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Araştırma Makalesi

Türkiye'deki Kayısı Üreticilerine Zaman Serileri Analizine Bağlı Ekonomik Bir Tavsiye

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Öz

Bu çalışmada, Türkiye' de bulunan kayısı üreticileri için makine ve iş gücü maliyetlerinin ekonomik olarak karşılaştırması yapılmış ve buna bağlı olarak üreticilere ekonomik tavsiye oluşturulmuştur. Türkiye İstatistik Kurumu (TÜİK) 2005-2020 yılları arası ekonomik verileri kullanılarak zaman serisi analizleri başarılı bir şekilde gerçekleştirilmiştir. Zaman serisinde Kuadratik ve Yarı Logaritmik analiz metodları uygulanarak 2020-2024 yılları arası trend tahminleri gerçekleştirilmiştir. Trend tahminleri mevsimlik işçilerin yıl bazında alacakları ücretler ve enflasyon verileri için uygulanmıştır. Enflasyon verilerine bağlı olarak makine fiyatları 2024 yılına kadar hesaplanmıştır. Tahmin verileri kapsamında elde edilen sonuçlara göre sadece makine kullanımı, makine + işgücü ve sadece işgücü maliyetleri karşılaştırmaları yapılmıştır. Bu karşılaştırma sonucunda üreticinin makine alımına ayıracağı sermayeyi 1 yıllık işçi ücreti ile amorti edebileceği ve bu vesile ile bir ömür kullanılacak makine alımını gerçekleştireceği ortaya çıkmaktadır. Ayrıca makine + işgücü kullanımı ile makineye ayrılan sermaye 2 yıl içinde karşılanabilmektedir. Bu durum basit makine gücünün kullanımı ile özellikle Covid-19 sürecinde Türkiye çapında tüm kayısı üreticilerinin hem sağlık hem maddi hem de zaman açısından kar etmesini sağlayabileceğini göstermektedir.

Anahtar kelimeler: Kayısı Üreticileri, Ekonomik Tavsiye, Ekonomik Karşılaştırma.

An Economic Advice to Apricot Producers in Turkey, Depend on Time Series Analysis

Abstract

In this study, an economic comparison has been made of machine power and labor costs for apricot producers in Turkey. Based on the results of these comparisons, economic advice has been created for producers. The time series analysis was successfully applied using the economic data of the Turkish Statistical Institute (TurkStat) between the years 2005-2020. The possible trend values forecasts for the years 2020-2024 were made by applying Quadratic and Exponential Growth methods in time series analysis. Trend forecasts were applied for seasonal workers' annual wages and inflation data. Machine prices have been calculated until 2024, based on inflation forecast data. According to the results obtained, only machine power use, machine power + labor and only labor costs were compared. As a result of this comparison, it has been determined that the apricot producers can amortize the machine costs with a 1-year workers' wages. Moreover, they will be able to have the machines to be used for a lifetime. In addition, the capital allocated for the purchase of machinery can be met within 2 years with the use of machinery power + labor force. This situation shows that with the use of simple machine power, especially during the Covid-19 pandemics, all apricot producers across Turkey can make a profit in terms of health, financially and time.

Key words: Apricot Producers, Economic Advice, Economic Comparison.

Introduction

Turkey is both a geographical bridge and a barrier connecting the continents of Europe and Asia (Sanli, 2018). Turkey, the majority of which are located in the Asian continent, is located at the junction of the Middle East, the Caucasus, the Balkans and the Eastern Mediterranean. Turkey, which is among the largest countries in the region in terms of population, plays an active role in both Europe and Asia as an agricultural area (Turkey, 2021).

