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Full Length Research Paper

Analysis of the factors affecting apple farming: The case of Isparta province, Turkey

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The commercial apple cultivation worldwide is in the midst of a major change in apple production management systems. The effects of these changes have considerably been felt in Turkey compared with the world increasing the production and consumption amounts. Therefore, the conventional orchards have been considerably transformed into modern orchards based on dwarf and semi-dwarf rootstocks in the producer provinces of Turkey, especially Isparta province, in recent years. The aim of the study is to analyze effects of the factors which consist of agricultural structure and infrastructure, the growers' socioeconomic and demographic characteristics and attributes affecting apple farming in Egirdir district of Isparta, Turkey. To this end, data collected through questionnaires carried out with 125 apple growers in Egirdir district was first used for factor and then multiple regression analyses in SPSS statistical program. The results of the study showed that if the planting distances, by renewing the apple rootstocks and willingness of the farm managers to work out of their own farms, were decreased and the other factors were gradually increased up to the optimum input levels, the growers' attribute and attitudes could be effectively used. As a result, the total apple production could be considerably increased in terms of technical effectiveness. If the scarce sources used for apple farming could be effectively used, a major contribution to the regional and national economy along with the annual incomes of the farmers could be realized.

Key words: Apple farming, factor and regression analysis, rootstocks, apple cultivar, modern apple orchard layout.

INTRODUCTION

The cultivated apple (*Malus domastica*) includes the majority of wild species of *Malus* belonging to *Malus sieversii*, which is widely believed to be the main mat-ernal wild ancestor of domestic apples from Kazakhstan and *Malus orientalis*. This is one of the pro-bable minor ancestors of domestic apples from Turkey and Russia, as well as Iran, which occupied an interme-diate position between the domesticated and wild species first originated in Central Asia. Thus, the region where its wild ancestors are still found today is accepted as a center of origin of the domesticated apple species (Gharghani et al., 2009). These species once moved west-ward very early in the history and spread north along the various branches of the Silk Road, which were once widespread in the forests of Asia Minor, the Cau-casus, Turkey and Iran and were later spread by the Romans throughout the Mediterranean and central Europe. Finally, they were introduced into the new World by early settlers who brought seeds with them from Europe (Janick, 2005).

Apple with 69.60 million metric tones fresh-weight harvested from 4.85 million hectares in 94 countries, in terms of the total production amount and the world's harvested area in 2008, is the fourth most extensively produced deciduous fruit crop worldwide after citrus, grapes and banana (FAO, 2010). It is the most ubiquitous and well-adapted of the temperate fruit crop species. On the other hand, it is not only consumed as fresh fruit but

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Table 1. The import, export, domestic consumption and consumption amounts per capita (kg) of top five apple producer countries (million tones).

Countries	Import		Export		Domestic consumption		Consumption per capita	
	2000	2007	2000	2007	2000	2007	2000	2007
China	0.16	0.16	0.30	1.02	20.30	27.01	15.93	20.21
United State	0.16	0.21	0.66	0.66	4.18	3.78	14.53	12.25
Poland	0.02	0.13	0.21	0.43	1.25	0.74	32.63	19.31
Iran	0.00	0.00	0.13	0.02	2.01	2.64	30.02	36.46
Turkey	0.0034	0.01	0.01	0.01	2.39	2.45	35.97	33.60
World	4.88	7.40	5.28	8.53	58.66	64.96	9.59	9.74

also used for making processed products and canned in syrup. Its availability in the market runs throughout the year due to its health-protecting properties, content and dietary databases and it represents the major source of intake of these compounds in the people's diets (Lamperi et al., 2008). Moreover, epidemiological investigations show that there has been an inverse correlation between the consumption of apples and many chronic human diseases in the recent years, as well (Knekt et al., 1996; Knekt et al., 1997).

The first five producer countries within the world's apple production in the years 2000 and 2008 are China with 20.44 and 29.85, United States with 4.68 and 4.43, Poland with 1.45 and 2.83, Iran with 2.14 and 2.66 and Turkey with 2.40 and 2.51 million tones. The shares of these five countries, China and Turkey in the total production are calculated as 52.67 and 60.75%, 34.61 and 42.89% and 4.06 and 3.61%, respectively (FAO, 2010). On the other hand, domestic consumption ((production + import) - export), export and average consumption amounts per capita (domestic consumption/population) of these countries and the world are given in Table 1. As can be understood from the figures explaining partly the agricultural macroeconomic indicators of each country, the commercial apple farming worldwide is in the midst of a major change in apple production management systems. Some major effects of these changes were considerably felt in Turkey compared with the world increasing the production and domestic consumption amounts as well and the shares of Turkey in the world's production, domestic consumption, export and import amounts between the years 2000 and 2007 have gradually decreased to 3.61 from 4.06%, 3.77 from 4.07%, 0.12 from 0.19% and increased to 0.07 from 0.06%, respectively (Table 1).

