Determination of effective factors and profitability on quince farmers in Turkey

Reception of originals: 12/04/2020
Release for publication: 06/30/2021

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Abstract

This study aims to determine effective factors in Turkey in the growing of quince and profitability. The primary material of the study was the data obtained by the survey method from 204 farmers in the districts and villages of Sakarya, Bursa, Antalya, Bilecik and Denizli, where quince growing is carried out intensively. The data used in the study were for the 2014 production period. Factors affecting quince growing were determined by factor analysis. Tobit and linear models were used to determine the factors affecting relative profitability. According to the results of factor analysis, effectual factors in quince growing; experience, sustainability, support and organisation, informatics, input, public extension activities, marketing structure. Based on Tobit model, the variables affecting the relative profitability of quince growing in the region; sustainability, marketing structure, quince growing system, indebtedness status in the last five years, frequency of following agricultural fairs. According to the linear model; It was determined that the variables of marketing structure, quince farming system, sustainability and frequency of newspaper reading were statistically significant. Thus, according to models of which were essential parameters for the development of the production obtained variables, quince and policymakers/decision-makers can bring about improvements in Turkey is advisable, quince production improvements at this point. Just in case the gains to be made by policymakers/decision-makers can be achieved improvements quince production in Turkey.

Key words*:* Quince, Profitability, Relative profit, Factor analysis, Tobit model, Turkey.

1. Introduction

Quince belongs to the genus *Cydonia of the Rosaceae* family. The cultivated species is *Cydonia oblongo Mill* (Soylu and Ayfer, 2003.). Quince is a fruit species that can be grown in

almost every region of Turkey (Büyükyılmaz, 1999). Turkey, according to data from 2018, production with 176 479 tonnes and 19 014 tonnes of quince and exports are in first place in the world (FAO, 2020).

Quince can grow in almost every region of Turkey. It is important to increase production in terms of added value since it ranks first in production and exports in the world. Gül and Akpınar (2006), examined developments in Turkey fruit production during the period 1961-2004. In the period, they found that quince production showed significant improvement due to the increase in planted areas. Turkey ranked first in the world quince production, in the 2000s, the share over 24% (Gül and Akpınar, 2006) and was 22% in 2010s (Şirikçi and Gül, 2017). Therefore, Turkey has decreased its share in the world production of quince. Turkey ranks first in the world quince exports. Turkey's share is over 40% in world exports quince in the 2000s, (Akpınar et al., 2006). It was 39% in the 2010s (Şirikçi and Gül, 2017). However, Turkey has decreased the share of exports in the world quince production. More than 5% of the quince production was exported in the 2000s (Akpınar et al., 2006), in the 2010s, 9% was exported (Şirikçi and Gül, 2017).

Farmers are essential stakeholders in terms of increasing production. Many variables can affect farmers' quince growing activity. In this study, it was tried to determine what the variables affecting the quince growing activity and to what extent these variables were influenced by factor analysis, which is frequently used in the field of agricultural economics. Economic research on quince growing in the world and Turkey is extremely scarce. Therefore, there is a lack of literature on the economy of the quince product. Specific to quince, there is no study on the factors affecting the growing and profitability. These factors were also influential in making this study.

In this study, we aimed to determine the effective factors in quince production and the socio-demographic characteristics that affect the relative profitability of farms.

2. Literature Review

According to FAO estimates, the majority of agricultural enterprises, which number more than 500 million worldwide, are small-scale, in the form of family farms. The classic aim of farms is to make a profit. The concept of sustainability of production also began to be focused on in the 1990s. In this study, we aimed to determine the profitability of quince farm and the factors that were effective in its production. As a result of the literature study, it is seen that studies in which quince cultivation is evaluated in economic terms throughout the

world are incomplete. There are also limited economic studies on this issue at the national level. The work done at the international level is summarised below.

Milic et al. (2010), in Serbia, examined the production characteristics and economic aspects of quince. They found that the installation period of quince is two years, the economic life is 45 years, and the transition to full efficiency is five years old, the cost of the facility is 3630 euros per hectare. In quince production, they determined that the cost of planting accounted for 41.1% of the cost (a sapling, marking, digging the pit of saplings, first watering). They found that the yield per hectare is 35000 kg, the sale price of kg is 0.35 euros, the cost of production per hectare is 3675 euros, and the net profit per hectare is 8580 euros.

Şirikçi and Gül (2019) determined the cost and profitability of quince cultivation in Turkey. They calculated gross production value, production cost, and absolute profit as 50829.1 TRL, 29651.1 TRL and 19363.6 TRL per hectare, respectively.

