0.41	0.72	0.49
Watermelon rental area (hectare)	1.18	1.37	0.49	1.09
Watermelon rental area (%)	73.06	77.13	40.58	68.89

Watermelon in the open (hectare)	1.60	0.07	0.00	0.58
Watermelon in the open production (tonnes)	98166.67	4137.93	0.00	35371.43
Watermelon in a low tunnel (hectare)	0.00	1.71	0.00	0.71
Production in the watermelon low tunnel (tonnes)	0.00	101172.41	0.00	41914.29
Watermelon in a high tunnel (hectare)	0.00	0.00	1.22	0.30
Production in the watermelon high tunnel (tonnes)	0.00	0.00	68882.35	16728.57
Seedling quantity (piece)	4825.00	5337.93	3641.18	4750.00

All of the producers stated that the seedlings they used were zucchini rootstocks and their grafts were watermelons of the desired variety. Farmers do not prefer ungrafted seedlings because their product quality is low, their resistance to diseases and pests is low, and they are more affected by adverse climatic conditions, therefore the yield is low and they do not meet the demands of the trader and the market. While purchasing the seedling variety, it considers the seedling variety, taking into account the demands of the market such as the period and shape. Farmers preferred Starburst F1, Odipus F1, Santa Matilde and Üstün watermelon varieties (Table 5).

Table 5: The use of seedling varieties

Varieties	Number (N)	Percent (%)
501 F1	2	2.9
Black 502 (Ayber F1)	6	8.6
Santa Matilde	13	18.6
Odipus F1	17	24.3
Joker	2	2.0
Starburst F1	19	27.1
Üstün	11	15.7
Total	70	100.0

Factors affecting the variety of preferences of producers were also questioned. According to this, it was determined that the factors such as production period, product physical properties, yield ability, ease of sale, and ease of payment are the factors that affect the variety preferences the most. Variety preferences of neighbouring producers, variety requests of traders and brokers, and drug dealer variety recommendations have a great impact on the preferences of producers.

Watermelon producers see themselves as moderately knowledgeable and above in agricultural struggle. Those who see themselves as moderately knowledgeable were 77.1%, those who see themselves as knowledgeable at 14.3% and those who see themselves as well-informed were 8.6%.

4.1. Watermelon production costs

To produce a good or service, a certain amount of inputs and services must be used. Here, we can express cost as the amount or value of the sacrifices made to produce goods and services. With another approach, the cost can be expressed as the sum of the monetary values of the inputs of the factors of production used in the production of a unit of goods or services (Erkuş et al., 2005).

Erkus et al. (2005) stated that production costs are handled in two parts internal and external costs. External costs mean incurred costs, in other words, include payments made to third parties and depreciation in production; on the other hand, they stated that internal costs express the costs that were not made but found through calculation, and include the labour costs calculated for the farmer and his family, and the costs calculated for the use of his/her assets.

Watermelon production was an agricultural production activity that provides high returns per unit area as of the period under review. On the other hand, the amount of capital invested by the producers in watermelon cultivation was also high. It was an activity in which intensive input and capital were also used. Therefore, both changes in watermelon prices and changes in input prices affect this activity significantly.

In this section, the production costs in watermelon cultivation were calculated in the enterprises handled with the single product budget method. Cost elements were discussed under the headings of variable and fixed costs.

Variable cost elements in watermelon production; seedling, fertiliser, spraying, irrigation, machinery rental fee, temporary labour, marketing costs (packaging, classification, washing, commission, etc.), other expenses and revolving fund interest.

Variable costs are costs that increase or decrease depending on the volume of production. These costs arise when production is made and vary depending on the amount of production (İnan, 2006).

The variable cost in the average of the farms interviewed in watermelon production was calculated as 4410.02 USD $ (Table 6).

The variable cost was determined as 4110.65 USD $ in the average of the farms producing watermelon in the open, 5060.02 USD $ in the average of the farms in the low tunnel watermelon production, and 3723.84 USD $ in the average of the farms in the high tunnel (underground-greenhouse) watermelon production (Table 6).

The highest rate among the variable cost items of the farms under consideration was seedling, fertiliser and machinery rent (Table 6).

Inan (2001) defines fixed costs as costs that do not change depending on the volume of production and that occur whether or not production is made.