Table 1 shows that while the annual apple amounts imported and produced in terms of apple supply as a physical product in Turkey increased to 24.3 from 0.5% between years 2000 and 2007, annual domestic consumption amount also increased by 0.3%, that is, increases in domestic consumption were significantly met via import. This means that apple supply was not enough to meet demand despite the reduction of consumption per capita to 33.60 from 35.97 kg. Consequently, Turkey's situation for both foreign trade and domestic production and consumption of apple crops are not at satisfactory levels in connection to its status in the world. This fact could dramatically stem from several factors related to agricultural structure and infrastructure, growers' socio-economic and demographic characteristics.

The best way to increase the apple production is to improve its yield. This could only be realized by modern high-density orchard systems established based on dwarf and semi-dwarf rootstocks which aim to achieve high yield at early tree age. With the modern orchard layout, tree sizes could be decreased and their density could be increased meaningfully by holding in size-controlling rootstocks and thus, they affect several aspects of apple tree growth and development, including yield and apple quality. Also, they impact the trees' resistance to drought, root pests and diseases (Ercisli et al., 2006; Koc et al., 2009). These advantages are not only limited to resistance, biologic and climatologic factors of the rootstocks, but also to easy application and implementation of production processes such as input uses, care, harvest, thinning, pruning and preparation of orchard.

Mostly, the standard apple cultivars in Turkey have mainly budded on these clonal rootstocks which are well known. These are: M9 (dwarf), MM106 (semi-dwarf) and MM111 (semi-vigorous) used in various types of soils and plantation systems (Mert and Soylu, 2010). Therefore, the modern high-density orchard layout based on these rootstocks have gained great importance for apple growers in central areas such as Isparta, Karaman and Nigde of Turkey, where there is intensive apple farming, in the last years. The most important producer provinces as regards the production amount in Turkey are Isparta with 0.53, Karaman with 0.37, Nigde with 3.24, Denizli with 0.20 and Antalya with 0.18 million tones in the same production period (TUIK, 2010). As one of the leader producer provinces in Turkey, Isparta produces 21.12% of the total apple crops and Eğirdir, the district having absolute and relative advantages on apple production of the province, accounts for about 35% (with 0.185 million tones production) of the total production (EDDA, 2010).

In the last decade, the modern apple orchard layouts have been enlarged in favor of dwarf and semi-dwarf rootstocks and have also been preferred to the conventional apple orchards in the district. In light of this information, the aim of the study is to analyze effects of the factors which consist of agricultural structure and infrastructure, the growers' socioeconomic and demographic attitude and attributes affecting apple farming to include apple cultivars such as 'starking and golden delicious' grown on dwarf, semi-dwarf and semi-vigorous rootstocks, in the production of apple, in Egirdir, Isparta.

MATERIALS AND METHODS

Material and determination of sample size

The data of the present research were collected from a face-to-face questionnaire conducted with 125 growers farming with apple cultivars grown on M-9 (dwarf), MM-106 (semi-dwarf) and MM-111 (semi-vigorous) rootstocks at apple orchards in Egirdir district of Isparta province[1] and its' six villages[2] in the year 2009. On the other hand, the secondary data used in the study were collected from the previous studies and from documents such as journals and brief reports published by some institutions like FAO, TUIK and DPT.

The villages having the apple orchards based on dwarf, semi-dwarf and semi-vigorous rootstocks and producing for local and national markets and consumers were chosen to represent the whole study area with objective sampling method. Then, the farms were randomly selected by simple random sampling method from the villages in the area of study according to apple orchard sizes. The size of sample was determined by using the following equation (Yildiz et al., 2006). The permissible error sample size was defined as 5% for 95% confidence level and the sample size was calculated as 125 apple farms.

$$n = \left(\frac{Z_{\alpha/2}^{2} \sigma^{2}}{d^{2}} \right)$$

where:

n = Required sample size.
μ = Population mean (8.65).
σ^2 = Population variance (29.86).
d = Deviation measure permitted $(\mu - \bar{x})$ (0.96).
$\bar{x}$ = Sample mean (7.69).
Z= Reliability coefficient (1.96).

[1] Isparta province is located in the southwestern part (the Mediterranean region) of Turkey. It has an area of 8993 km² and a population of 547525. The province is well known for its apples, roses and rose products, and carpets. The province is situated in the Lakes Area of Turkey's Mediterranean Region and has many freshwater lakes.
[2] The villages are Tepeli, Aksu, Sari Idris, Yukarı Gokdere, Pazarkoy and Sevincbey.