Akpinar et al. (2018) identified factors affecting the profitability of buffalo farms using Tobit and linear model.

There were various studies apart from quince, which determines the criteria affecting farmers' product decision by Factor Analysis. For example, Dağıstan et al. (2008) determined the influential factors on sheep farms, Mutlu Çamoğlu and Saka (2012) on hazelnuts exporters, Akpinar et al. (2018) on buffalo farms.

Therefore, with this study, we determined the factors that were effective in quince farm's profitability and production and tried to develop recommendations on its sustainability.

3. Materials and Methods

3.1. Materials

The primary material of this research was the data obtained by the survey method from the quince producing farmers in the districts and villages where quince production is intensely made in the provinces of Sakarya, Bursa, Antalya, Bilecik and Denizli. The data used in the study were for the 2014 production period. We selected quince producers in Geyve, and Pamukova districts in Sakarya, Gürsu, Kestel, Osmangazi districts in Bursa, Korkuteli district in Antalya, Honaz, Merkezefendi, Pamukkale districts in Denizli, Osmaneli district in Bilecik province as the main mass.

It was calculated that 204 farmers would be interviewed by the stratified sampling method in the provinces mentioned above that make up the research area. A face-to-face survey study was conducted considering the quince production shares of the provinces, with

98 farmers in villages of Pamukova and Geyve districts of Sakarya province, with 37 farmers in villages of Gürsu, Osmangazi, Kestel districts of Bursa province, with 33 farmers in villages of Korkuteli district of Antalya province, with 21 farmers in villages of Osmaneli district of Bilecik province, with 15 farmers in villages of Merkezefendi, Pamukkale and Honaz districts of Denizli province.

Research region constituted 68.5% of the total quince planted area in Turkey, according to data from 2019. Its production share was 73.0% of the quince production (TURKSTAT, 2020). The provinces that make up the research area were given in Figure 1.

Figure 1: Research region
Source: MAP, 2016.

3.2. Methods

Factor analysis was used to determine the factors affecting quince growing in enterprises. Factor analysis is one of the widely used multivariate statistical techniques that make many interrelated variables less significant and independent factors (Kalaycı, 2006). The extent to which the explanatory variables are suitable for analysis in factor analysis is measured by the Kaiser-Meyer-Oklin (KMO) test. The KMO sampling adequacy criterion is an index used to compare the size of the observed correlation coefficients with the size of the partial correlation coefficient. It is stated that as the KMO value decreases, the applicability of the factor analysis technique decreases. According to this, KMO value at 0.90 is considered to be very perfect, good at 0.80, medium at 0.70, low at 0.60, very bad at 0.50 and unacceptable at 0.50 (Joseph et al., 1992). The main criteria taken into account when deciding on the number of factors are the eigenvalue and variance criteria. In practice, factors with eigenvalues above one are selected. In the variance criterion; the cumulative variance value is

checked, and the last cumulative variance value is expected to explain the factors created adequately. The element of commonality gives the variance of any variable defined by all factors. The component of commonality and cumulative variance are high show that the model and data are sufficiently suitable (Ness, 2000).

The Tobit model was used to determine how the socio-economic and demographic characteristics of the producers are useful on the relative profitability of the subsidies. The Tobit model developed by James Tobin in the 1950s is an extension of the Probit model. It is a nonparametric alternative to least squares regression (Liao, 1994). Tobit model is a model that deals with limited dependent variables (Tobin, 1958). This model is also called censored or discrete regression models (Amemiya, 1984; Gujarati, 2004).

4. Results and Discussion

4.1. Factors affecting farmers' quince growing

In the study, factors with an eigenvalue above one were selected in determining the number of factors (Table 2). In the study, the analysis was made using 44 variables that have properties that can affect the quince growing of the farmers (Table 1). Then, factor loadings of the determining factors were determined by using "varimax rotation solution technique". The results of the analysis were evaluated, considering the variables with a factor load of over 0.50. Here, it was aimed to reveal the attitude of the farmer by examining the factors affecting the quince growing of the producers. The average value of the Kaiser-Meyer-Olkin test (KMO) was 0.68. This showed that the variables used were applicable for factor analysis (Table 2).