In this study, the fixed cost elements of watermelon production were general administrative expenses, land rent, permanent-family labour cost, greenhouse depreciation and greenhouse interests.

The fixed cost of watermelon cultivation was determined as 2257.31 USD $ on the farm's average (Table 6).

The fixed cost was determined as 1209.32 USD $ in the average of the farms producing watermelon in the open, 1360.99 USD $ in the average of the farms in the low tunnel watermelon production, and 5265.85 USD $ in the average of the farms in the high tunnel watermelon production (Table 6).

Land rent and greenhouse depreciation had the highest share among the fixed cost items in watermelon production of the interviewed farms (Table 6).

The total production cost in watermelon cultivation was determined as 6667.33 USD $ on the average of farms (Table 6).

Total production cost was determined as 5319.97 USD $ in the average of the enterprises producing watermelon in the open, 6421.01 USD $ in the average of the enterprises in the low tunnel watermelon production, and 8989.68 USD $ in the average of the enterprises in the high tunnel watermelon production (Table 6).

In the farms interviewed, the highest value among the watermelon production cost items was seedling, land rent, fertiliser, total labour, greenhouse depreciation, and machinery rent (Table 6).

Table 6: Production costs in watermelon farms

Cost elements	Open	Low tunnel	High tunnel	Average
	Cost per farm (USD $)			
Machine rental cost	508.32	558.77	398.34	502.51
Temporary labour costs	465.38	528.63	359.43	465.85
Fertilisation cost	807.27	903.31	670.62	813.87
Pesticide cost	101.81	165.07	99.19	127.38
Irrigation cost	117.68	127.95	88.42	114.83
Seedling cost	1452.98	1675.34	1043.67	1445.70
Marketing cost	103.30	144.16	155.56	132.92
Other variable costs	267.12	603.76	648.81	499.28
Working capital interest	286.79	353.02	259.80	307.68
Total variable cost	4110.65	5060.02	3723.84	4410.02
General administration expenses	123.32	151.80	111.72	132.30
Land rent	875.10	942.13	709.74	862.71
Permanent-family labour	210.90	267.06	191.51	229.46
Greenhouse depreciation	0.00	0.00	2835.25	688.56
Greenhouse interest	0.00	0.00	1417.63	344.28
Total fixed cost	1209.32	1360.99	5265.85	2257.31

Total production costs	5319.97	6421.01	8989.68	6667.33
	Cost per hectares (USD $)			
Machine rental cost	316.06	314.04	327.14	317.18
Temporary labour costs	289.35	297.10	295.18	294.04
Fertilisation cost	501.93	507.67	550.75	513.72
Pesticide cost	63.30	92.77	81.46	80.40
Irrigation cost	73.17	71.91	72.62	72.48
Seedling cost	903.41	941.57	857.12	912.52
Marketing cost	64.23	81.02	127.76	83.90
Other variable costs	166.08	339.32	532.84	315.15
Working capital interest	178.31	198.41	213.36	194.20
Total variable cost	2555.85	2843.81	3058.22	2783.60
General administration expenses	76.68	85.31	91.75	83.51
Land rent	544.10	529.49	582.88	544.54
Permanent-family labour	131.13	150.09	157.28	144.83
Greenhouse depreciation	0.00	0.00	2328.47	434.62
Greenhouse interest	0.00	0.00	1164.23	217.31
Total fixed cost	751.91	764.90	4324.61	1424.81
Total production costs	3307.75	3608.71	7382.83	4208.41
	The share in the production costs (%)			
Machine rental cost	9.55	8.70	4.43	7.54
Temporary labour costs	8.75	8.23	4.00	6.99
Fertilisation cost	15.17	14.07	7.46	12.21
Pesticide cost	1.91	2.57	1.10	1.91
Irrigation cost	2.21	1.99	0.98	1.72
Seedling cost	27.31	26.09	11.61	21.68
Marketing cost	1.94	2.25	1.73	1.99
Other variable costs	5.02	9.40	7.22	7.49
Working capital interest	5.39	5.50	2.89	4.61
Total variable cost	77.27	78.80	41.42	66.14
General administration expenses	2.32	2.36	1.24	1.98
Land rent	16.45	14.67	7.90	12.94
Permanent-family labour	3.96	4.16	2.13	3.44
Greenhouse depreciation	0.00	0.00	31.54	10.33
Greenhouse interest	0.00	0.00	15.77	5.16
Total fixed cost	22.73	21.20	58.58	33.86
Total production costs	100.00	100.00	100.00	100.00

The average variable cost per hectare of the farms interviewed for watermelon production was calculated as 2783.60 USD $ (Table 6).