Methods used for econometric analysis

Participants in the questionnaire were asked to respond to each question, indicating string and numeric variables with regard to agricultural infrastructure and structure, farmers' attitudes and demographic characteristics related to apple farming. Of the 20 numeric variables including agricultural infrastructure and structure, 7 were regarding the main variable input amounts applied for apple farming (applied irrigation water, soil and leaf chemical fertilizers and manure, fungicides, acaricides and insecticides amounts), 7 were relevant to labour force amounts used for apple orchard care, preparation and harvest (weed and pest control, thinning, pruning, harvest and hauling, tillage, irrigation and fertilization application processes) and 6 were associated with the apple orchard layout and yield (planting/spacing distance based on row and rootstock distance, age, number, acreage and yield of apple orchard).

On the other hand, of the 9 string and 2 numeric variables referring to farmers' demographic characteristic and socioeconomic attitudes, 3 were related to farmers' demographic characteristics (experience of farm managers as numeric variable, education of those farmers (0: primary school graduate, 1: high school and college graduates) and the ways to obtain technical knowledge of those farmers (0: conventional, 1: the others; from agricultural expert, publication, sample farms, advertisement, etc.), 8 were interested in farmers' socioeconomic attitudes (M-9 and MM-111 rootstocks standardized with 1 impact on MM-106 rootstock marked with zero, apple cultivars (1: starking delicious, 0: golden delicious), irrigation system (0: flood/surface irrigation, 1: drip irrigation), farming types (1: apple farming, 0: the others), farm size as a numeric variable, working out of own farm (1: yes, 0: no) and social security insurance (1: yes, 0: no).

After editing and coding, the data were first grouped by factor analysis to determine the main numeric factors affecting farmers' apple farming and its yield at apple orchards. Then, these data sets and the others were used by multiple regression analysis to measure the effectiveness of the crucial factors affecting the apple production amount.

Factor analysis is a data reduction technique that reduces the number of variables used in an analysis by creating new variables (called factors) that combine redundancy in the data (SPSS 15.0, 2006). The first step in factor analysis is to determine the number of relevant factors. Therefore, the factor analysis conducted in this study reduced the number of numeric main inputs pertaining to apple farming from 20 into 6 having Eigen-values greater than 1.0. This was done by principal component analysis[3] using the varimax rotation method[4]. Factor analysis was used initially to identify underlying aspects that could explain a correlation among a set of main factors used for apple farming. The aim of factor analysis in the study was to identify the main factors affecting the apple farming that accounted for a relatively large proportion of the variance in the sample. This subset could then be used for multiple regression analysis (MRC).

In the second step of the analysis, the 6 main factors obtained from factor analysis and the other 11 variables which were included in farmers' demographic characteristics and socioeconomic attitudes were directly used for MRC. For this end, logarithmic-

[3] A factor extraction method used to form uncorrelated linear combinations of the observed variables. The first component has the maximum variance. Successive components explain progressively smaller portions of the variance and are all uncorrelated with each other. Principal component analysis is used to obtain the initial factor solution. It can be used when there is a single correlation matrix.
[4] This method is an orthogonal rotation method that minimizes the number of variables that have high loading on each factor. It simplifies the interpretation of the factors.

linear functional form and enter MRC selection technique estimated by Ordinary Least Squares (OLS) method in this study were chosen to estimate the relationship between dependent and independent variables. MRC is a statistical technique that allows the relationship between a set of dependent and independent variables to be predicted. As for OLS, it seeks to minimize the sum of the squared differences between the observed in a set of ` and predicted squares from the regression model (Allison, 1997).

As the comparison and selection criterions among them, the coefficient of determination (R-square), F statistical test and standard error are taken into account by being the major determinants. Particularly, the first-two of these are the most widely used goodness-of-fit measures for regression models and they are the best determinants that described the relationship between dependent and independent variables (Gujarati, 2005). Additionally, the presence of autocorrelation and multicollinearity in MRC models was assessed by using Durbin-Watson d statistic. This was done by analyzing partial correlation coefficients (r) based on correlation matrix and by calculating the variance inflating factor (VIF), respectively (Topcu, 2008). SPSS 15.0 statistical software program was used for both factor and MRC analyses.

RESULTS AND DISCUSSION

Kaiser Normalization (KMO), which compares partial correlation coefficients with the observing ones, was calculated as 0.75 for the crucial factors impact on apple farming based on infrastructure and structure characteristics of dwarf, semi-dwarf and semi-vigorous apple orchards. This means that data sets are at good level for factor analysis since the test score is greater than 0.50 (Table 2).

Principal component analysis by using varimax rotation, first, grouped 20 variables related to apple farming into six factors with Eigen-values greater than 1.0. The six factors explained 69.33% of the total variance. F1, which accounted for 29.22% of the total variance, was dominated by major variable input amounts needed for apple farming. Therefore, F1 was linked with variable input amounts. F2 accounted for 12.76% of the total variance and gave the study information about labour force amounts for apple orchard care and harvest. F3 reported 7.86% of the total variance and was stated by labour force for tillage and fertilization and irrigation applications. This could be named as labour force amount for apple orchard preparation. F4 explained 7.14% of the total variance and was related to planting distance based on row and plant distance and age of apple cultivars. It could be determined, therefore, with the planting distance and age of apple trees. On the other hand, F5 and F6 accounted for 6.28 and 6.08% of the total variance and consisted of acreage and the number of apple orchards and apple yield, respectively. So, they could be called apple orchard size and yield, respectively (Table 2).