Table 1: Variables and properties used in the factor analysis

Variables	Description	Explanation
s2_yas	Farmer age	Continuous variable
s2_ciftcilikyil	Farming experience	Continuous variable
s2_ayvacilikyil	Quince growing experience	Continuous variable
s2_bilgisayar	Computer presence at home	Continuous variable
s2_internet	Internet presence at home	Continuous variable
s3_bilgisayarbilgi	Computer usage information	Ordinal variable
s3_interntbilgi	Internet usage information	Ordinal variable
s42_3_girdi	Participation status to high input prices	Ordinal variable

s42_5_tarimdestek	Adequacy status of supports for agriculture	Ordinal variable
s42_7_ayvadestekkarar	The effectiveness of supports for quince growing in production decision	Ordinal variable
s42_8_ayvadestekdevamlilik	The effectiveness of supports for quince growing in production continuity	Ordinal variable
s42_9_ayvadestektüm	The status of farmers utilisation from the support for quince growing	Ordinal variable
s42_10_ayvaaltyapi	The competence of the farm infrastructure for quince growing	Ordinal variable
s42_13_ayvapazarluretim	The effect of marketing of quince products on production	Ordinal variable
s42_15_orgutyet	Organisational qualification status in quince growing	Ordinal variable
s42_16_orgutonem	Organisation importance status in quince growing	Ordinal variable
s42_17_pazarlorgutonem	Organisation importance status in quince products marketing	Ordinal variable
s42_19_tarimteskilatıbilgi	Providing sufficient information support of the agricultural organisation in quince growing	Ordinal variable
s42_22_iklimdegisikligi	The impact of climate change on quince growing	Ordinal variable
s42_27_onemligecim	The status of quince growing as an important source of income in the region	Ordinal variable
s42_28_kazanc	The status of quince growing being a lucrative activity	Ordinal variable
s45_universite	Benefiting from universities in quince growing and marketing	Ordinal variable

Table 2: KMO and Bartlett's test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.68
Bartlett's Test of Sphericity	Approx. Chi-Square	2890.54
	df	231
	Sig.	0.00

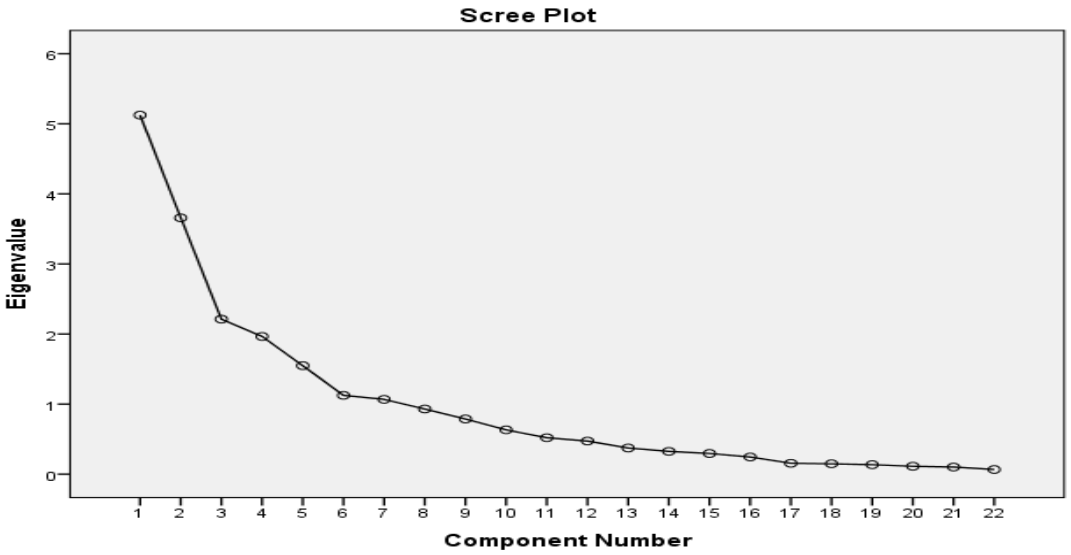

Figure 2: Scree plot of factors affecting quince growing

Figure 2 showed that the graph of seven factors, which are useful in quince growing after factor analysis, with eigenvalues above 1.00.

Factor analysis in the initial solution; considering the eigenvalue, variance and additive variance criteria, it was decided that seven factors were sufficient. These seven main factors explained 75.90% of the variance. These seven factors explained 23.29%, 16.63%, 10.05%, 8.93%, 7.04%, 5.11%, and 4.85% of the total variance, respectively (Table 3).