Turkey, which has large agricultural areas, also draws attention in terms of agricultural product variety. Turkey is the leading country in the world in the production of apricot fruit, which is one of these agricultural products (Ercisli, 2009; Kaplan, 2019; TUIK, 2021). While the amount of apricot produced worldwide is 4,257,241 tons per year, 985,000 tons of this production is covered by Turkey (Kaplan, 2019). Malatya province constitutes the majority of apricot production in Turkey, followed by Igdir province apricot production (Ercisli, 2009; Kaplan, 2019; TUIK, 2021). Although Igdir province is in the position of an assistant in apricot production, it has the highest productivity with 159 kg per tree in Turkey (Ercisli, 2009; Kaplan, 2019; TUIK, 2021).

In terms of taste and freshness, apricots, which reach their most mature period in the first or second week of July, are started to be collected from the branch during this period (Unal, 2010). While the mature apricot harvesting process takes place around 10-14 days on average, this process decreases or increases depending on the changing region, soil and climatic conditions (Unal, 2010).

Considering the social and economic history of Turkey, the use of human labor has always been in the first place during the apricot harvesting period (Gezer and Dikilitas, 2002; Unal, 2010). The main reason for this is that apricot harvesting by machine can damage mature apricots or apricot trees. Moreover, the possibility that rotten apricots can damage healthy apricots while the apricot is being downed from the tree, and the high level of machinery prices due to the high taxes applied throughout the country, increases the prejudices against machine power. However, when today's conditions are evaluated, it has been determined that such thoughts should be left behind with this study. Especially considering the Covid-19 pandemic conditions, regional travel restrictions restrict the travel of seasonal agricultural workers, while health concerns indicate the presence of lower numbers of agricultural workers (Aday and Aday, 2020). This decrease in the number of agricultural workers inevitably leads to an increase in the daily wage costs of the workers. Especially considering the Covid-19 pandemic conditions, regional travel restrictions and health concerns cause the presence of lower numbers of agricultural workers. This decrease in the number of agricultural workers inevitably leads to increases in the daily wages of workers.

Within the scope of this study, it shows how much economic advantage the machine power can provide during the Covid-19 pandemic process for the apricot producers in Turkey, which plays a leading role in the world apricot production (Ercisli, 2009; Kaplan, 2019). Based on seasonal worker wages and inflation data used since 2005, labor and machine power cost efficiency analyze were made for the years 2021-2024. In particular, the labor costs + machine costs, only labor costs, and machine costs were compared. Within the scope of the study, Quadratic Trend Analysis (QTA) and Exponential Growth Method (EGM) analyze, which are two different methods from time series analysis, were used to make better, more realistic forecasts for apricot producers (Celik, 2020). According to both analysis method results, it has been revealed that if manufacturers switch to machine power within a 3-year period from 2021, or if they use human and machine power as a hybrid, they will be able to amortize their machine costs 1 or 2 years later.

Material and Method

The data of the Turkish Statistical Institute (TurkStat) were used for annual worker wages and annual inflation data used in the study. In addition, domestic and foreign internet resources were used for the annual average wages of the hoe and apricot machines. General inflation changes and possible worker expenditures for the producer in Apricot production were forecasted from 2020 to 2024 by Minitab program – QTA and EGM analyze. QTA is generally a non-linear statistical forecast technique for the future, and it was thought that using this method would give more ideal results, especially in case of Turkey's economic conditions, past economic trends and the possible continuation of today's possible economic variables in the future. In QTA, quadratic trend tests are performed to determine the coefficients of orthogonal polynomials and the possible future figure. Thus, the continuity course is determined according to the trend of the data. QTA is used as a regression equation and this equation is Eq.1;

$$Y_t = b_0 + b_1 t + b_2 t^2 \quad \text{(Eq.1)}$$

here b_0; intercept, b_1 and b_2 ; 1st and 2nd time variables, respectively; and t is time (Khan et

al., 2003; Costamagna et al., 2007; Abid et al., 2014).