Table 3 showed whether or not econometric problems were related to the measurement results. When econommetric problems in the MRC model were statistically tested, it could not detect them since partial correlation coefficients in correlation matrix used for multicollinearity diagnostic were less than 0.80. Also, this was due to the calculated VIF values (that is, between 1.30 and 2.12) fallen between 1.00 and 2.50 and DW d (2.005) value computed by Durbin-Watson statistic used for auto-correlation diagnostic been higher than d_u (1.94) and 4-d_u (1.54) critical values. Consequently, in the MRC model, there is no problem related to auto-correlation and multicollinearity (Kalayci, 2005). Therefore, these data sets could be used for MRC model.

In the MRC model, $Adj.R^2$ as determination coefficient was calculated as 0.80, that is, all independent variables explained 80% of dependent variables. OLS estimates of the model coefficients and other statistic measurements were shown in Table 3, as well. As the table were statistically analyzed, the F-statistic was calculated as 30.85 (p: 0.000) and the null hypothesis was rejected, in which all coefficients are equal to zero. On the other hand, partial regression coefficients of F1, F2, F4, F5, F6, RS1, RS2, AC, IS, EF, FS, WO, FT and ED were statistically found to be significant at $p < 0.001$ and 0.05, respectively. Additionally, the signs of all regression coefficients were found in compliance with economic theories, as well.

Of these factors, the coefficients of the planting distance and age of apple trees (F4) and working out of own farm (WO) had the negative signs (Table 3). Therefore, as the planting distance and age of apple trees and WO increased, the annual apple production amount obviously decreased. This situation indicated that there was an inverse relationship between these factors and the apple production amount. At apple orchards under research, the average age and planting distance of apple cultivars on M-9, MM-106 and MM-111 rootstocks were analyzed as 15.60, 19.00 and 17.50 years and 5.30 × 5.70, 5.70 × 6.50 and 5.70 × 6.90 m, respectively.

These results compared with that of the previous researches showed that the average planting distances and ages of that for an economic production must be 1.5 × 3.5, 3.0 × 4.0 and 5.0 × 6.0 m and between 8 - 10, 9 - 11 and 11 - 13 years for optimal yield, respectively. Furthermore, the most productive and economic life-cycle phases of apple orchards were reported as between 4 and 14 for dwarf and semi-dwarf; 15 and 20 years for semi-vigorous rootstocks according to agro-ecological attribute and environment conditions, respectively (Tareen et al., 2003; Karaoglu, 2005; Gul, 2006; Mouron et al., 2006; Tekintas et al., 2006; Bayav, 2007; Kucukyumuk, 2007; ALP, 2008). These results also showed that when the planting distance based on row and plant distance and age of apple trees were increased, the annual apple production amount gradually decreased since the planting distance and apple trees' age were more than the optimum planting distance and economic productive age.

As for WO, working out of the farm manager's own

Table 2. Factors and correlated variable loadings related to apple farming.

Variables	Factor loadings*					
	F1	**F2**	**F3**	**F4**	**F5**	**F6**
Variable input amounts (F1)						
Irrigation water amount (l/da)	0.870	0.053	0.079	0.192	0.128	-0.015
Chemical fertilizer amount for soil (kg/da)	0.825	0.280	0.149	0.039	0.064	0.119
Fungicide amount (kg/da)	0.802	0.285	0.117	-0.018	-0.045	-0.013
Chemical fertilizer amount for leaf (kg/da)	0.800	0.113	0.171	0.006	0.121	-0.044
Manure amount (tone/da)	0.709	0.430	0.265	0.032	0.267	-0.110
Acaricide amount (kg/da)	0.575	-0.066	0.139	0.031	0.473	0.393
Insecticide amount (kg/da)	0.504	0.181	0.442	0.138	0.166	-0.208
Labour force amounts for apple orchard care and harvest (F2)						
Labour force for weed control (hour/da)	0.415	0.826	0.156	-0.201	0.166	0.133
Labour force for thinning (hour/da)	0.093	0.815	-0.069	0.140	0.185	-0.224
Labour force for pruning (hour/da)	0.348	0.678	0.362	-0.032	0.266	0.075
Labour force for pest control (hour/da)	0.272	0.574	0.085	-0.177	-0.202	-0.105
Labour force for harvest and hauling (hour/da)	0.204	0.505	-0.111	0.088	0.095	-0.072
Labour force amounts for apple orchard preparation (F3)						
Labour force for tillage (hour/da)	0.306	0.064	0.833	0.024	0.079	-0.074
Labour force for fertilization and irrigation application (hour/da)	0.061	0.152	0.748	0.045	0.288	0.098
Age and planting distance of apple trees (F4)						
Planting distance between trees over row (meter)	-0.051	0.102	0.223	0.873	0.024	0.025
Planting distance between rows (meter)	0.073	0.198	-0.095	0.852	0.083	-0.072
Age of apple tree (years since planting) (year)	-0.050	-0.293	0.205	0.658	0.253	-0.159
Apple orchard size (F5)						
Acreage of apple orchard (da)	0.155	0.281	0.291	0.179	0.791	0.015
Number of apple orchard (number)	0.114	0.037	0.032	0.102	0.700	0.361
Apple yield (F6)						
Apple yield (tone/da)	0.106	0.007	0.066	0.107	0.099	0.916
Eigen-value	5.551	2.425	1.493	1.356	1.193	1.155
Share of explained variance (%)	29.215	12.761	7.856	7.139	6.278	6.078
Cumulative share of explained variance (%)	29.215	41.976	49.832	56.970	63.248	69.326
KMO (Kaiser-Meyer-Olkin) statistic						0.750
Bartlett's test of Sphericity	(Chi-square, df: 171):1031.865 (p: 0.000)					

