

Socio-Economic Factors Affecting The Adoption of Some New Production Techniques in Fruit Production in Turkey: A Case Study of Isparta Province

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Abstract

Fruit growing is an important branch of agricultural production in Turkey. Isparta province has an essential place in fruit growing in the country. Unlike the case in Turkey in general, the fruit production of the province is performed in orchards and its infrastructures for fruit processing and storage are quite advanced. However, the problems of yield and quality lead to the failure to utilize the existing potential. In the previous studies, these problems were discovered to be because the innovations providing increases in yield and quality in fruit growing were not adopted by the farmers. The effects of some socio-economic factors on the adoption of the yield- and quality-increasing innovations by the fruit growing farms in Isparta province were investigated in this study. The data were obtained through the questionnaires carried out with 111 fruit growing farms between December 2011 and February 2012. In the study, whereas the using drip irrigation method and having leaf & soil analyses made are taken as dependent variables and education, age, population, experience, agricultural income, area, and the number of visits to agricultural establishments are taken as the independent variables and the Logit Regression Analysis, one of the multivariate statistical analysis methods, was used. According to the results of the logit regression model, none of the factors addressed in the use of clonal rootstocks and application of integrated control methods by the fruit farmers in Isparta province were found effective. Of the factors considered, the farm area and their visits to agricultural establishments were found to have a significant and positive effect but population was found to have a significant and negative effect on farmers' having leaf&soil analyses made, while only agricultural income was found to have a significant and positive effect on their use of the drip irrigation method in irrigation.

Keywords: Drip irrigation, leaf-soil analyze, logit model.

Türkiye’de Meyve Üretiminde Bazı Yeni Üretim Tekniklerinin Benimsenmesini Etkileyen Sosyo-Ekonomik Faktörler: Isparta İli Örneği

Öz

Meyvecilik, Türkiye’de önemli bir tarımsal üretim dalıdır. Isparta ili ülke meyveciliğinde önemli bir yere sahiptir. İlin meyve üretimi, Türkiye genelinin tersine kapama bahçelerde yapılır ve meyve işleme, depolama altyapısı oldukça ileridedir. Ancak verim ve kalite sorunları mevcut potansiyelin değerlendirilememesine neden olmaktadır. Daha önceki çalışmalarda bu sorunun, meyvecilikte verim ve kalite artışı sağlayan yeniliklerin, üreticiler tarafından benimsenmemiş olmasından kaynaklandığı belirlenmiştir. Bu çalışmada, Isparta ilindeki meyve üreten işletmelerin verim ve kalite artırıcı yenilikleri benimsemelerinde, bazı sosyo-ekonomik faktörlerin etkisi araştırılmıştır. Veriler, 2011 Aralık- 2012 Şubat döneminde 111 meyve üreticisi işletme ile yapılan anket çalışmaları ile elde edilmiştir. Çalışmada bağımlı değişken olarak damla sulama yöntemi kullanma ve yaprak/toprak analizi yaptırma alınırken bağımsız değişken olarak eğitim, yaş, nüfus, deneyim, tarımsal gelir, alan ve tarımsal kuruluşları ziyaret sayısı alınmış ve çok değişkenli istatistik analiz yöntemlerinden biri olan Logit Regresyon Analizi kullanılmıştır. İşletmelerin meyve bahçelerini sulamada damla sulama yöntemini kullanmaları, incelenen değişkenlerden yalnızca işletme geliri ile ilişkili olduğu, yaprak-toprak analizi yaptırma alanı, tarımsal kuruluş ziyaretleri ve nüfus değişkenlerinin rol oynadığı belirlenmiştir.

Anahtar Kelimeler: Damla sulama, yaprak-toprak analizi, logit model.

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Geliş Tarihi/Received: 15.04.2018 Kabul Tarihi/Accepted: 29.05.2018

Makalenin Türü: Araştırma
Category: Research

Introduction

Fruit production is an important production activity in terms of the nutrition of the people, its providing of raw materials for fruit processing industries, its providing of employment due to its intensive requirement for labor, its higher value-added than those of the other products, and its being subject to foreign trade.