Another method most commonly used in time-series analysis is EGM. In general, this method can give accurate forecast results when there is a tendency to continuously increase or decrease continuously in a series. The EGM formula is Eq.2 (Khan et al., 2003; Costamagna et al., 2007; Abid et al., 2014);

$Y_t = b_0 + e^{b1t}$ (Eq.2)

here b_0 is for intercept, b_1 is for time variable and t is the time. In order for the forecasts made as a result of trend analysis to be closer to reality, it is desirable that the historical data be in longer series. But in conditions where this is not possible, short-term data can be made more regular by the Double Exponential Smoothing (DES) method in order to equalize the data fluctuation and obtain results closer to reality (Costamagna et al., 2007; Abid et al., 2014). The data used for the years 2005-2020 have been generally accepted as short-term data and the DES method was applied in order to deal with some fluctuations in the inflation data, and then estimate analyses have been carried out with QTA or EGM. The main purpose of choosing next 3-year periods in both estimation analysis methods is that the data obtained in the past periods are defined as short-term intervals. In other words, data from 2005 or earlier periods must be found in order to carry out a longer-term forecasting study.

The numerical data obtained from the analysis were evaluated to compare the accuracy of the periodic forecasting analyses. These data are respectively Mean Absolute Percentage Error (MAPE), Mean Absolute Deviation (MAD) and Mean Squared Deviation (MSD). The MAPE, MAD and MSD data are important for metric evaluations in the forecasts, and the analysis method with the smaller of these three values is preferred for a more consistent estimation (McKenzie, 2011; Konarasinghe, 2016; Khair et al., 2017).

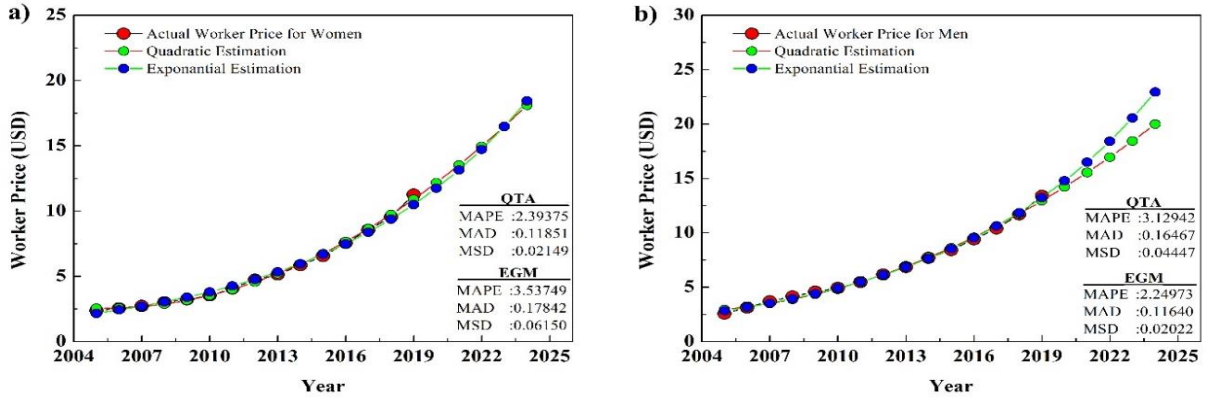

Figure 1. QTA and EGM analysis results applied to daily wages for seasonal workers. a) Female worker wage analysis, b) Male worker wage analysis.

Results and Discussion

In the first stage of the study, time-dependent change analyzes were made on the daily working wages of male and female workers. As a result of the graphic analysis of these values, which were determined depending in the years, it was determined that they were in the process of continuous increase at certain rates every year. In the second stage, using QTA and EGM methods, a total of 4 years from 2020 and a total of 3 years from now on, were analyzed. The use of two different forecast analysis methods was made to obtain more realistic estimation results.