The variable cost amounted to 2555.85 USD $ on the average of the farms producing watermelon in the open per hectare, 2843.81 USD $ on the average of the farms in the low tunnel watermelon production, and 3058.22 USD $ on the average of the farms producing high tunnel watermelon (Table 6).

The fixed cost of watermelon cultivation per hectare was determined as 1424.81 USD $ on the average of farms (Table 6).

The fixed cost per hectare was calculated as 751.91 USD $ on the average of the farms producing watermelon in the open, 764.90 USD $ on the average of the farms in the low tunnel watermelon production, and 4324.61 USD $ on the average of the farms in the high tunnel watermelon production (Table 6).

The total production cost in watermelon cultivation per hectare amounted to be as 4208.41 USD $ on the average of the farms (Table 6).

The production cost per hectare was calculated as 3307.75 USD $ on the average of the farms producing watermelon in the open, 3608.71 USD $ on the average of the farms producing low tunnel watermelon, and 7382.83 USD $ on the average of the farms producing high tunnel watermelon (Table 6).

The variable cost in the average of the farms interviewed for watermelon production constituted 66.14% of the total production cost (Table 6).

The share of the variable cost in the total cost was 77.27% in the farms producing open watermelon, 78.80% in the average of the farms in the low tunnel watermelon production, and 41.42% in the average of the farms in the high tunnel watermelon production (Table 6).

It was determined that the fixed cost in the average of the farms interviewed in watermelon production constituted 33.86% of the total production cost (Table 6).

The share of fixed cost in the total cost was determined as 22.73% on the average of the farms producing watermelon in the open, 21.20% on the average of the farms in the low tunnel watermelon production, and 58.58% on the average of the farms in the high tunnel watermelon production (Table 6).

Among the watermelon production cost items in the interviewed farms, the highest share was seedling with 21.68%, land rent with 12.94%, fertiliser with 12.21%, total labour with 10.43%, greenhouse depreciation with 10.33%, and machinery rent with 7.54% (Table 6).

In high tunnel farms, the highest share in watermelon production cost items was greenhouse depreciation (31.54%), greenhouse interest with 15.77%, seedlings with 11.61%, land rent with 7.90%, fertiliser with 7.46%, total labour with 6.13%, machinery receives the rent with 4.43% (Table 6).

Gül et al. (2004) found variable costs of watermelon production in Adana province as 1567.05 USD $, fixed costs of 758.53 USD $ and total costs of 2325.58 USD $ for the 2002 production season. Gül et al. (2004) determined the production costs and profitability of the watermelon product in Adana, and they calculated that variable cost accounts for 67.4% of total production cost and 32.6% of fixed cost.

Rostami et al. (2018) classified five systems of watermelon production systems, namely, custom tillage, conservation tillage, traditional planting, semi-mechanised planting, and mechanised planting in Iran. They calculated that traditional planting was with a

minimum net profit of $2618.14 per hectare, and the highest net profit, on the other hand, belonged to mechanised planting with $2752.88.

4.2. Profitability indicators in watermelon production

Gross production value (GPV) is obtained by adding the annual productive value increases in plant and animal production to the value found by multiplying the production amounts of plant and animal products produced in a year in agricultural enterprises with the prices received by the farmers (Açıl and Demirci, 1984).

The GPV obtained by the interviewed farms in watermelon production on the average of the farms was calculated as 13089.56 USD $ (Table 7).

In the average of the enterprises producing watermelon in the open, GPV was 9311.77 USD $, in the average of the farms producing low tunnel watermelon, GPV was 12994.51 USD $, in the average of the farms producing high tunnel (underground-greenhouse) watermelon, GPV was found as 18585.05 USD $ (Table 7).

The GPV obtained in watermelon production per hectare was determined as 8262.12 USD $ (Table 7).

It was calculated as 5789.70 USD $ per hectare in farms producing watermelon in the open, GPV amounted to be as 7303.12 USD $ per hectare in farms producing low tunnel watermelon and was 15263.08 USD $ per hectare in farms producing high tunnel (greenhouse) watermelon (Table 7).