In Turkey, fruit growing is an important sector in which 16.9 million tons of production is performed by using about 16% of the plant production areas, which has a share of 2.3% in the world's production (FAO, 2015), and which has a high potential for competition. Production in the fruit growing sector, which deals with labor- and capital-intensive agricultural crops, regularly increases by the year. There has been a 21% increase in the fruit production areas with

an increase in production in the commercial dimension, particularly along with the development of the agricultural infrastructure

and the supporting policies implemented (Table 1).

Table 1. The plant production areas, their quantity, and their value in Turkey

Products	Production Areas (.000 hectares)				Production Value (.000 TL)			
	2002	2014	Change (%) (2002/2014)	Share (%)	2002	2014	Change (%) (2002/2014)	Share (%)
Field Crops	17.935	15.789	-12	80	14.566.411	42.035.199	186	43
Fruit	2.674	3.238	21	16	10.634.530	29.853.674	181	30
Vegetables	930	804	-14	4	7.656.579	26.099.407	241	27
Total	21.539	19.831	- 8	100	32.857.520	97.988.281	199	100

Turkey has a quite favorable climate for all fruit species other than the tropical horticultural plants due to its geographical location on earth. It is the birthplace of the cultivation of horticultural plants and the homeland of many fruit species growing worldwide (Ağaoğlu et al.,

1997). In Turkey, which has self-sufficiency and a significant chance of exportation in fruit production, grapes (25%), apple (15%), orange (11%) and olive (10%) get the greatest shares in production, respectively (Table 2).

Table 2. Quantities of production according to the fruit species in Turkey (.000 tons)

Product Name	2002	2006	2007	2008	2009	2010	2011	2012	2013	2014	Share (%)
Grape	3.500	4.000	3.613	3.918	4.265	4.255	4.296	4.185	4.055	4.175	25
Apple	2.200	2.002	2.458	2.504	2.782	2.600	2.680	2.889	3.128	2.480	15
Orange	1.250	1536	1427	1427	1.690	1.711	1.730	1.661	1.781	1.780	11
Olive	600	1.767	1.076	1.464	1.291	1.415	1.750	1.820	1.676	1.768	10
Mandarin	590	791	744	757	846	859	872	875	942	1.047	6
Lemon	525	710	652	673	784	787	790	710	726	725	4
Peach	455	507	487	503	547	539	546	611	638	609	4
Pear	340	318	356	356	384	380	386	443	462	462	3
Cherry	210	310	398	338	418	418	439	471	494	446	3
Hazelnut	600	661	530	801	500	600	430	660	549	412	2
Pomegranate	60	91	107	128	171	209	218	315	383	397	2
Strawberry	145	211	251	261	292	300	302	352	373	376	2
Fig	250	290	210	205	244	255	260	275	299	300	2
Apricot	315	460	558	716	661	450	650	760	780	270	2
Other	2.233	1.337	1.453	1.543	1.513	1.607	1.644	1.784	1.709	1.628	10
Total	13.273	14.991	14.320	15.594	16.388	16.385	16.993	17.811	17.995	16.875	100

TurkStat, 2015.

There have been increases in the fruit exportation quantity and value of Turkey by year. However, even though Turkey is among the great producing countries in many fruit species in the world's production, it has failed to reflect its advantage of production in exportation.

The farmers who have difficulty in financing as fruit production is substantially performed in dispersed orchards by the small-sized family

farms are unable to benefit adequately from the new production technologies; the production costs turn out to be high; the problem of quality and crop losses continue in the sector; and the supply accumulates in a short period owing to the shortness of the harvest period. For such reasons, exporters cannot procure desired general and quantities of crops in compliance with the standards in line with the demands abroad.

Likewise, in the competition analyses performed as well, it was expressed that Turkey had no comparative advantage in some fruit species and that the competitive power would decrease in the future as no productivity or efficiency could be achieved in many fruits including cherry, for which there was a competitive advantage. Therefore, in the report by the specialization commission for plant production, it was stated that it was of great importance to enhance the technology transferred to agriculture and to ensure that farmers efficiently utilize technology absolutely through simultaneous and effective farmer training and extension activities in the period of “the Tenth Development Plan”, and it was aimed to achieve significant developments in production and exportation by providing the fruit sector with such a structure that it would provide the supply of the products of the quality desired by the domestic and foreign markets (Anonymous, 2014).