Table 1 shows the values of the data visually given in Figure 1. Especially when we look at the data for 2019, while the daily wage for female workers is 11.26 USD, this value was forecasted as 10.9 and 10.49 USD in the QTA and EGM analyzes, respectively. When male worker wages are analyzed, the value which was 13.39 USD according to 2019 data was forecasted as 12.94 and 13.23 USD in QTA and EGM analyzes, respectively. Accordingly, within the scope of 2019 data, QTA and EGM forecast results are too close to the actual values. Also, according to the results of trend analysis in Figure 1, MAPE, MAD and MSD values for QTA and EGM were compared. Since the values obtained from the two analyzes are very small and close to each other, there is no any obstacle to using these two methods in the forecasting. The wages of male workers in 2024 are expected to be 19.99 USD according to the QTA result, it is expected to be 22.94 USD according to the EGM result. While the wages of women workers are expected to be 18.10 USD according to the QTA results, it is expected to be 18.44 USD according to the EGM results.

Table 1. Seasonal worker wages and QTA and EGM analysis results.

Years	Daily Worker Price for Men (USD)	QTA for Men (USD)	EGM for Men (USD)	Daily Worker Price for Men (USD)	QTA for Women (USD)	EGM for Men (USD)
2005	2.57	2.95	2.83	2.37	2.55	2.16
2006	3.13	3.18	3.16	2.55	2.57	2.42
2007	3.70	3.50	3.53	2.73	2.67	2.71
2008	4.15	3.88	3.94	3.02	2.87	3.04
2009	4.58	4.34	4.40	3.23	3.16	3.40
2010	4.93	4.87	4.91	3.53	3.53	3.80
2011	5.47	5.47	5.49	4.06	3.99	4.26
2012	6.17	6.15	6.12	4.74	4.55	4.77
2013	6.84	6.90	6.84	5.13	5.19	5.33
2014	7.69	7.73	7.63	5.84	5.92	5.97
2015	8.41	8.62	8.52	6.55	6.74	6.68
2016	9.40	9.59	9.51	7.55	7.65	7.48
2017	10.40	10.64	10.62	8.55	8.64	8.38
2018	11.68	11.75	11.85	9.55	9.73	9.38
2019	13.39	12.94	13.23	11.26	10.90	10.49
2020		14.21	14.77		12.17	11.75
2021		15.54	16.49		13.52	13.15
2022		16.95	18.41		14.96	14.72
2023		18.44	20.55		16.49	16.48
2024		19.99	22.94		18.10	18.44

In the second stage of the study, it was aimed to determine the economic benefit of using the machine power. The machine power also benefits to accelerate apricot production with low cost and to harvest in a short time. A general internet search was conducted for the apricot harvester machine and it was determined to cost an average of 342 USD as of 2020 prices (Kadmec, 2021). On the other hand, the cost of the hoeing machine was investigated in order to enable the apricot harvesting machine to move easily on the soil. The main reason for supplying a hoe in this section is to obtain high traction power with low cost. In the internet research, the cost of a 7 HP gasoline hoe machine is calculated as 512.95 USD in 2020 prices (Capa, 2021). It has been determined that if the hoe machine and the apricot harvester are supplied together, a total cost of 854.95 USD will be incurred for the producer.

Although the future forecasts will be made within the scope of the trend analysis, it is known that the prices for the hoe and apricot machine generally vary according to the Consumer Price Inflation (CPI). In this context, the inflation forecasts until 2024 were made based on the consumer inflation rates of previous years.

Figure 2 shows the annual inflation forecast for the period until 2024, based on the inflation data for the years 2005-2019. At the first stage, when the 2005-2019 data (red dots) were included in the trend analysis as raw data, it was determined that

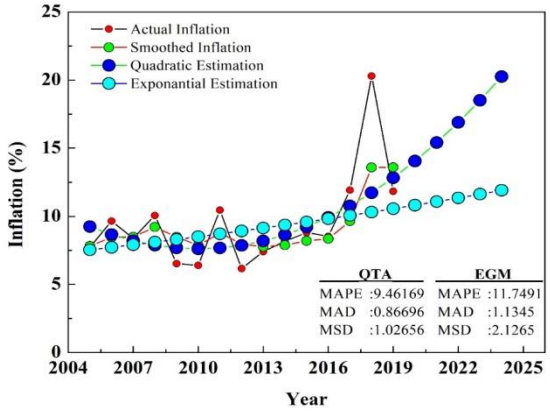

Figure 2. Inflation forecast data until 2024 based on QTA and EGM analysis.

the results obtained for the period until 2024 were not realistic. Due to the inflation data reaching 45%, the Double Trend Smooth (DES) method was first used on the raw data, and then QTA and EGM analyzes were performed (Adamuthe et al., 2015). As it is known, the inflation data can vary depending on both economic and non-economic conditions (political, health, disaster, etc.). Although Turkey's geopolitical and political stability affects its inflation stability, and also, today's health disaster, the Covid-19 process, affects the countries as inflation variability.