Table 3: Factor analysis initial solution results

Total variance explained

Component	Initial eigenvalues			Extraction sums of squared loadings			Rotation sums of squared loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.12	23.29	23.29	5.12	23.29	23.29	3.36	15.28	15.28
2	3.66	16.63	39.92	3.66	16.63	39.92	3.09	14.03	29.31
3	2.21	10.05	49.97	2.21	10.05	49.97	3.03	13.76	43.07
4	1.97	8.93	58.90	1.97	8.93	58.90	2.18	9.91	52.98
5	1.55	7.04	65.94	1.55	7.04	65.94	2.13	9.68	62.67
6	1.12	5.11	71.05	1.12	5.11	71.05	1.64	7.48	70.14
7	1.07	4.85	75.90	1.07	4.85	75.90	1.27	5.76	75.90

Factor analysis rotation results were obtained according to the varimax method. Among the variables, those with a factor load of 0.5 and above were taken into consideration (Table 4).

Table 4: Rotated component matrix

	Component						
	1	2	3	4	5	6	7
s2_yas	**0.85**	-0.12	-0.05	-0.01	0.08	-0.08	0.03
s2_ciftcilikyil	**0.92**	-0.04	-0.01	-0.06	0.04	0.00	-0.01
s2_ayvacilikyil	**0.86**	0.04	-0.04	-0.01	0.00	-0.05	0.06
s2_bilgisayar	0.08	-0.08	-0.06	**0.91**	-0.01	0.07	-0.03
s2_internet	0.11	-0.05	-0.07	**0.91**	-0.05	0.05	0.06
s3_bilgisayarbilgi	-0.70	0.04	-0.04	-0.45	0.01	0.03	0.17
s3_interntbilgi	-0.69	-0.02	-0.04	-0.44	0.01	0.00	0.13
s42_3_girdi	-0.01	-0.06	0.28	0.02	**0.82**	0.17	0.17
s42_5_tarimdestek	-0.09	-0.06	-0.17	0.06	**-0.88**	0.13	0.06
s42_7_ayvadestekkarar	-0.02	0.14	**0.78**	-0.11	0.31	0.30	0.03
s42_8_ayvadestekdevamlilik	-0.04	0.11	**0.69**	-0.08	0.23	0.49	-0.15
s42_9_ayvadestektüm	-0.10	**0.80**	0.12	0.02	-0.11	0.05	-0.22
s42_10_ayvaaltyapi	-0.05	**0.74**	0.31	-0.08	0.05	0.17	-0.11
s42_13_ayvapazarluretim	-0.05	-0.13	0.09	-0.02	0.05	0.20	**0.80**
s42_15_orgutyet	-0.09	-0.21	**-0.74**	0.18	-0.03	0.41	0.11
s42_16_orgutonem	0.04	**0.64**	0.28	-0.04	-0.03	-0.14	0.44
s42_17_pazarlorgutonem	-0.03	0.30	**0.76**	0.04	0.16	-0.07	0.17
s42_19_tarimteskilatıbilgi	-0.08	0.04	0.02	0.11	-0.09	**0.88**	0.18
s42_22_iklimdegisikligi	-0.09	0.25	**0.64**	0.09	0.05	-0.06	0.38
s42_27_onemligecim	0.00	**0.79**	0.24	-0.15	0.07	0.02	0.04
s42_28_kazanc	-0.06	**0.62**	-0.09	0.10	0.44	-0.26	0.12
s45_universite	-0.12	-0.44	-0.14	0.14	**-0.51**	0.39	0.15

According to their values, these variables were named. These seven main factors are; experience, sustainability, support and organisation, informatics, input, public extension activities, marketing structure.

Factor 1: Experience

This factor was explained 23.29% of the total variance. The age of the farmer is related to his farming experience and his experience in quince farming. In quince farming activity, the age of the farmer and the period of experience are essential in the continuity and sustainability of the growing. Besides, it was determined as an indicator that the selection of the aquaculture system was effective in decision making (Table 4).

Factor 2: Sustainability

The second important factor in quince growing is the sustainability factor that explains 16.63% of the total variance. We found the variables defining the sustainability factor; the status of the regional producers to benefit from the supports for quince and the support of infrastructure were found to be essential variables in terms of the continuity of the product. Also, we determined that quince production is an important source of livelihood and profitable activity in the region are important criteria for the continuity of growing (Table 4).

Factor 3: Support and Organisation

This factor could explain 10.05% of the criteria that affect the quince growing of the farmers. Not only this factor was a factor affecting the production decision and sustainability of the support given to the producers by the Ministry of Agriculture and Forestry in quince growing, but also it was an indication of the importance of organisation in quince marketing. A negative correlation was also found for the adequacy of agricultural organisation in this factor. (Table 4).