Gross profit in watermelon growing enterprises was found by subtracting the variable costs from GPV (Açıl and Demirci, 1984; Kıral et al., 1999). Accordingly, the average gross profit of the farms was calculated as 8679.54 USD $ (Table 7).

Gross profit was determined as 5201.12 USD $ in the average of the farms producing watermelon in the open, as 7934.50 USD $ in the average of the farms in the low tunnel watermelon production, and as 14861.21 USD $ in the average of the farms in the high tunnel (underground-greenhouse) watermelon production (Table 7).

The gross profit value in the average of the enterprises was determined as 5478.52 USD $ per hectare (Table 7).

Gross profit value per hectare was calculated as 3233.85 USD $ in open watermelon production farms, 4459.31 USD $ in low tunnel watermelon production farms, and 12204.86 USD $ in high tunnel watermelon production farms (Table 7).

Absolute (net) profit was found by subtracting the production cost for watermelon production from GPV (Kıral et al., 1999). The main purpose of the business is to seek ways to generate profits and maximise that profit. The average absolute profit of enterprises in watermelon production was calculated as 6422.23 USD $ (Table 7).

Absolute profit was calculated as 3991.80 USD $ in the average of the enterprises producing watermelon in the open, 6573.51 USD $ in the average of the enterprises in the low tunnel watermelon production, and 9595.36 USD $ in the average of the enterprises in the high tunnel watermelon production (Table 7).

The absolute profit value per hectare was determined to be 4053.71 USD $ in the average of enterprises (Table 7).

Absolute profit value per hectare was determined as 2481.95 USD $ in farms producing watermelon in the open, 3694.41 USD $ in farms producing low tunnel watermelon, and 7880.25 USD $ in farms producing high tunnel watermelon (Table 7).

Taylor et al. (2003) conducted a small, repeated, field study of watermelon in 1997, 1999, and 2000, and found that production management intensity affects watermelon yield and profitability in Oklahoma. The authors applied two different production methods and three different varieties. Low-intensity management consisted of the use of soil fertilisation and weed control. High-intensity management included the same weed control and fertilisation as low-intensity management, but also included plastic mulch, drip irrigation, pest control, and plant disease control. The authors calculated that yields from the seedless triploid genotype 'Gem Dandy' consistently yielded more positive net income than 'Allsweet' or 'Sangria' under high-intensity management. Under low-intensity management, they determined the net profit from 'Gem Dandy' to be $102.89, $1159.45 and $1663.39 per hectare in 1997, 1999 and 2000, respectively. They calculated the total cost as $2383.73, $2702.00, and $3821.39 per hectare from 'Gem Dandy', respectively.

Gül et al. (2004) calculated the GPV per hectare as 4432.54 USD $, gross margin as 2865.49 USD $, and net profit as 2106.96 USD $ of the watermelon farms in Adana.

Relative profit was found as the ratio of GPV to the cost of production. Relative profit shows how proportionally one option is over another. Relative profit better measures the return of production activities (Kıral et al., 1999). The relative profit in watermelon cultivation was calculated as 1.96 (Table 4.25).

The relative profit was determined as 1.75 on the average of the farms producing watermelon in the open, 2.02 on the average of the farms in low-tunnel watermelon

production, and 2.07 on the average of the farms in high-tunnel watermelon production (Table 7).

The relative profit value calculated in the average of the enterprises in watermelon production for the 2021 production season indicates that the watermelon production activity was profitable. 196 USD $ GPV was obtained for each 100 USD $ production cost in watermelon production in the region during the examination period. Therefore, a profit of 96 USD $ was provided for every 100 USD $ production cost. While this profit was 102 USD $ in the low tunnel, and 107 USD $ in the high tunnel, it decreases to 80 USD $ in the open.

Sarı et al. (2004) determined the physical quantities of the inputs used in watermelon cultivation in Adana province. The authors found the average watermelon cultivation area in the enterprises to be 7.87 hectares. They determined that the cultivation was commonly done under cover and the average yield per hectare was 57613 kg in the 2002 production season.