Table 2. Annual inflation data and QTA and EGM analysis results.

Years	Actual Inflation (%)	Double Trend Smooth (%)	QTA (%)	EGM (%)
2005	7.72	7.83	9.24	7.54
2006	9.65	8.45	8.66	7.72
2007	8.39	8.49	8.20	7.91
2008	10.06	9.21	7.88	8.10
2009	6.53	8.49	7.68	8.30
2010	6.40	7.86	7.61	8.50
2011	10.45	8.78	7.68	8.71
2012	6.16	7.97	7.87	8.92
2013	7.40	7.77	8.19	9.14
2014	8.17	7.88	8.64	9.36
2015	8.81	8.20	9.22	9.59
2016	8.53	8.35	9.93	9.82
2017	11.92	9.65	10.77	10.06
2018	20.30	13.59	11.73	10.31
2019	11.84	13.59	12.83	10.56
2020			14.05	10.82
2021			15.41	11.08
2022			16.90	11.35
2023			18.51	11.63
2024			20.25	11.91

When Table 2 and Figure 2 are analyzed together, it is seen that the inflation data for 2019 after DES are close to the QTA and EGM forecasts. While the inflation rate in 2019 was 11.84%, this rate was forecasted as 12.83% and 10.56% in the QTA and EGM analyzes, respectively. While the accuracy rate was calculated as 91.6% with the QTA method, this rate was calculated as 89.2% with the EGM method. Although the values are close to each other, the QTA method data seems closer to reality in terms of trend analysis. The differences in the MAPE, MAD, and MSD values compared in both methods are support the ideal forecast results. However, a detail that should be known is that inflation data may vary for countries depending on both internal and external factors. In this case, the inflation values that can be obtained for the future may reach higher levels. However, when the general conditions of today's Turkey (Health, political, economic, foreign relations, etc.) are examined, in the QTA and EGM forecasts, it seems inevitable that inflation will continue its upward trend.

In terms of the integrity of the study, after the inflation forecasts were created until 2024, the total cost of the hoe and apricot machines was calculated according to annual inflation values. The total machine cost trend according to 2020-2024 QTA and EGM inflation forecasts is given in Figure 3.

In Figure 3, two different trend formations are seen according to QTA and EGM analyzes according to 2020 price lists. In particular, according to the inflation data obtained with QTA, a total machine fee of 1643.72 USD is expected to be paid in 2024. This situation is calculated as 1320.90 USD according to EGM inflation forecasts.

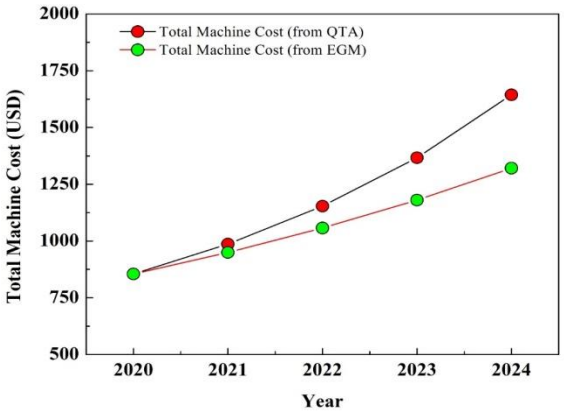

Figure 3. Total machine costs until 2024.