Factor 4: Informatics

According to the analysis results, the fourth factor that is effective in quince growing can be expressed as informatics. Information technologies such as computers and the internet, which have an important place in daily life and are continually developing, were determined to be effective in quince growing. A tight correlation was found between this factor and computer and internet ownership. The factor could explain 8.93% of the total variance. There

was a weak negative correlation between the computer and internet usage information criteria and the informatics factor (Table 4).

Factor 5: Input

Another critical factor in the quince growing of the farmers is the input factor. Fertiliser and pesticide are essential to cost elements in quince growing. Indirectly, fuel is one of the most important input items. Therefore, high input prices affect production decision. A high correlation was found between this factor and high input prices. It was explaining 7.04% of the total variance (Table 4).

Factor 6: Public extension activities

According to the factor analysis findings, the sixth factor effective in quince growing is the public extension. The T.R. Ministry of Agriculture and Forestry manages and implements many public extension service activities for producers, such as expanding the use of new agricultural techniques - technology in agriculture, engaging in activities to increase crop - animal production, creating new market opportunities, and leading the organisation of promotional activities related to crop - animal production. At the same time, they have to inform the producer about these activities. A high correlation was found between the availability of sufficient information support of the agricultural organisation for quince growing in the region and public extension service. This factor could explain 5.11% of the total variance. (Table 4).

Factor 7: Marketing structure

The seventh factor was marketing structure. One of the most important factors in terms of the sustainability of agricultural production was the marketing of the product. The marketing structure of the quince was a factor that affects the quince growing. It was explained 4.85% of the total variance (Table 4).

4.2. The factors affecting the profitability of farmers in quince growing

The socio-demographic characteristics of the interviewed farms and the effect of supports on the profitability of quince growing were analysed using the Tobit model. Accordingly, the data were analysed by adding the socio-demographic characteristics and benefiting from the supplements variables, in addition to the factor analysis results that emerged in determining the effective factors in the quince growing farms. The dependent and explanatory variables used in the model, and the explanations of the variables were given in Table 5.

Table 5: Variables and properties used in Tobit and linear model

	Description	Explanation
Dependent variable		
Y	Relative profit	Continuous variable
Explanatory variables		
F2	Sustainability	Continuous variable
F7	Marketing structure	Continuous variable
X_1	Quince growing system	1=Classic, 2=GAP, 3=Modern, 4= Organic
X_2	Indebtedness in the last five years	1=Decrease, 2=Same, 3= Increase
X_3	Agricultural fair follow-up frequency	Ordinal variable
X_4	Newspaper reading frequency	Ordinal variable

In the model, the relative profits (R.P.) of farms in quince growing were taken as the dependent variable. Explanatory variables were sustainability factor, marketing structure factor, quince growing system, indebtedness status in the last five years, frequency of following agricultural fairs. In the estimated model, the relative profitability of the farms obtained from the quince production activity was defined as the dependent variable. The model can be expressed as

RP = f (F2, F7, X_1, X_2, X_3). The factors affecting the quince growing farms obtained by factor analysis, (sustainability and marketing structure factors) were used as explanatory variables in the analysis of the Tobit model (Table 6).

According to the analysis results, the F7 variable was found to be statistically significant at a 1% significance level on the dependent variable of profitability in quince

growing. A positive relationship was found between the profitability dependent variable and the F7 variable. At this point, improvements in the F7 (marketing structure) factor will positively affect the relative profit in quince growing (Table 6).

The X_1 variable is also statistically significant at 1% significance level on relative profitability in quince growing. However, it has a negative effect. This situation showed that moving towards the modern/organic system in the quince growing system (1 = Classic 2 = Good agriculture 3 = Modern 4 = Organic) will decrease their relative profitability (Table 6).

A statistically significant relationship at a 5% significance level has emerged between X_2 (indebtedness in the last five years) and relative profitability. Therefore, with the increase in debt during the previous five years, the relative profitability indicator of the enterprise will increase in quince growing (Table 6).

On the other hand, there is a negative relationship between the relative profit dependent variable and the F2 (sustainability) independent variable at the 5% significance level. Based on this finding, it can be stated that improvements in the F2 (sustainability) factor may reduce their relative profitability (Table 6).

A 10% negative relationship was found between the relative profit dependent variable X_3 (frequency of agricultural fair follow-up) that the farmers obtained from the quince production activity. Accordingly, it can be concluded that if the frequency of tracking agricultural fairs increases, the relative profitability in quince growing will decrease (Table 6).