* Bold numbers indicate the largest loading for each variable.

farm and using family individuals as permanent labour force could effectively prevent the application of the variable inputs and the optimal labour force usage arising from orchard preparation, care, harvest and hauling processes need for apple farming in terms of technique and economy. Apple production amount could decrease more and more due to non-effective and non-optimum usage of these production factors.

On the other hand, the other factor coefficients had positive signs and when their amounts were increased as the additional units, apple production amount significantly increased. This means that there was a linear relationship between these factors and apple production amount.

Of the factors affecting positively the apple production amount, F1 consisting of three main variable inputs such as irrigation water, pesticides and fertilizer increased

Table 3. Multiple regression analysis results of the factors affecting apple production amount.

Variables	Multiple linear regression model				Collinearity statistics		Correlations	
	Coefficients	Std. error	t_h-value	p-value	Tolerance	VIF	Partial	Part
Constant	2.785	0.186	15.006	0.000*	-	-	-	-
F1	0.183	0.021	3.079	0.003*	0.648	1.543	0.158	0.066
F2	0.214	0.028	4.106	0.000*	0.585	1.710	0.369	0.163
F3	0.086	0.021	1.629	0.106	0.570	1.753	0.156	0.065
F4	-0.226	0.023	-4.580	0.000*	0.649	1.540	-0.405	-0.182
F5	0.666	0.019	12.410	0.000*	0.549	1.821	0.768	0.494
F6	0.236	0.021	3.945	0.000*	0.705	1.418	0.155	0.064
RS1	0.264	0.067	4.184	0.000*	0.697	2.116	0.375	0.166
RS2	0.187	0.059	2.358	0.013*	0.633	2.099	0.122	0.050
AC	0.130	0.061	2.508	0.014*	0.585	1.709	0.236	0.100
IS	0.236	0.057	4.852	0.000*	0.670	1.491	0.425	0.193
FT	0.098	0.185	2.175	0.032**	0.773	1.298	0.206	0.087
EF	0.131	0.003	2.517	0.013*	0.585	1.710	0.236	0.100
FS	0.169	0.013	3.554	0.001*	0.699	1.430	0.325	0.141
ED	0.124	0.091	2.375	0.019**	0.580	1.723	0.224	0.094
TK	0.051	0.064	1.072	0.286	0.687	1.456	0.103	0.043
WO	-0.143	0.062	-2.506	0.014*	0.496	2.058	-0.235	-0.100
SS	0.057	0.096	0.990	0.324	0.771	2.122	0.095	0.039

n: 125, R^2: 0.83, Adj R^2: 0.80, $F_{(17,107)}$: 30.849*, d_L=1.54, d_u=1.94, DW d=2.005, *p < 0.01 and **p < 0.05.

the production amount if their amounts increased. The annual average fertilizer for soil and leaf as chemical and manure; chemigation/pesticides as fungicide, insecticide and acaricide and irrigation water amounts applied for apple production in farms under research were about 11.22 kg/da for soil and 0.2 kg/da for leaf (total 11.42 kg/da); 2.5 t/da: 1.6, 0.53 and 0.5 kg/da (total 2.63 kg/da) and 0.5 million l/da, respectively. According to the results of the previous researches conducted in the same research regions, the total amounts of chemical fertilizer between 10.9 and 32.8 kg/da, manure between 2.9 and 4.0 t/da, pesticides between 2.60 and 5.40 kg/da and irrigation water between 0.5 and 0.8 million l/da were applied for the apple production (Ozer, 2001; Demircan and Yilmaz, 2005; Demircan et al., 2005; Karaoglu, 2005; Gul, 2006; Bayav, 2007; Kucukyumuk, 2007).