In this context, the current situation has been revealed by evaluating the analysis results and calculations (worker wages, inflation data and total machine costs). In this part of the study, for the main purpose, the process of determining has been started that how many years the worker wages costs will depreciate the machine costs. Because of that the forecasts of how long the worker's wages can be amortized depending on the machine costs is again compared separately according to the QTA and EGM data, and shown in Figure 4 and Figure 5.

Figure 4 shows the comparison of workers' wage cost, machine cost, and worker+machine costs between 2020-2024 according to QTA forecast values. In terms of worker wages, the total harvest time is assumed to

be 10 days. In addition, 2 male and 2 female workers working per day were taken into account. In machinery expenditures, only the total machine cost and machine +1 female job +1 male worker cost were calculated on a yearly basis. In this context, considering the payments to be made to the workers as of 2020, it is seen that the 2020-2021 payments exceed the machine wage in total, and the total payment to be made in the years 2020-2022 again exceeds the machine + worker wage. In other words, if machine power is used from 2020, only machine wages can be amortized within 1 year, while worker+machine wages can be amortized within 2 years. This situation is also seen as a result of the analyzes based on the EGM estimates given in Figure 5.

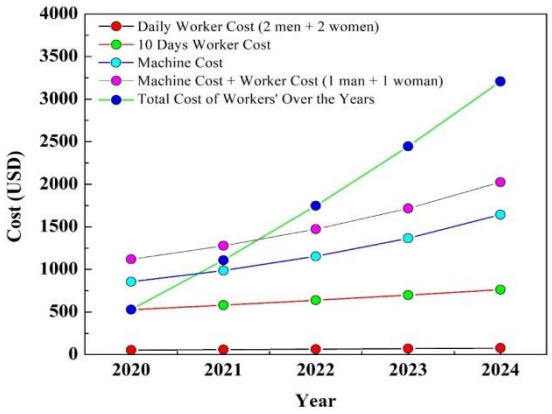

Figure 4. Amortization comparison to QTA worker and machine wages forecasts.

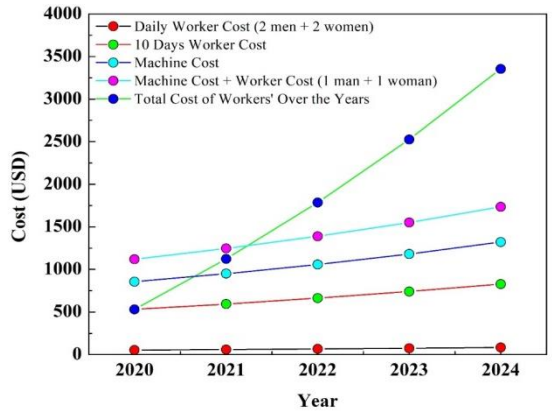

Figure 5. Comparison of amortization against EGM worker and machine wages forecasts.

Comparison of amortization after EGM forecasts was obtained again similar to QTA data. Within the scope of each forecast analyzes, it shows that apricot producers will start to make profits by amortizing their machine fees after 3 years on average. Moreover, besides the economic profit, the producer will also save time by shortening the harvest time.

Conclusion

Within the scope of the study, using QTA and EGM methods, seasonal workers' annual wages and inflation changes were forecasted. Depending on the inflation change, the prices of the hoe and apricot machines have been successfully analyzed for the period 2020-2024. It was determined that the worker wage forecasts were at the closest levels to the actual values according to the MAPE values. In the inflation data, due to the economic fluctuation in 2018, the DES method was applied and then QTA and EGM analyzes were made. Machine prices were calculated based on inflation data. Finally, the annual costs of worker wages and machine costs were calculated. According to the results obtained, the machine fee is amortized in 1 year only with the use of the machine, and in 2 years with the use of 1 man and 1 woman worker, and then the manufacturer makes an economic profit. As a result, it has been determined that all apricot producers across Turkey can profit both in terms of money and time with the use of simple machine power. In addition, by reducing the use of workers, it will be possible to prevent the spread of the Covid-19 epidemic by preventing worker mobility.

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