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Research Article

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Turkey, sericulture, silkworm cocoon, sericulture product

A Study On The Sericulture in Turkey

Abstract
Sericulture, or silk farming, is the cultivation of silkworms to produce silk. Although there are several commercial species of silkworms, Silk was believed to have first been produced in China as early as the Neolithic Period. Sericulture has become an important cottage industry in countries such as Brazil, China, France, India, Italy, Japan, Korea, and Russia. Today, China and India are the two main producers, with more than 60% of the world's annual production. In this case, the sericulture production in Turkey, as the export-oriented shows could increase in the future. Sericulture production was begun in Anatolia which is Asian part of Turkey in A.D. 552 during Byzantium Emperor of Justinianus. The city of Bursa became a textile city which was famous for silk and silk trade centre. In middle of 16th silk textile industry was developed. Apart from city of Bursa, cities of Istanbul, dirne, Amasya, Denizli, Izmir and Konya were important sericulture centers In addition; the increase of government support in sericult production is also hope for the future of sericulture production in Turkey. In this study, using the silkworm cocoon data between the years of 1991-2019, the future 5-year production is estimated. For this, estimates were tested in the MINITAB program using the ARIMA Model, which is widely used in agricultural production estimates. Unconscious use of pesticides in Turkey, problems with mulberry tree cultivation, technical problems and rural-urban migration results are known to be important issues of the sericulture sector.However, thanks to government subsidies and export-oriented policies, it has been determined that silkworm cocoon production will increase in the next 5 years.

INTRODUCTION

In historical documents, it is estimated that the first information about sericulture was in China and spread to the whole world with the development of trade in the following years. The history of sericultur in Turks dates back to very old times. In the Ottoman Empire, sericulture and the number of people who did this work started to increase after the 16th century. (Gonzalezet et al., 2018; Shuobin; 2015; Wei et al., 2012). The silk industry started with 60 catapult factories established in Bursa in 1845, and the number of factories established in Bursa and Izmit reached 85 in 1860. With the Sericulture Institute established in Bursa, domestic silkworm seeds were produced and sericulture production started for the first time by scientific methods. In 1926, after the proclamation of the Republic, issues related to the care and feeding of silkworm in Turkey in 1940 and placed under legal protection, a variety of facilities in order to maintain and increase the cocoon production in Turkey was established in Bilecik (Akkuş, 2013; Kaya and Tutkun, 2012; Kumar, 2017; Yılmaz, 2017). The first silk cooperatives established in Adapazari in Turkey and in subsequent years, these and other cooperatives, merged in 1940, Bursa Koza Agricultural Sales Cooperatives Union (Kozabirlik) have established. The establishment of a cooperative on sericulture caused an increase in production and an economic value in this sector (İnalcık, 2013; Yılmaz et al., 2015). The earliest information about sericulture is based on Chinese sources. Sericulture has spread to all over the world through trade routes from its homeland, China. Towards the middle of the 16th century, sericulture started to develop in the Ottoman Empire and the number of people working in this sector increased especially in Bursa. After the proclamation of the Republic, with Act No. 859 issued in 1926, issues related to sericulture care and nutrition in Turkey has been under legal protection. Cooperatives established in 1940 (Kozabirlik), thanks to Turkey was one of the few countries that produce the sericulture seeds. Sericulture in Turkey can be carried out twice a year, in spring and autumn; it is economically more efficient because it is carried out only in the spring feeding. Sericulture is in approximately 30 countries around the world. For example, China (661 million tones) and India (130 million tons) that meets approximately 90% of production. Turkey is ranks 9th in the world with about 151 tons of sericulture production. When analyzed data between 2019 and 1991 related to sericulture in Turkey; in 1991, it is seen that number of villages in sericulture decreased from 1635 to 675, number of households in sericulture from 29689 to 2062, number of opened boxes from 50623 to 5890, and silkworm cocoon from 1353 to 90. Although a decline in sericulture production data in Turkey, in both quantity and value of exports increased between 2009 and 2017 were identified (from 154 $ million to 531 million $). (INERCO, 2020). The number of countries engaged in sericulture production in the world as well as in Turkey is around 30. Among these countries, while China ranks first with about 600 thousand tons in cocoon production, India is followed by 130 thousand tons (Hunter, 2013). With about 800 thousand tons of sericulture production, these two countries meet about 80% of world production. Turkey in sericulture production, about 151 tonnes annually, is located in the first row sericulture production in the world. Another important data related to sericulture is the data related to raw silk production. While China ranks first in raw silk production with about 158 thousand tons, India follows this country with 30 thousand tons. The raw silk productions in Turkey is around 30 thousand tons is considered as an important value (ISC, 2019; Tas, 2013). Sericulture production in Turkey for many years due to suitable climatic conditions in spring and autumn, but this production made in recent years, has just started to be made in the spring. The most important reason for this