As for labour force amounts that are related to apple orchard care and harvest (*F2*) and preparation (F3) processes, there was a strict relationship between F2 and F3 referred to as labour force amounts used for pre-harvest and harvest at apple orchards and which revealed the total labour force potential. However, when the regression coefficients were considered, F2 had a stronger and more important impact on apple production amount than F3 had. At apple orchards under research, the annual average labour force amounts used per decare, which belong to F2 factor, were calculated as 2.28 for weed control, 10.15 for thinning, 13.5 for pruning, 6.6 for pest control and 47.1 h for harvest and hauling; while those related to F3 factor were 1.5 for tillage and 5.25 h for irrigation and fertilization application processes and the total labour force amount for F2 and F3 factors was 86.38 h.

According to the results obtained from the previous researches, the annual average labour force amounts needed for the same farming processes were between 5.04 and 5.51, 2.35 and 7.27, 19.45 and 19.87, 5.28 and 9.11, 56.23 and 60.74, 2.68 and 5.50 and 5.62 and 5.93 h, respectively, while the total was between 96.65 and 104.82 h (Ozer, 2001; Demircan et al., 2005; Strapatsa et al., 2006; Gul, 2006; Mouron et al., 2006; Mouran and Scholz, 2008). The results of this study compared with that of previous researches showed that both the annual variable input and the labour force amounts used for apple production were less than the regional standard norms or most closer to them. Therefore, apple production amount could considerably increase by increasing the variable input and labour force amounts.

In this study, the apple orchard sizes (F5) with the average 8.6 da acreage and the number of two apple orchards per farm were also calculated and the average yields (F6) of apple orchards were based on bothM-9, MM-106 and MM-111 rootstocks with 3.15, 2.51 and 2.86 t/da and starking and golden delicious apple cultivars with 2.96 and 2.83 t/da, respectively. These findings were supported by the results of previous researches related to the average apple orchard sizes reported between

Table 4. Analysis of MRC model.

Log APA = f (F1, F2, F3, F4, F5, F6, RS1, RS2, AC, IS, FT, EF, FS, ED, TK, WO, SS)		
Dependent variable		
APA	:	Annual apple production amount (tone)
Independent variables		
F1	:	Variable input amounts
F2	:	Labour force amounts for orchard care and harvest (hour/da)
F3	:	Labour force amounts for orchard preparation (hour/da)
F4	:	Age (year) and planting distance (meter) of apple trees
F5	:	Orchard size (da)
F6	:	Apple yield (tone/da)
RS1	:	M-9 rootstock impact on MM-106 rootstock
RS2	:	MM-111 rootstock impact on MM-106 rootstock
AC	:	Apple cultivar
IS	:	Irrigation system
FT	:	Farming type
EF	:	Experience of farm manager
FS	:	Farm size (da)
ED	:	Education of farm manager
TK	:	The ways to obtain technical knowledge
WO	:	Working out of own farm
SS	:	Social security insurance

4.5 and 18.8 da and reaching to optimum orchard size with 18 da. The average yields for these rootstocks varied between 2.8 and 7.0, 2.0 and 3.5, 2.5 and 4.0 t/da and the apple cultivars varied between 1.89 and 3.5 and 1.5 and 3.2 t/da, respectively (Lee et al., 2000; Ozer, 2001; Tareen et al., 2003; Cetin et al., 2004; Karaoglu, 2005; Canals et al., 2006; Gul, 2006; Mouron et al., 2006; Peck et al., 2006; Tekintas et al., 2006; Mouron and Scholz, 2008; Bravin et al., 2009). When compared to the results of the previous researches, these results showed that the orchards could be expanded in order to reach optimum orchard size and the apple yield and production amount can be increased by considering the most productive rootstocks and apple cultivars based on the optimum orchard layout and variable input applications.

Of the rootstocks used at the apple orchards under research, the productivity effects of M-9 *(*RS1) and MM-111 (RS2*)* on MM-106 were positive and the marginal addition of M-9 and MM-111 were more than M-106 when the results of regression analysis is taken into consideration. In the research area, therefore, for the apple orchards established by basing the rootstocks, 42, 41 and 17% consisted of M-9, MM-111 and MM-106 rootstocks, respectively. This situation could also be explained by analyzing the productivities of the rootstocks. Actually, M-9 and MM-111 rootstocks are the first-two of the rootstocks mostly used as dwarf and vigorous in Turkey and in the world in the last years. Additionally, apple cultivars on M-9 and MM-111 are very productive and are the most widely-used rootstocks. They come into bearing within 2 - 3 and 4 - 5 years of planting and have an excellent choice for smaller orchards. As for the apple cultivars *(*AC*)* selected as ‘starking delicious’ with 68% and ‘golden delicious’ with 32%, starking delicious was preferred more than golden delicious, which had more major effect on the apple productivity and production amount as a result of the regression analysis (Lee et al., 2000; Ozer, 2001; Tareen et al., 2003; Tanasescu and Paltineanu, 2004; Karaoglu, 2005; Mouron et al., 2006; Tekintas et al., 2006; Kucukyumuk, 2007; Mouran and Scholz, 2008; Bravin et al., 2009).