Table 7: Various profitability indicators in watermelon farms

Indicators	Open	Low tunnel	High tunnel	Average
Planting area (hectare)	1.61	1.78	1.22	1.58
Production (kg per farm)	97333.33	104517.24	68882.35	93400.00
Yield (kg per hectare)	60518.13	58740.31	56570.05	58954.01
GPV (USD $ per farms)	9311.77	12994.51	18585.05	13089.56
Gross profit (USD $ per farm)	5201.12	7934.50	14861.21	8679.54
Net profit (USD $ per farm)	3991.80	6573.51	9595.36	6422.23
GPV per hectare (USD $)	5789.70	7303.12	15263.08	8262.12
Gross profit per hectare (USD $)	3233.85	4459.31	12204.86	5478.52
Net profit per hectare (USD $)	2481.95	3694.41	7880.25	4053.71
Relative profit	1.75	2.02	2.07	1.96
Production cost per kg (USD $)	0.05	0.06	0.13	0.07
Sale price per kg (USD $)	0.10	0.12	0.27	0.14

In the research, the marketing problems of watermelon producers vary according to the farms. Issues in order of importance; (1) excessive volatility and uncertainty of prices, (2) low sale prices, (3) the length of the payment term, (4) lack of bargaining opportunity, (5) the goods are given and the merchant disappears, (6) the sole trader buys, (7) insufficient condition, (8) product losses.

However, the top three problems faced by farmers were, in order, excessive fluctuation and uncertainty in prices, high product loss, number of buyers and long payment terms.

The relative profit in the interviewed farms changed between 0.64 and 3.51. Therefore, some farms were below one value of the relative profit (Figure 3).

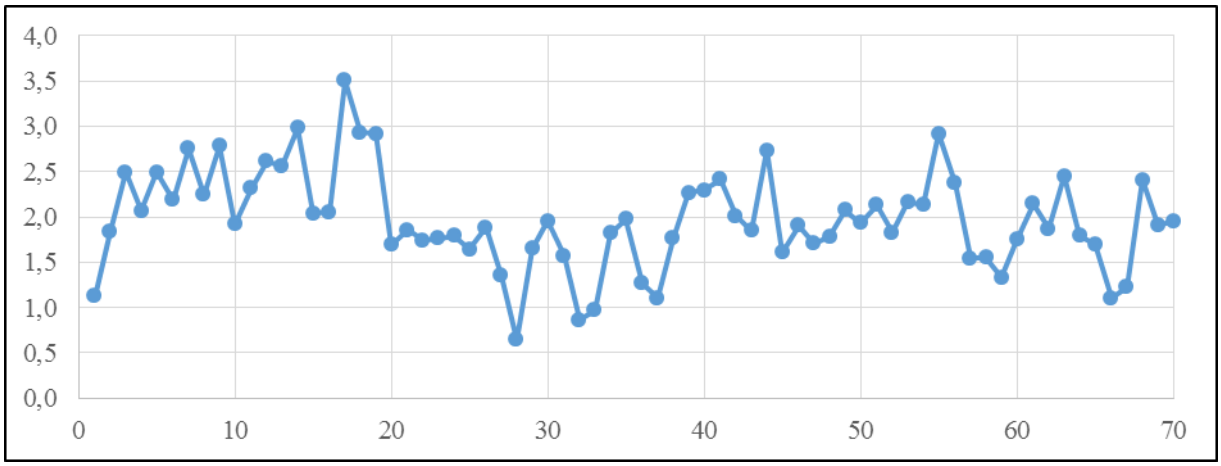

Figure 3: Relative profit values of watermelon-producing farms

The amount supplied in many agricultural products differs according to the seasons. That's why prices fluctuate. The demand for agricultural products continues throughout the year. The adaptation of supply to demand is delayed and this reveals seasonal price fluctuations (Demirtaş and Erkan, 2002; Yılmaz and Gül, 2014). Therefore, this also applies to the watermelon product. To show this, the annual watermelon prices received by the producers were examined. Here, the TURKSTAT dataset for the year 1980-2021 was used. For monthly prices, the TURKSTAT data set for the period 2003:01-2021:12 was used.