situation is the migrations from the villages that is engaged in sericulture to the city. In Turkey, infused (hatched) silkworms, at the end of April and distributed to producers in the Aegean and Mediterranean regions at the beginning of May. This is an important support for sericulture. Sericulture eggs are sold in full and half boxes and there are around 20,000 live eggs in each packed box. A box silkworm in Turkey, to about 40 kg of product is obtained and this value is an important value for sericulture. The average sericulture production in Turkey is approximately 25-30 kg per business. This situation varies according to seasonal effects and technical knowledge level of the producers. Sericulture production in Turkey is done only in the western region. For example, in Kulp district where Diyarbakır Chamber of Agriculture Silk Production Center is located, Kozabirlik produced approximately 100-120 tons of wet cocoons annually (Fuller, 1999; Kozabirlik, 2015; TSI, 2019). Between the years 1991-2019 the number of villages engaged in sericulture in Turkey from 675 to 1635, the number of households from 2062 to 29 689, while the number of combo box is dropped from 50 623 to 58 900. Athough a reduction in the data related to the production of sericulture in Turkey, quantity and value of products exported sericulture year shows an increase in the stacks. Between 2009 and 2017, the value and quantity of dry cocoon increased from 30 675 to 35 315, from $ 154 million to $ 531 million. (Özer and Top, 2017; Republic of Turkey Minister of Trade, 2019; Republic of Turkey Agriculture and Forestry, 2019; TSI, 2019). Sericulture production is a sector in need of support. In many countries of the world, silkworm producers are supported. For example, in European Union countries, sericulture producers are provided with a direct income support of € 133 per box, provided that at least 20 kg of product is obtained. Sericulture is supported substantially in recent years in Turkey. In 2017, approximately 5 million silkworm eggs were distributed free of charge, and each silkworm egg pays 5 TL to the Kozabirlik seed producer. In addition, 70 TL per kg is paid for each box and 50 TL per kg for fresh cocoon. Supporting the provision and exporter of premium support for exports to Turkey will also lead to an increase in sericulture sericulture production in the future. (Republic of Turkey Minister of Trade, 2019; (Offical Newspaper, 2019). The most determining factor in the world sericulture market is the price policies implemented by China. On the other hand, countries such as Uzbekistan and India, sericulture rates, these elements are determined by the Chinese market and other countries such as Turkey, which affects the production of sericulture closely. In this situation, it is supported sericulture which is one of the most important inputs for production to promote the cultivation of mulberry trees and mulberry trees to make free distribution for it in Turkey. Kozabirlik has distributed 485 150 mulberry seedlings in the last ten years (2008-2017) and distributes silkworm eggs that the producer needs for free. Therefore, Turkey has been one of the few countries in the world producing silkworm eggs. These developments indicate that Turkey will be an important manufacturer of sericulture in the future (Republic of Turkey Minister of Trade, 2019). The most important problems in Turkey regarding the current times, the use of pesticides in an unconscious way and sericulture production is being done in the home or small operators. In addition, the migration from village to city, adversely affect the sericulture production in Turkey. Increased demand in ecological and natural products in recent years, with increasing demand, as well as the demands of the machine made carpets silk carpets, which will also positively affect the sericulture in Turkey. Both in Turkey and in the world, the number of required scientific studies on both the nature of sericulture is quite low. In fact, academic studies on sericulture concentrate more on agricultural areas. However, since sericulture is an economic sector, it is