In order to make a viable apple farming economically and technically, the apple growers must also have some demographic and socioeconomic attributes such as technical knowledge, experience, technical and general education at a good level, social security and agricultural insurances and the modern (dwarf) apple orchards with an effect orchard layout based on the most productive rootstocks and apple cultivars adapting to the region conditions, which have high investments of capital (that is, the operation systems used for irrigation, fertigation, chemigation and mechanization) and labour force. Of these factors, irrigation systems (IS), farming types *(*FT), farm size (FS), the experience (EF), the education (ED), social security situation (SS) and the way to obtain technical knowledge (TK) of farm managers had a positive impact on the apple production amount in regression model.

The apple growers used drip and flood irrigation as two irrigation systems for apple farming. Drip irrigation system with a share of 42% had a strong effect on floor irrigation due to saving from the use of input amounts such as irrigation water, fertigation, energy and labour amounts. Therefore, the farms could reduce the operation costs by increasing total production amount and gain an intensive comparative advantage. On the other hand, the farmers that specialized only on apple production (78%), obtained technical information from agricultural experts (88%), graduated from high-school and college (79.6%) and had social security insurance (88%) had a higher advantage than the others on apple yield and production amount. Additionally, the average experience of farm manager and farm size were calculated as 19.88 years and 21.6 da and the marginal increases of these factors were expected to increase the production amount, as well (Rebelo and Santos, 2000; Ozer, 2001; Cetin et al., 2004; Tanasescu and Paltineanu, 2004; Gul, 2006; Mouron et al., 2006; Uzunoz and Akcay, 2006; Mouran and Scholz, 2008).

Conclusion

This study was conducted to analyze effects of the factors consisting of the structural and infrastructural attributes of apple orchards established with apple cultivars as 'starking and golden delicious' grown on dwarf (M-9), semi-dwarf (MM-106) and semi-vigorous (MM-111) rootstocks, as well as socioeconomic and demographic characteristics of the growers on apple farming. The results of this study showed that if the planting distances rejuvenated the apple rootstocks (F4) from the main factors grouped, the willingness to work out of farm manager's own farm (WO), as socioeconomic factors, was decreased. The other factors were gradually increased to the optimum input levels and the growers' attitudes could effectively now orient their target. Total apple production amount could be considerably increased in terms of technical effectiveness.

Mostly, when the variable input and labour force amounts and orchard sizes for apple farming could be increased up to the optimum levels, both yield and total production amount could be increased. Thus, the scarce sources used for apple farming could be effectively applied. Consequently, the implementation of these results, explaining the rational apple grower attribute and attitudes, could also provide a major contribution to the regional and national economy along with the annual incomes of the farms.

REFERENCES

Allison PD (1997). Survival analysis using the SAS System. SAS Institute, Cary NC, USA.

ALP (2008). Afghanistan Alternative Livelihoods Program for the Eastern Region. Apple production. Perennial Crop Support Series, Jalalabad, Afghanistan.

Bayav A (2007). Adoption levels of the innovations and research findings, and impact assessments in the apple growing enterprises in Isparta province (MS thesis). Adnan Menderes Univ., Nat. Sci., Aydin.

Bravin E, Kilchenmann A, Leumann M (2009). Six hypotheses for profitable apple production based on the economic work-package within the ISAFRUIT Project. J. Horticult. Sci. Biotech., (Special Issue): 164-167.

Canals LM, Burnip GM, Cowell SJ (2006). Evaluation of the environmental impacts of apple production using life cycle assessment (LCA): case study in New Zealand. Agric., Ecosyst. Environ., 114: 226-238.

Cetin B, Ozer H, Kuscu H (2004). Economics of drip irrigation for apple (Malus domestica). New Zealand J. Crop Horticult. Sci., 32: 349-354.

Demircan V, Yilmaz H (2005). The analysis of pesticide use in apple production in Isparta province in terms of economy and environmental sensitivity perspective. J. Ecol., 15 (57): 15-25.

Demircan V, Yilmaz H, Binici T (2005). Determination of cost and return of apple production in Isparta province. J. Agric. Econ., 11(2): 71-80, Izmir.

EDDA (2010). Egirdir District Directorate of Agricultural Data, Isparta, Turkey.

Ercisli S, Esitken A, Orhan E, Ozdemir O (2006). Rootstocks used for temperate fruit trees in Turkey: An overview. *Sodininkyste ir Darzininkyste*, 25: 27-33.

FAO (2010). Statistical database. Available: http://www.fao.org.

Gharghani A, Zamani Z, Talaie A, Oraguzie NC, Fatahi R, Hajnajari H, Wiedow C, Gardiner SE (2009). Genetic identity and relationships of Iranian apple cultivars and landraces, wild Malus species and representative old apple cultivars based on simple sequence repeat marker analysis. Genet. Resour. Crop Evol., 56: 829-842.