New technologies, the first condition for being able to provide the development aimed at in the sector, are developed by the agricultural research institutions and universities and brought to farmers through agricultural extension activities, and it is ensured that they adopt them. Hence, the rapid conveyance of the innovations developed to increase yield and quality as a result of the R & D studies to farmers and their adoption and implementation by farmers will both contribute to the elimination of the inadequacies in the quantity and quality of the raw materials – already one of the greatest problems of the sector – and provide Turkey with an advantage in the fruit growing sector in the future.

The share of Isparta province, where the study was carried out, in the fruit production of Turkey is 5% (TurkStat, 2015; FAO, 2015). Although the majority of production is performed again by small-sized family farms, it is carried out in orchards, unlike the case nationwide. The high production quantity has enabled the investments in the infrastructures for processing and storage to increase. Nevertheless, the low yield and fruit quality per unit area lead to problems about profitability at the stages of production and processing. In the previous studies, it was established that the problems of low yield and low fruit quality (Karamürsel et al., 2011) resulted from the failure to adequately

adopt the new production practices (Karamürsel et al., 2013). Thus, there was a need to investigate the socio-economic factors which limited or promoted the adoption of some production technologies likely to be regarded as innovations for the study area.

Using the drip irrigation method in irrigation, performing production with clonal rootstocks in fruit plantations and having leaf & soil analyses made are the factors determined as innovations for the study area in this study.

Such studies may yield important results in focusing on research and extension activities (Llewellyn et al., 2005). It is thought that the findings will contribute to enhancing the efficiency of research, extension, and supporting activities carried out to develop fruit growing in Turkey.

Material and Method

Study Area

This study was conducted in the districts-towns/villages with intensive fruit production in Isparta province, located in the Western Mediterranean Subregion of Turkey, between December 2011 and February 2012. In terms of location and climate, Isparta province has a wide variety of plants since it is located in the transitional zone of Central Anatolia, Western Anatolia, and Mediterranean Regions. Fruit orchards constitute about 16% of the agricultural lands in Isparta province, the economy of which is based widely on agriculture. Covering 89% of the total fruit production areas, apple, cherry and apricot plantations come to the forefront in terms of the quantity of production.

Population and Sample

In this study, the districts-towns/villages in which apple, cherry and apricot were intensively produced in the province were determined with the purposive sampling method to represent the study area, while the number of farms to be surveyed was specified with the Simple Random Sampling Method. The data obtained from the questionnaires performed with 111 farms through the face-to-face interviewing method constituted the primary source of the study.

Statistical Analysis

The data obtained from the farmers were analyzed using the SPSS package program. The

subjects likely to be innovations in fruit production were specified, and the Logit Regression Analysis – one of the multivariate statistical analysis methods – was made so as to reveal the degrees of influence of the factors considered to be likely to affect the adoption of the specified innovations by the farmers.

In the regression analysis, the dependent variable is often affected by not only those variables which can easily be digitized on a well-defined scale (e.g. income, production, price, cost, height, and heat) but also those variables which are qualitative in essence (e.g. gender, race, nationality, war, earthquake, political turmoil, and a change in government policies).

The Linear Probability Model (LPM) occurs ($Y_i = \beta_0 + \beta_1 X_i + u_i$) when a dummy dependent variable is regarded as a linear function of the independent variable(s). It is very simple to use the LPM.

Upon understanding that the qualitative data encountered especially in the fields of economy and social sciences were unsuitable for being evaluated with the classical methods used to analyze continuous data, complex statistical methods were developed in line with the need for different methods to evaluate such data. The logit model, one of these methods, is a natural alternative of the regression model in such cases as the fact that the variables represent an option like the occurrence or non-occurrence of an event or that they are a category in a given classification, and it offers users more effective ways of prediction.

In the logit model, the dependent variable is discrete and the predicted probability values range from 0 to 1. Since it is accepted in the logit model that the independent variables explain the dependent variable better, it was preferred to use the logit model in this study (Amemiya, 1985). The logit model dependent on the cumulative logistic probability function is expressed as follows (Gujarati, 1995).

$$P_i = F(z_i) = F(\sim + X_i) = \frac{1}{1 + e^{-(z_i)}} = \frac{1}{1 + e^{-(\sim + X_i)}}$$

The following equation is obtained by reorganizing the above-mentioned equation and

by taking the natural logarithm of both sides of the equation.