important to conduct economic analyzes related to this sector. This study is an economic study related to the sericulture sector. Estimates related to Turkey's future in sericulture production, ARIMA model is very important to work with.

MATERIAL and METHODS

In this study, the data used as the material is composed of data of sericulture in Turkey. These; the sericulture history of Turkey and like data the number of villages in sericulture, number of households in sericulture, number of opened boxes and silkworm cocoon, sericulture export and sericulture import consists of data, Turkey's sericulture. These data, Turkey Ministry of Commerce, Ministry of Agriculture has been obtained from official institutions such as the Turkey Statistical Institute has also been obtained from academic studies and other documents which are related to sericulture in Turkey. These data are listed as follows:

The sericulture history of Turkey

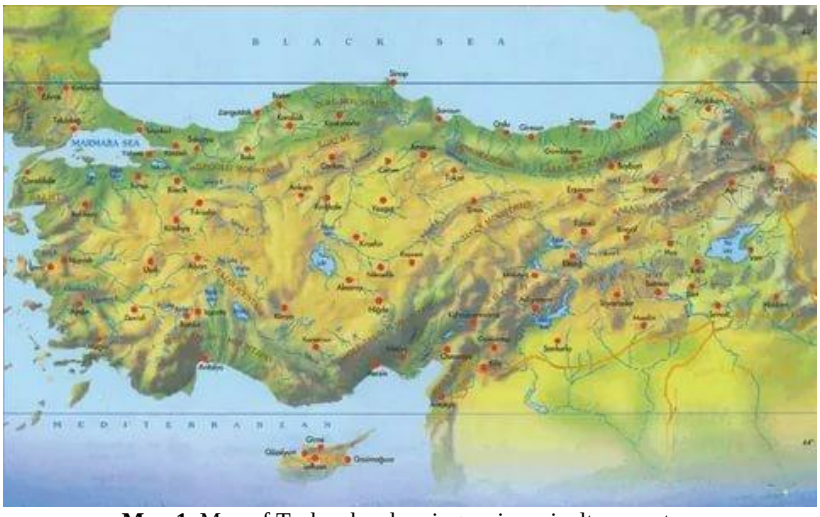
Turks with a history of about 5000 years have a rich civilization. These civilizations spread over a wide area from Central Asia to Anatolia. The Turks not only kept their own culture alive, but also spread these cultures in a wide geography and were influenced by other cultures. The cultural and artistic values of the Turks have gained an economic value over time. The Central Asian Civilization moved to the west with the Silk Road stretching from Central Asia to Anatolia and the Turks played an important role in this. Because the Turks used this trade route for many years and continued their dominance in the regions where this road existed. This road played an important role in the transportation of silk that is one of the most important wealth of that period, to the west. (Cherry, 1987; Huesser, 1927). Historical documents show that sericulture spread from China to the world and it is known that Turks have an important role in this. The fact that the Turks lived side by side with the Chinese for many years played an important role in learning Turkish silkworm. Sericulture developed in the Ottoman Empire in the 16th century. For many years, the silk industry has been one of the main production sectors in Anatolia. It is known that there were 37 silk drawing factories and more than 5000 silk looms only in Bursa in 1860. In the 1500s, silkworm cultivation and silk fabric weaving had an important place in the Ottoman economy. In those years, small handicrafts and silk production with primitive methods not only had an important place in the Middle East market, but also received intense demand from European markets (Yılmaz, 2017, Toprak, 2008). In addition to Bursa, in the cities such as Istanbul, Edirne, Amasya, Denizli, İzmir and Konya, silk fabrics were touched to improve the sector. The silk drawing industry started with 60 catapult factories established in Bursa in 1845, and the number of silk drawing plants established in Bursa and Izmir reached 85 in 1860. After the proclamation of the Republic, the most important developments related to sericulture, enacted in 1926, Law No. 859 sericulture seed production in Turkey was also guaranteed. In the 19th century, sericulture has made great progress in the Osmalian State, largely based in Bursa. So much so that when entering the second half of the century, Ottoman raw silk was sought in Lyon and London markets with the effect of steam *philature factories,* which helped to transform cocoons into quality raw silk. In the 19th century, silkworm has made great progress in the Osmalian State, mainly Bursa-based. So much so that when entering the second half of the century, Ottoman raw silk was sought in Lyon and London markets with the effect of steam philature factories, which helped to transform cocoons into quality raw silk. One of the most important developments related to sericulture breeding in the Ottoman State is the education given in this sector. Harir Darü't Talimi, who carried out training activities in Duyun-u Umumiye Management after 1888, started his sericulture education after 1926 (Yıldırım, 2013). (Figure 1).