Gul M (2006). Technical efficiency of apple farming in Turkey: A case study covering Isparta, Karaman and Nigde provinces. Pak. J. Biol. Sci. 9(4): 601-605.

Gujarati DN (2005). Basic econometrics. Reference Publish, Istanbul, 33:540-578. ISBN: 975-7860-99-9.

Janick J (2005). The origins of fruits, fruit growing, and fruit breeding. Plant Breed. Rev., 25: 255-320.

Kalayci S (2005). SPSS Applications, Multi-Variables Statistics Techniques. IstEdn. Asil Publish, Ankara, pp: 273-305. ISBN: 975-9091-14-3.

Karaoglu E (2005). Working of expert system on apple farming (MS thesis). SDU., Nat. Sci., Isparta.

Knekt P, Jarvinen R, Teunanen A, Maatela J (1996). Flavonoid intake and coronary mortality in Finland: a cohort study. Br. Med. J., 312: 478-481.

Knekt P, Jarvinen R, Seppanen R, Hellovaara M, Teppo L, Pukkala E, Aromaa A (1997). Dietary flavonoids and the risk of lung cancer and other malignant neoplasms. Am. J. Epidemiol., 146: 223-230.

Koc A, Akbulut M, Orhan E, Celik Z, Bilgener S Ercisli S (2009). Identification of Turkish and standard apple rootstocks by morphological and molecular markers. Genet. Mol. Res., 8(2): 420-425.

Kucukyumuk Z (2007). Investigation of rootstock and variety effect on mineral nutrition of apple trees (MS thesis). SDU, Nat. Sci., Isparta.

Lamperi L, Chiuminatto U, Cincinelli A, Galvan P, Giordani E, Lepri L, del Bubba M (2008). Polyphenol levels and free radical scavenging activities of four apple cultivars from integrated and organic farming in different Italian areas. J. Agric. Food Chem., 56: 6536-6546.

Lee BN, Kang KH, Woo SG, Lee BS (2000). Economic review on dwarf apple farm by establishing type. 15th International Horticultural Congress, 524: 65-72.

Mert C, Soylu A (2010). Shoot location and collection time effects on meristem type culture of some apple rootstocks. Pak. J. Bot., 42(1): 549-557.
Mouron P, Scholz RW, Nemecek T, Weber O (2006). Life cycle management on Swiss fruit farms: Relating environmental and income indicators for apple growing. Ecol. Econ., 58 : 561-578.
Mouron P, Scholz RW (2008). Management influence on income risk in an apple production system on Swiss fruit farms, Int. J. of Fruit Sci., 7 (4): 47-70**.**
Ozer OO (2001). The economic analysis of controlling disease and pest which is apple production at farms in Tokat province (MS thesis), Ankara Univ., Natural Sci., Ankara.
Peck GM, Andrews PK, Reganold JP, Fellman JK (2006). Apple orchard productivity and fruit quality under organic, conventional, and integrated management. Hort. Sci., 41(1): 99-107.
Rebelo J, Santos A (2000). Applied technologies in apple production in the north of Portugal: A microeconomic evaluation. Proceedings of the 14th International Symposium on Horticultural Economics, 536: 301-310.
SPSS 15.0 (2006). SPSS base 15 user's guide. Chicago, pp: 210-212. ISBN: 0-13-241152-0, IL 60606-6412.
Strapatsa AV, Nanos GD, Tsatsarelis CA (2006). Energy flow for integrated apple production in Greece. Agric, Ecosyst, Environ., 116(3-4): 176-180.
Tanasescu N, Paltineanu C (2004). Fruit yield and tree growth for various irrigation methods at Pitesti-Maracineni in the Golden Delicious apple cultivar. Proceedings of the 4th International Symposium on Irrigation of Horticultural Crops, 664: 639-645.
Tareen MJ, Tareen AQ, Kamal JA, Siddiqui BD (2003). Influence of MM-106 and M-9 root stocks on Starking delicious apple. Int. J. Agric, Biol., 5(3): 339-340.
Tekintas FE, Kankaya A, Ertan E, Seferoglu HG (2006). Determination of performances of some apple cultivars budded M-9 grown in Aydin province. ADÜ J. Agric. Fac., 3(2): 27-30.
TUIK (2010). Statistical database. Available: http://www. turkstat.gov.tr.
Topcu Y (2008). Analysis of success in dairy farms: Case study of Erzurum Province. J. Facc Agric., OMU, 23(1): 17-24.
Uzunoz M, Akcay Y (2006). A profitability analysis of investment of peach and apple growing in Turkey. J. Agric. Rural Dev. Tropics Subtropics, 107 (1): 11-18.
Yildiz N, Akbulut O, Bircan H (2006). “Statistics” 5th ed, Aktif Press, Erzurum, Turkey, p. 135