The current prices of watermelon received by the farmers were converted into USD by taking into account the dollar rate of the Central Bank of the Republic of Türkiye. At the same time, watermelon prices received by farmers were converted into real prices (2003 prices) by taking into account the annual and monthly Producer Price Index (PPI) based on 2003=100. The fluctuations of prices from year to year, coefficients of variation and price volatility were calculated. In theory, volatility refers to an uncertain movement of a random variable over a period of time. The volatility in agricultural product prices is of great importance as the associated uncertainty is one of the main factors affecting the income security of producers and traders, which threatens the performance of agriculture and the welfare of consumers (World Bank, 1996; OECD, 2011).

When the current prices of watermelon were examined in the period 1980-2021, in 2021, the prices of watermelon in the hands of farmers in Türkiye increased more than 8 million times compared to 1980. On the other hand, the Producer Price Index increased more than 9.5 million times in the same period. This indicates that the increase in watermelon prices is below the increase in the index, and therefore there is a situation against watermelon producers. The coefficient of variation covering forty-two years was 115.08 at current prices

for Türkiye and 114.73 for Antalya province. The concepts of volatility and uncertainty express two basic meanings of volatility. Here, variability refers to all movements, uncertainty refers to unknown movements (Wolf, 2004). The volatility in current watermelon prices in the period under consideration was 44.17%, while for Antalya it was 49.83%. Price volatility is defined as an important economic problem.

When the current prices (USD $) were examined; while the prices of watermelon, which were received by farmers in 1980 in Türkiye average were 179.84 USD per ton and 163.14 USD in Antalya, they decreased by 30.66% and 28.38% in 2021 and became 124.70 USD and 116.84 USD, respectively. In Türkiye and Antalya, the highest price was 417.88 USD and 583.71 USD in 2010, and the lowest price was in 1985 at 91.48 USD and 89.57 USD (Figure 4). In this period, the coefficient of variation in current prices was calculated as 30.66 for Türkiye and 28.38 for Antalya. This variation can be observed in Figure 4. Therefore, annual variation in watermelon prices was high and there were annual fluctuations.

When examining real prices (2003 prices); while the prices of watermelon received by farmers in 1980 in Türkiye average were 234.88 TRY per ton, 213.06 TRY for Antalya, they decreased by 15.85% and 13.08% in 2021 and became 197.64 TRY and 185.18 TRY. In Türkiye, the highest price was 361.23 TRY in 1993 and the lowest price was 160.84 TRY in 1982 (Figure 5). In this period, the coefficient of variation in real prices was calculated as 23.60 for Türkiye. The price volatility received by the producer was also at the rate of 24.07%. This variation can be observed in Figure 5. The annual variation in watermelon prices was high. In Antalya, the highest price was 493.27 TRY in 2010, and the lowest price was 153.02 TRY in 2019 (Figure 5). In this period, the coefficient of variation in real prices was calculated as 27.22 for Antalya. The price volatility received by the producer was 31.18%. It can also be seen from Figure 5 that it has a variation above the Turkish values. The high price volatility also caused significant risk and uncertainty in farmer incomes.

The monthly real prices of watermelon farmers (2003-2021) were the lowest in July and August, and the highest in May and April. In general, prices were at their highest during the first season of watermelon. In this period, the coefficient of variation in monthly real prices was calculated as 53.83 for Antalya. The monthly price volatility received by the producer was 48.50%. For Türkiye, it was calculated as 40.58. The monthly price volatility received by the producer was 35.34%. The data in Antalya province had a variation above the Turkish values. There were seasonal fluctuations as well as annual fluctuations in watermelon prices. High price volatility also causes significant risk and uncertainty in farmer incomes, and this situation may change if producers make decisions for early crops.