Figure 1. Harir- darü't- talimi' was the first Turkish silkworm education center in Bursa

After the proclamation of the Republic, regulations made in the sericulture sector in Turkey, sericulture training activities and showed a significant improvement with the establishment of Kozabirlik. In 1940, the first cooperative was established in Bilecik and Adapazarı to continue and increase cocoon production in Bursa. Later, these cooperatives merged and on May 11, 1940, S.S. Bursa Koza Agricultural Sales Cooperatives Union (Kozabirlik) was established. In addition, Kozabirlik Seed Production Facility was established in 1963. In this establishment, production of hybrid seeds resistant to diseases and high yield per box has been provided. (Taşlıgil, 1996).

Turkey's sericulture data

Statistic data related to sericulture in Turkey Turkey Statistical Institute (TSI), data were obtained from the Ministry of Agriculture and Commerce. In this study, the values of these data between 1991-2019 were used. Sericulture data in Turkey, especially in Bursa, Balikesir, Ankara, Izmir, Bursa, Elazig, Diyarbakir, Istanbul and Denizli was obtained based in the provinces. These provinces are those that have suitable climatic conditions for the production of sericulture (Map 1). (TSI, 2020).



Map 1. Map of Turkey by showing main sericulture centers

Some data related to sericulture production in Turkey is seen in the table below. Based on these data, the increases and decreases of the data related to the production of sericulture were statistically revealed (Table 1).

Table 1. Sericulture data in Turkey (1991-2019) (Republic of Turkey Minister of Trade, 2019)

Years	Number of villages in sericulture	Number of households in sericulture	Number of opened boxes	Silkworm cocoon
1991	1 635	29 689	50 623	1 353
1992	1 009	17 703	27 732	782
1993	951	14 544	25 884	724
1994	647	12 151	17 953	452
1995	532	7 493	9 702	271
1996	398	5 756	7 529	215
1997	325	3 863	5 741	161
1998	255	3 115	4 543	136
1999	260	3 019	4 964	133
2000	230	2 210	3 147	60
2001	213	1 555	2 445	47
2002	327	2 356	3 839	100
2003	280	2 758	5 097	169
2004	273	2 888	5 161	143
2005	277	2 677	5 669	157
2006	233	2 527	5 699	127
2007	212	2 274	5 273	125
2008	195	2 193	5 564	125
2009	203	2 295	5 683	136
2010	194	2 134	5 477	126
2011	295	2 623	5 808	151
2012	342	2 572	5 576	134
2013	327	2 343	5 261	121
2014	340	1 760	3 739	80
2015	474	1 956	4 674	115
2016	576	2 001	5 303	103
2017	659	2 128	5 686	102
2018	693	2 210	6 238	94
2019	675	2 062	5 890	90