Table 6: Tobit model results

	Coefficient	Std. Error	z	P
C***	1.489704	0.289901	5.138672	0.0000
F2**	-0.165622	0.076036	-2.178220	0.0294
F7***	0.201857	0.069184	2.917664	0.0035
X_1***	-0.300591	0.091085	-3.300100	0.0010
X_2**	0.263140	0.107329	2.451706	0.0142
X_3*	-0.068387	0.040055	-1.707330	0.0878
	Error Distribution			
SCALE:C(7)	0.969174	0.047981	20.19905	0.0000
R-squared	0.110064	Mean dependent var		1.649841
Adjusted R-squared	0.082959	S.D. dependent var		1.029099
S.E. of regression	0.985489	Akaike info criterion		2.843881
Sum squared resid	191.3240	Schwarz criterion		2.957738
Log-likelihood	-283.0759	Hannan-Quinn criteria.		2.889939

Avg. log-likelihood	-1.387627			
Left censored obs	0	Right censored obs		0
Uncensored obs	204	Total obs		204

*****:**%1 level of significance, ****:**%5 levels of significance, ***:**%10 levels of significance

In the linear model, the relative profits of the farms in quince growing were taken as the dependent variable. Sustainability, marketing structure, quince growing system, debt status in the last five years and newspaper reading frequency were taken as explanatory variables. The calculated model can be written as:

RP = 1.215 - 0.301 QPT + 0.188 QMS + 0.279 QDS -0.159 QS +0.076 QNW (Table 6).

The model, with a corrected R^2 value of 0.087, was decided to be significant (Fcalculate> Fscale value; 4.858> 2.21). According to the analysis results, it was determined that the variables of sustainability, marketing structure, debt status, newspaper reading frequency, quince growing system were statistically significant on profitability in quince growing (Table 7).

The variables of the farmer's quince growing system and marketing structure were statistically significant at a 1% significance level. However, the quince farming system was a negative effect on profitability. In other words, production other than conventional production would be to decrease the relative profitability of the farmer. If the farmer is engaged in organic production, the relative profitability of the farmer will decrease by 1,204 units. Besides, the fact that the quince farming system was modern/organic will reduce their relative profitability. On the other hand, one unit of improvement in the marketing system would be to increase its relative profitability by 0.188 units (Table 7).

There was a statistically significant relationship at the 5% significance level between the indebtedness of the farmer, sustainability variables and relative profitability. There was a positive relationship between the relative profit dependent variable and the independent variables of debt. Therefore, the increase in the indebtedness of the farmer in the last five years would be to increase the relative profitability indicator of the enterprise in quince growing by 0.837 units. However, there was a negative relationship between the relative profit and sustainability in quince growing. Based on this finding, it can be stated that increasing sustainability may decrease their relative profitability (Table 7).

There was a positive relationship between the relative profit obtained by the farmer from the quince production activity and the frequency of newspaper reading of the farmer.

Accordingly, increasing the frequency of newspaper reading might be to increase the relative profitability in quince growing by 0.076 units (Table 7).

Table 7: Linear model results

	B	Std. Error	t	Sig.
Constant	1,215	0,306	3,967	0,000
X_1***	-0,301	0,092	-3,254	0,001
F7***	0,188	0,070	2,697	0,008
X_2	0,279	0,109	2,562	0,011
F2**	-0,159	0,077	-2,074	0,039
X_4*	0,076	0,044	1,720	0,087

***:%1 level of significance, **:%5 levels of significance, *:%10 levels of significance

5. Conclusions and Recommendations

Influential factors in quince growing farms, according to the results of factor analysis were experience, sustainability, support and organisation, informatics, input, public extension, marketing structure.

Factors affecting the relative profitability in quince growing in the region were sustainability, marketing structure, quince growing system, indebtedness status in the last five years, frequency of following agricultural fairs. According to the linear model, it was determined that the quince growing system and the frequency of newspaper reading were statistically significant on profitability in quince growing farms. Therefore, it was determined that the variables obtained from the models were essential parameters for the improvement of quince production. Improvement in quince production can be achieved with the furtherances of policymakers/decision-makers at this point.

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7. Acknowledgement

This work is part of Bekir Sıtkı Şirikçi's MSc. Thesis. This thesis was supported by Süleyman Demirel University Scientific Research Projects Management Unit with 4153-YL1-14 project number.