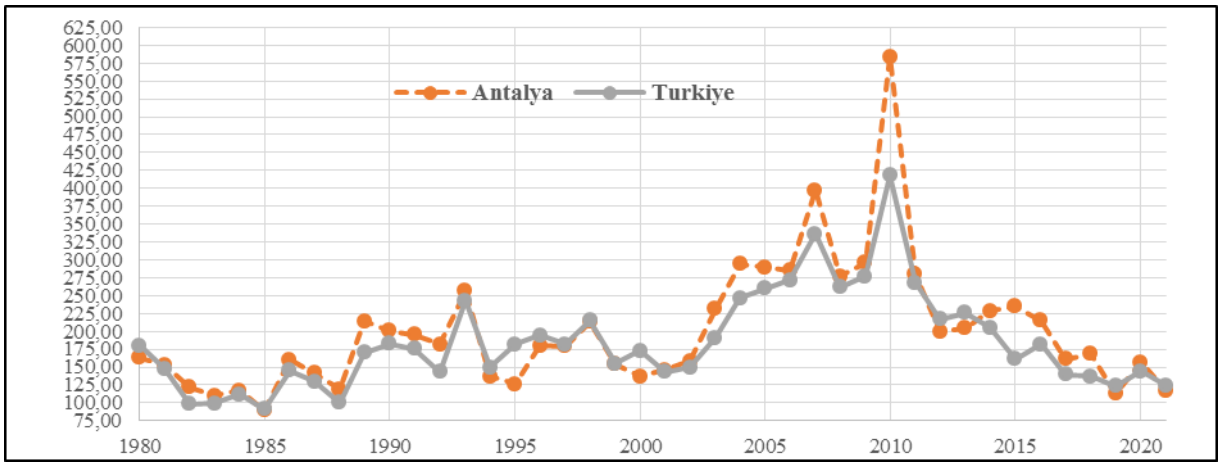

Figure 4: Watermelon price (USD $, tonnes)

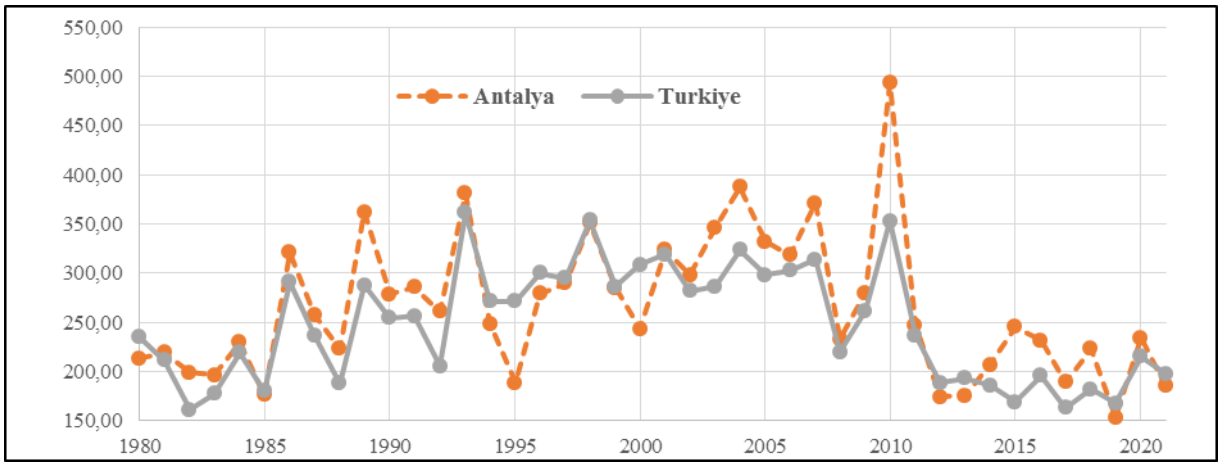

Figure 5: Watermelon real price (TRY, tonnes)

The export rate of watermelon has increased in the world and in important producing countries. For example, 4.2 kilograms of every 100 kilograms of watermelon in the world became the subject of export. In Türkiye, it exceeded 2 kilograms. Volatility in watermelon prices is in question in all countries. According to FAOSTAT figures, price volatility at the producer level is 39.04% in China, 26.12% in Türkiye, 44.49% in Spain, 15.12% in Mexico, 30.48% in Italy, 43.44% in Morocco, 44.75% in Iran, 14.12% in the USA, and 30.28% in Greece. Therefore, price uncertainty exists in all countries. At the same time, being subject to more exports increased the unit value. The world average has exceeded 400 USD per ton in recent years.

5. Conclusions and Recommendations

In the study, the economy of watermelon production with different production models was examined. It was determined that the cost of watermelon was the lowest and the profitability was lower in the farmers growing watermelon in the open compared to other systems. It was determined that the watermelon cost was the highest and the profitability indicators were the highest in the watermelon growing enterprises in the high tunnel (greenhouse). According to the theory of the economy, since these enterprises put their products on the market earlier, their sales prices are higher. However, the costs were also higher. At this point, it is important to shape foreign trade policies by taking into account the watermelon harvest times. It is now more and more subject to foreign trade.

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