Data for the years 1991-2019 regarding the production of sericulture in Turkey are examined; in 1991, the number of villages in sericulture decreased from 1635 to 675 in 2019. In the same period, number of households in sericulture decreased from 29689 to 2062, number of opened boxes from 50623 to 5890, and silkworm cocoon from 1353 to 90. Foreign trade data such as export and import rank first among the most important indicators of an economic sector. Sericulture sector in Turkey's foreign trade data, are promising for the future. The export and import of dry cocoons and silk yarn in a country related to silkworm is an important economic indicator. According to the data of 2011, China ranks first in dry cocoon exports with 10 300 tons, followed by Italy with 719 tons. Turkey's dry cocoon values between 2009 and 2017 the export value shown in Table 2. (Republic of Turkey Minister of Trade, 2020; TSI 2020).

Table 2. Turkey export value and quantity of dry cocoon (2009-2017). (Republic of Turkey Minister of Trade, 2019; TSI 2020)

Years	Quantitiy (kg)	Value (Dollar)
2009	30.675	154.182
2010	67.568	381.820
2011	7.884	31.343
2012	80.238	666.287
2013	30.445	361.335
2014	11	921
2015	5.350	64.200
2016	31.081	307.189
2017	35.315	531.295

As seen in Table 2, Turkey is a country that is a net exporter of dried cocoon in a country field. Turkey, in 2009 has made about 154 million $ dry cocoon export value in 2019 and has raised approximately 531 million $. In short, Turkey has increased by approximately 300% over the last decade the export of dry cocoon. Another important thing is the sericulture value is the silk worm export value. The silk export value of Turkey in the last decade, are given in Table 3.

Table 3. Silk yarn export quantity and values by years in Turkey (2008-2018)

Years	Quantitiy (kg)	Value ($)
2008	50.423	864.930
2009	18.295	325.607
2010	21.937	388.769
2011	21.334	196.898
2012	22.446	341.166
2013	16.094	445.650
2014	22.295	446.674
2015	22.615	520.411
2016	29.229	283.506
2017	23.174	141.104
2018	64.922	496.108

Turkey, in 2018 about 50 thousand kg of silk yarn exports in 2008 increased to approximately 65 thousand kg. Turkey, Egypt, mainly in Iran, Iraq, Turkmenistan, and Azerbaijan serves to countries such as silk worm exports. These values are seen in table 4.

Table 4. The total silk worm exports to some countries, Turkey (2018)

Countries	**Quantity (kg)**	**Value (dollar)**
Egypt	41 590	195 083
Iraq	3868	14 052
Iran	4 117	28 537
Italy	75	1 458
Belgium	1 260	5 696
Turkmenistan	1 160	6 484
Georgia	360	39 234
Azerbaijan	2 252	12 006
Afghanistan	373	2 017
Tajikistan	1 077	5 009
Other	8 790	186 532
Total	**64 922**	**496 108**

According to 2018 data, Turkey's exports in the first row of silk yarn Egypt Georgia when this country is followed by Iran and Iraq (Table 4). (TSI, 2019). Turkey's imports of silk thread are very important for sericulture sector. Because of this product affects the Turkish carpet industry closely. Silk thread import, especially from China, is a negative example for the Turkish carpet industry. However, in recent years, the interest in Hereke Turkish carpets will have a decreasing effect on silk yarn imports. Changes in Turkey's import of silk yarn between the years 2008-2018 are given in table 5.

Table 5. Value and quantity, imports of raw silk of Turkey (2008-2018). (TSI, 2020).