$L = \ln$

$$\left[\frac{P_i}{(1 - P_i)} \right] = z_i = \sim + {}_1X_1 + {}_2X_2 + {}_3X_3 + \dots + {}_nX_n$$

In this study, the Logit model was selected due to the appropriateness of the data for the model and since they could be computed easily. Using the drip irrigation method, having leaf & soil analyses made and using clonal rootstocks were considered the dependent variables (innovations) in the model. For instance, users of the drip irrigation method (1) and nonusers of the drip irrigation method (0) were considered the dummy variables.

The variables affecting the adoption or non-adoption of the innovation were taken as the age of the farmer, his/her duration of education, the population on the farm, farmer's farming experience, the agricultural income of the farm, the farm area, and the number of its visits to agricultural establishments.

"Odds" and "odds ratio" are important concepts in the logit model. Odds (or likelihood) is a probability ratio and defined as "the ratio of the number of occurring events to the number of non-occurring events" (Morgan and Teachman, 1988). "The Odds Ratio" is the ratio of two odds or two likelihoods to each other (Menard, 2002). The odds ratio is symbolized with $-\Psi$ or $\text{Exp}(\beta)$ (Exponentiated logistic coefficients).

$$\text{Odds} = \frac{p(x)}{1-p(x)}$$

It is formulated as where $p(x)$ denotes the probability of occurrence of an event X , while $1-p(x)$ denotes the probability of its non-occurrence (Mertler and Vannatta, 2005).

An odds ratio greater than 1 shows that the likelihood of occurrence of the event increases, but an odds ratio smaller than 1 shows that the likelihood of occurrence of the event decreases (Morgan and Teachman, 1988).

Results and Discussion

Socio-economic characteristics of the fruit farmers in Isparta Province

The socio-economic characteristics of farmers are essential factors which are effective on the conducting of agricultural production activities, the attitudes and behaviors of farmers, and the

adoption and implementation of new techniques. The mean age of the farmers is 50 years; their duration of education is 7 years; and their farming experience is 27 years. The farms carry out their activities in an area of 34 decars on average and earn an annual agricultural income of TL 50.463 (Table 3).

Table 3. The Socio-economic characteristics of the farms under examination

Characteristics	Mean	Min.	Max.	Std. Dev.
Age of the farmer (years)	50	27	76	11,18
Duration of education of the farmer (years)	7	5	15	2,9
Population on the farm (people)	4	1	9	1,83
Farmer's farming experience (years)	27	2	65	12,81
Agricultural income (TL/year)	50.463	2.200	175.550	40.541
Farm area (da)	34	3	120	29,83
Number of visits to agricultural establishments by the farmer (number/years)	2,15	1	4	0,67

Factors which are effective on the use of the drip irrigation system

The positive effects of drip irrigation on the yield and quality of fruits were determined by many national researchers (Çevik et al., 1992; Tepeli et al., 2011, Küçükyumuk et al., 2013), as in the international literature. According to the results of the logit regression model, only agricultural income out of the factors addressed in the use of the drip irrigation method in irrigation by the fruit farmers in Isparta province was found to have a significant and positive effect. According to this result, the probability of farms to use the drip irrigation method in

irrigation increases with an increase in their agricultural incomes. The accurate prediction rate of the model is 95.5%, while Nagelkerke's determination coefficient (R^2) is 0.36 (Table 4). In the literature as well, it was reported that the farm income was an effective factor in applying the innovations (Bayav and Armağan, 2008; Ebojei et al., 2012) and that those farmers who were small-sized and even performed production for subsistence in many developing countries were unable to apply the capital-intensive technologies owing to their inadequate financial power (Niels, 1981).

Table 4. The socio-economic factors affecting the use of the drip irrigation method

Variable	Notation	Coefficient	Standard Error	Exp (B)
Constant	B ₀	-0,038	4,422	1,070
Age of the farmer	X ₁	0,067	0,065	0,730
Duration of education of the farmer	X ₂	-0,315	0,207	0,701
Population on the farm	X ₃	-0,355	0,304	1,006
Farmer's farming experience	X ₄	0,006	0,057	1,000
Agricultural income	X ₅	0,00006	0,00004*	0,952
Farm area	X ₆	-0,049	0,033	5,597
Number of visits to agricultural establishments by the farmer	X ₇	1,72	1,277	0,963

