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DETERMINATION OF THE POTENTIAL FIG (FICUS CARICA L.) AND CHESTNUT (CASTANEA SATIVA) PRODUCTION FIELDS WITH THE USE OF GEOGRAPHIC INFORMATION SYSTEM IN THE KOSK DISTRICT OF AYDIN PROVINCE

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Summary

In order to enhance the contribution of fig to the national economy and to raise farmers' income level, it is necessary to encourage further cultivation of fig and direct farmers to fig production instead of alternative products. Most of the areas suitable for chestnut production are forestlands. There are orchards arranged with oak and chestnut trees with oak being predominant. Chestnut population in these areas should be increased. Cultivation area of this product that has many fields of use needs to be extended. Directing farmers to products that are storable in medium term with a broad market and high income is important both for the national economy and the farmers. The purpose of the present study is to remind producers the significance of two important products: fig and chestnut in the Kosk district of the Aydin province, Turkey, and to determine the areas suitable for growing these products within the study area. For this purpose the questioning and analysis features of GIS was employed. In this study, rainfall, temperature, soil texture, slope, elevation, wind direction, were taken into account to identify appropriate fields. As a result, approximately area of 13886 hectare of fig production and 3430.7 hectare of chestnut production were found as suitable area.

Keywords: chestnut, fig, Geographic Information System (GIS), production areas, Aydın

INTRODUCTION

Fig is known as a product that has a history as old as the history of humanity and Turkey is the world leader in fig production and export. In addition, it is one of the fruits that have the oldest history of development among other fruits that are as old as human history. Its homeland is stated to be Turkey, from where it spread to Syria, Palestine and later to China and India through the Middle East (Anonymous, 2010). Although being a subtropical plant, due to its wide ecological adaptation capability fig is grown in the entire shore zone of Turkey. However, the most convenient areas for growing fig are the Buyuk Menderes and Kucuk Menderes basins. In Turkey, 80% of fig is grown in the Buyuk Menderes basin of Aydin Province, while the rest is grown in Izmir Kucuk Menderes. In Kucuk Menderes mostly dried fig production is carried out. Also, table fig cultivation is carried out in some regions of the country such as Marmara, Mediterranean, Black Sea and Southeastern Anatolia.

Chestnut agriculture in Aydin province is generally concentrated on the 600-m high fields on the northern side of the Buyuk Menderes River and on the southern slopes. In this sense the districts where most chestnut is produced are Nazilli, Sultanhisar, Kosk, Kuyucak and the central district. Having great economic importance for Aydin province, chestnut is a member of the Castanea genus of the Fagaceae family. Natural distribution areas of chestnut are particularly the temperate regions of the Northern Hemisphere such as China, Korea, Turkey, South Europe, North America, and Bolivia in the Southern Hemisphere. It is reported in some sources that chestnut was initially grown in the city of Kastanis (today's Kastamonu) in Anatolia, from where it got its name (Anonymous, 2009).

There are generally two approaches in defining what a Geographical Information System (GIS) is. GIS is defined, from technical aspect, as a body of robust instruments that collect, store, process, convert and display real world positional data. From theoretical/corporate perspective on the other hand, GIS is defined as a system that supports decision making through positional data interaction. By combining these two definitions, GIS can be defined as a digital information system that supports decision making and collects, stores, processes and displays positional data in line with the needs of the organization it is used by (Akca and Esengun, 2003).

GIS technology is widely utilized in the areas of computer based mapping, preparing city plans, land consolidation, determination of land and plot values by position, environment and natural resources management, geology applications, marketing, determination of shortest routes with lightest traffic, education, health (hospital services), military applications, tourism, planning of entertainment venues, determination of population density and population growth rates,

determination of crime and diseases distribution in cities and planning of service forces such as police and fire departments (Cosar and Engindeniz, 2011).

In the study conducted by Basayigit et al. (2008) thematic maps displaying the upper and lower limits and distribution of each soil characteristics on basin basis were generated. These maps were prepared with 1:00000 – 1:250000 scales and with details suitable for these scales. It was reported that the maps generated in the study constitute general information for researchers and those involved with plant growing, soil productivity, and plant nutrition and fertilization, and that they would provide preliminary information on the soil characteristics intended for fruit cultivation applications in areas within the boundaries of Isparta province.