Years	Quantitiy (kg)	Value ($)
2008	96 571	1.924.232
2009	54 572	1.145.832
2010	92 422	2.205.181
2011	113 991	3.358.819
2012	47 957	1.575.124
2013	58 300	2.424.858
2014	57 947	2.291.283
2015	36 499	1.523.632
2016	26 496	1.013.688
2017	14 571	614 222
2018	16 549	747 913

Turkey's imports of raw silk yarn in 2008, this value decreased from 1,924,232 dollars in 2018 to 747 913 dollars. This case illustrates Turkey's future orientation can also be increased production and export of sericulture (Tablo 5). In sericulture, the mulberry tree is one of the most important inputs. In sericulture, the mulberry tree is one of the most important inputs. Because without a mulberry tree, sericulture cannot have a natural habitat, so sericulture production is not technically possible. Therefore, the presence of mulberry trees in a country or a region reveals that silk insects also exist. Mulberry tree cultivation is carried out wherever there are suitable climatic and soil conditions. In Turkey, mainly in the Marmara Region, it is made of mulberry tree cultivation in many regions. It is naturally possible to produce sericulture in regions where mulberry tree is grown. In Table 6, data on the mulberry tree yetiştiriclig seen in Turkey. (TSI, 2020). Turkey regarding the production values of the mulberry tree, although it has shown a decrease in the years 1988-2015 after 2015 has increased the production values associated with mulberry tree. The most important reason for this situation is that the state supports mulberry tree growing (Table 6). (TSI, 2020).

Tablo 6. Mulbery data (1988-2019). (TSI, 2019)

Years	Number of trees (bearing)	Number of trees (nonearing)	Production (Tonnes)
1988	3 052	751	90 000
1989	2 960	704	85 000
1990	2 870	684	80 000
1991	2 845	656	82 000
1992	2 780	630	80 000
1993	2 770	610	76 000
1994	2 740	620	78 000
1995	2 713	564	75 000
1996	2 650	553	74 000
1997	2 590	525	73 000
1998	2 475	510	65 000
1999	2 425	500	65 000
2000	2 440	485	60 000
2001	2 210	415	55 000
2002	2 130	380	55 000
2003	2 180	375	55 000
2004	2 130	365	50 000
2005	2 120	366	55 000
2006	2 029	353	51 558
2007	2 095	560	61 665
2008	2 301	539	65 140
2009	2 393	537	67 986
2010	2 479	507	75 096
2011	2 453	359	76 643
2012	2 446	379	74 170
2013	2 423	380	74 600
2014	2 384	380	62 879
2015	2 416	328	69 334
2016	2 402	333	71 724
2017	2 366	347	74 383
2018	2 324	353	66 647
2019	2 021	375	69 317

Time-series as an estimation method in the study Autoregressive Mobile, one of the analysis techniques ARIMA (Box-Jenkins) methods, which is the average technique, was used. In statistical tests and estimates, MINITAB package program was used. For this study, in this statistical analysis, silkworm cocoon production data (1991-2019) was used. Because this data is the main factor that directly affects future sericulture production. In addition, in the study, the number of sericulture village, which directly and indirectly affect silkworm cocoon production, the number of households, the number of boxes opened, sericulture export, import and other mulberry tree cultivation were used. Also, in this study the maps relating to the production of sericulture in Turkey and usage in some photos. Thus, a better understanding of the study was provided. Before creating the ARIMA model and proceeding to the estimation phase, production values such as silkworm production values (number of villages in silkworm, number of silkworm households, number of boxes opened and silkworm cocoons) were firstly created to increase the forecast success. Then, Generalized Dickey-Fuller (ADF) test was performed to test whether the data, one of the most important assumptions of the model, provides these values. After the data was stabilized, the prediction phase started. Because of the data must be stationary for time series applications (Özmen and Şanlı, 2017; McLeod et al, 1977; Shathir and Salah, 2016; Zhang, 2018).