Accuracy of prediction (%)=95,5; Nagelkerke R^2 =0,364

*P<0,10

Factors which are effective in having leaf and soil analyses made

Fertilization is a considerably important cultural operation in fruit production. It is impossible to achieve the desired yield and quality in those fruit orchards where no adequate and balanced fertilization is performed. The abusing of fertilizers is as inconvenient as the underuse of fertilizers due to the antagonistic effect among the nutrients and for environmental reasons (Karamürsel et al., 2004). The plant nutrition practices widely carried out with conventional methods brought about such negative cases as increasing the production costs, the failure to attain the expected increases in yield and quality through fertilization, and an increase in

environmental problems (Özyazıcı et al., 2007). First of all, the situation should be determined with leaf & soil analyses for the plant nutrition practice aiming to increase yield and quality by adding the plant nutrients detected to be deficient.

The farm area and their visits to agricultural establishments were found to have a significant and positive effect but the population was found to have a significant and negative effect on the fact that the fruit farmers in Isparta province had leaf & soil analyses made. This is thought to be related to income. The accurate prediction rate of the model is 77.5%, while Nagelkerke's determination coefficient (R^2) is 0.33 (Table 5).

Table 5. The socio-economic factors which affected having leaf & soil analyses made

Variable	Notation	Coefficient	Standard Error	Exp (B)
Constant	B ₀	-0,351	2,102	0,704
Age of the farmer	X ₁	-0,021	0,031	0,980
Duration of education of the farmer	X ₂	0,083	0,097	1,086
Population on the farm	X ₃	-0,476	0,167***	0,621
Farmer's farming experience	X ₄	0,024	0,027	1,024
Agricultural income	X ₅	-0,000008	0,00001	1,000
Farm area	X ₆	0,034	0,017**	1,035
Number of visits to agricultural establishments by the farmer	X ₇	1,330	0,508***	3,782

Accuracy of prediction (%)=77,5; Nagelkerke R^2 =0,329
***P<0,01 **P<0,05

Factors which are effective on the use of clonal rootstocks

The objectives of modern fruit growing are to obtain larger amounts of crops of higher quality per unit area and to use efficient inputs. The high-density orchards established with clonal rootstocks increase quality and yield and provide an advantage of labor. The competitive countries in the sector have rapidly converted their plantations into high-density orchards with clonal rootstocks. None of the factors addressed in the adoption of the use of clonal rootstocks by the fruit farmers in Isparta province were found effective.

Conclusion

In this manuscript, it was intended to determine some socio-economic characteristics likely to be effective on the adoption of innovations by the fruit farmers in Isparta province. According to the results of the logit regression model, none of

the factors addressed in the use of clonal rootstocks by the fruit farmers in Isparta province were found effective. Of the factors considered, the farm area and their visits to agricultural establishments were found to have a significant and positive effect but population was found to have a significant and negative effect on farmers' having leaf & soil analyses made, while only agricultural income was found to have a significant and positive effect on their use of the drip irrigation method in irrigation.

Installation of the drip irrigation system requires a large investment and financing for the fruit growing farms in Isparta, whose agricultural structure is based on small-sized family farms. Although a subsidy through a 50% grant has already been granted within the scope of the Program for Supporting Rural Development Investments by the Ministry of Food, Agriculture and Livestock and a 5-year term loan has already been provided by Ziraat Bank,

the amount of this support is inadequate (Anonymous, 2015; TCZB, 2015).

In conclusion, the sustainability of fruit production and the providing of the sector with a competitive structure may substantially be overcome by closely monitoring the changes in the world production and trade, by conveying the results of R & D studies to farmers, and by including them in the production practices. Nevertheless, it is essential to adopt the innovation brought to farmers and intended to be applied to the characteristics of farmers and to the physical conditions of farms, to take this matter into consideration when planning the training & extension activities towards farmers, to put agricultural subsidies – elements which introduce and promote innovations – into use, and to eliminate the problems resulting from the farm size.

In addition, a national project to ensure the flourishing of the innovations developed in the research institutes/stations and to enable them to be brought to the farmers has been conducted since 2012 by the Department of Training, Extension, and Publications of the Ministry of Food, Agriculture, and Livestock, which will be useful for the access of farmers to an agricultural innovation in a shorter period of time.

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