In this series, special version of ARMA (p, q) and AR (p) and MA (q) models are used. However, there may also be time-dependent changes in the mean and variance in the time series. In this case, the series is stationary. The stagnation of the time series is done by taking the first and second differences of the series. In this case, the model is ARIMA (p, d, q). (Assam *et al*, 1994; Hamzaçebi and Kutay, 2004).

ARIMA (p, d, q) Model is formulated as formulated

$\varphi 0 + \varphi 1\ Yt\text{-}1 + \varphi Yt\text{-}2 \ldots\ldots\ldots\ldots + \varphi Yt\text{-}p + Et\text{-}\ \theta 1Et\text{-}1 - \theta 2Et\text{-}2\text{-}\ldots\ldots\ldots\ \theta 1Et\text{-}1t\text{-}q$ (1).

Here *Yt*; d here; the observation values taken in degrees, εt; t is the error terms in time, $\varphi\ i\ 1,2,3\ldots p)\ \ \theta j(j = 1,2,3\ldots q);$ model parameters, p and q autogressive process (AR) and moving average (MA) values, respectively. ADF Unit Root Test was used survival of stationary light. In this test, handled by Dickey and Fuller (1979; 1981), If a fixed and trending process is followed and if it has become stationary in a serial trending process, this value is taken as a basis without monitoring other processes. If the series has not become stationary, with a constant term and no stability has been achieved in this, constant term-free testing is performed, and because of this process, the value that renders the series stationary is based on (Enders, 1995). The ADF test covers the following equations.

$\Delta YYtt = \delta\delta YYtt{-}1 + \Sigma\ \delta\delta ii\Delta YYtt{-}jj + \varepsilon\varepsilon ttppjj{=}1$ (2)

$\Delta YYtt = \mu\mu + \delta\delta YYtt{-}1 + \Sigma\ \delta\delta ii\Delta YYtt{-}jj + \varepsilon\varepsilon ttppjj{=}1$ (3)

$\Delta YYtt = \mu\mu + \beta\beta\beta\beta + \delta\delta YYtt{-}1 + \Sigma\ \delta\delta ii\Delta YYtt{-}jj + \varepsilon\varepsilon ttppjj{=}1$ (4)

The hypotheses established unit root test is as follows;

$H0$: $\delta = 0$ (Unit has root, so time series is stationary It is not).

$H1$: $\delta < 0$ (Serial unit does not contain root, it is stationary).

The first difference processor (Δ) in the equations, (Yt) t, shows the time series used in the period, (μ) constant term, (βt) time trend, (εt) error term, (p) delay length.

Tests of logarithmic data		t-statistic	Importance level
Increased Dickey-Fuller tests		1.083317	0.9014
Test critical values	% 1	-2.301572	
	% 5	-1.752062	
	%10	-1.560904	

Tests of data with second-degree differences.		t-statistic	Importance level
Increased Dickey-Fuller tests		- 6.055410	0.0000
Test critical values	% 1	- 2.541572	
	% 5	1.652052	
	%10	1.795909	

RESULTS

ADF unit root tests results

Turkey sericulture production data according to the ADF test results, test statistics 1.06663613, it is seen that the series contains a unit root is larger than the critical value. The severity rating shows that the series is not stationary 0.6742> 0.05 groove. Also, increasing trend analysis values that the series is influenced by the seasonal factor. Therefore, silkworm production values were made stationary by taking the differences before the estimation process. In the ADF test results and trend analysis of silkworm production values, which became stationary after taking the 2nd-degree differences, the test statistics – 6,055410 are smaller than the critical values

and the series does not contain a unit root. Also, the severity level is less than 0,000 <0.05 and the trend disappearing shows that the series has become stagnant and can be used for prediction with ARIMA.

ARIMA (Box-Jenkins) model and prediction

The data were made stationary, the most suitable ARIMA models were determined and the best statistical results were obtained in ARIMA (2,2,2), ARIMA (2,2,3) and ARIMA (3,2,1) models. Among these models, ARIMA (3,2,1) was used for estimation because it has more meaningful values and better predictive performance. Table 2 shows the program outputs with the statistics results of the ARIMA (3,2,1) model. When Table 2 is analyzed, it is seen that the model is significant at the significance level of 0.05 (p <0.05). Mean Error Frames (MSE): 0.22357 was obtained as a very low value. Again, when looking at Ljuing box chi-square statistics, it can be said that the model is significant and sufficient at 5% (p> 0.05) significance level. So the model can be used for estimation.

Table 7. Statistical results for ARIMA (3,2,1) model

Tip	Coefficients	STandart error	T	P (importance level)
AR 1	-0.3185	0.1482	-2.01	0.072
AR 2	-0.421	0.15	-3.18	0.001
AR 3	-0.6509	0.1344	-4.44	0.000
MA 1	0.785	0.0748	12.21	0.000
Constant	-0.00287	0.004852	-0.75	0.413

Difference	2	Number of observations (original series)	30	degrees of freedom (degrees of freedom)	30
SD (degrees of freedom)	25	MSE (Mean square error)	0.22357	SS (Sum of error squares)	6.85911

Box-pierce (Ljuing box) ki-kare statistics.

Lag (Delay)	12	26	35	45
(Chi- square	13.4	15.2	-	-
SD	8	17	-	-
P-Value	0.048	0.535	-	-

Silkworm production estimation results of ARIMA (3,2,1) model were obtained (Table 7). Looking at the results in general, according to the results obtained from the logarithmic estimation data of the silkworm production amount, it is estimated that the amount of Silkworm cocoon production will increase to approximately 108 in 2021, 128 ‘in 2022, 146 in 2023 and 166 in 2024. Thus, 5-year production estimates of Silkworm cocoon production were made.

DISCUSSION

Date of sericulture in Turkey is based on very old. It is a known fact that Turks play an important role in spreading silkworm from China to the whole world. Especially, the use of the trade ways of silkworm breeding by Turks has been an important factor in the spread of this product. The geographical structure of Turkey, especially in western regions, climatic conditions and soil structure, is very suitable production of sericulture. However, silkworm breeding as an economic value and sustainability of this sector are influenced by many other factors. At the beginning of these, the economic problems of the sector, environmental pollution, mulberry tree cultivation, and machinery carpet and other textile production take the first place. In the study,

silkworm cocoon production, which is one of the basic production values for silkworm breeding, is taken as a basis. Based on the production values of Silkworm cocoon production (1991-2019), production values between 2021 and 2024 were tried to be estimated by ARIMA model. It is predicted that silkworm cocoon production may increase between these years. Among the reasons his increase, it is assumed that state subsidies have a significant effect and the distribution of mulberry seedlings by the state is an important factor. However, the decrease in the number of villages and households making sericulture may also reveal that the sector is not seen as an economic value. It can also be said that the development of machine-made carpet production and other silk industry contributes negatively to the economic life of the sector. However, the increase in the value of exports sericult production in Turkey is positive for the future of this sector. Factors such as agricultural spraying, the development of industry in these regions and migration from village to city affect this sector negatively. However, in this study, in front of us that within 5 years, the state should support the production of sericulture in Turkey, both production and mulberry trees has been confirmed in the ARIMA model can be increased thanks to policies to export both. This model can be used in many sectors related to agricultural production and can give correct results. The present global silk production is fluctuating around 70, 000 to 90, 000 M.T. and the demand for silk is annually increasing by 5%. With the increase in population and also with the increased demand for fashionable clothing items due to fast changing fashion designs in developed countries, the demand for silk is bound to increase even more. For increasing the silk production we require highly productive mulberry varieties and silkworm races and also silkworm races tolerant to adverse climatic conditions and diseases which can come mainly from the sericultural germplasm resources and also from the wild relatives of *Bombyx* available in the natural habitats.

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