In their study, Basciftci et al. (2013) used GIS to determine the yearly changes in water levels of 18 wells within the boundaries of the Konya Closed Basin and prepared the underground water database of the area. Due to unauthorized digging of wells and climatic and ecological events, underground water levels in the area have been falling and, by means of GIS, the authors monitored and set forth the decrease in water levels in the Konya closed basin.

Doygun and Erdem (2012) determined the interactions between area usage potential in Bornova district of Izmir province and the actual area usage structure by utilizing GIS and remote sensing technologies. The study conducted with the purpose of determining area usage potential showed that the district is mostly suitable for afforestation (45.98%) and that in its current state the lands in the district are used in accordance with the potential at a rate of 68.94%.

In the study conducted by Erdogan et al. (2013) a criterion that can be used as a base in Kutahya province urban development plan and intended to aid in the evaluation of proposed recreational areas was set forth. Within the scope of ecological land usage, 8 factors that enable the determination of recreational areas in the city center were taken into consideration. In the determination of the suitability value weights of the determined factors, Analytical Hierarchy Process (AHP) method was used due to its capability of making mathematical assessment in terms of consistency rate. Factor weights were determined by taking the consistency rate into consideration and receiving the opinions of 5 experts on recreational area arrangement. By comparing these factor weights with each other, their priority values were determined. Factor maps of the study area were superpositioned in GIS environment by using these priority values and in the end the proposed recreational areas were determined.

Sonmez and Sari (2004) reported that the use of GIS is essential in the evaluation of remote sensing data in a more comprehensive and accurate way, in obtaining continuous information on the real status of agricultural land use and change, and obtaining and utilizing precise information.

The purpose of the present study is to remind producers the significance of two important products such as fig and chestnut, and to determine the areas

suitable for growing these products within the study area. For this purpose it was planned to employ the questioning and analysis features of GIS.

MATERIAL AND METHOD

In the determination of the convenient spots for fig and chestnut trees in the study area temperature, precipitation, wind direction as well as other climate data, and data on the elevation, soil characteristics and slope were used in GIS environment. While the criteria taken as basis in determining the areas suitable to cultivate fig are presented in Table 1 (Anonymous, 2012), those that are used to determine areas suitable for chestnut are presented in Table 2 (Ozcagiran et al., 2007).

Table 1. Criteria taken as basis for fig

Criteria	Minimum	Optimum	Masimum
Precipitation	550 mm	625 mm	1200 mm
Temperature	-9°C	18°C – 20°C	40°C
pH		6-7.8	
Altitude	0 m	100 m – 600 m	700 m
Slope	% 0	% 15 – 30	% 70
Aspect	Better develops on sun-exposed south-facing slopes.		
Soil characteristic	Sandy loam alluvial soils that rich in lime.		

Table 2. Criteria taken as basis for chestnut

Criteria	Minimum	Optimum	Maximum
Precipitation	600mm	1000mm	1600mm
Temperature	-30°C	10°C – 15°C	35°C
pH		5-6.3	
Altitude	600m	800m-1200m	1400m
Slope	%10	%50	%70
Aspect	In north-facing slopes after 1400 meter, if there is no prevailing wind from the north there is no problem for cultivation		
Soil characteristic	Calcifuge (ideal %1, maximum %4)		

GIS applications were carried out through ARC GIS software. The study was based on making evaluations in GIS environment by using the integration

of previously prepared numeric and textual data with the data processed on topographic maps. By storing and analyzing these data in GIS environment as map layers, the potential fig and chestnut cultivation areas are determined. The topographic maps used were the 1:25000 scaled topographic maps of the Kosk district as the study area (m20a4, m20a2, m20a1, m19b3 and m19b2). The coordinate values present in four corners of each topographic map were entered into the GIS environment and coordinate assignation was carried out with the 'rectify' command.

Precipitation and temperature data, soil structure and direction values were gathered and digitalized in the GIS environment. Elevation values from topographic maps were processed exactly in the GIS software. Contour lines were drawn for every increment of 5 m and the related elevation values were inscribed on each contour line. By calculating the areas between these values, slope index map was prepared. A separate map was generated for each criterion. By superpositioning these values the areas suitable for fig and chestnut production were tried to be determined.

RESULTS

According to reference criteria, areas at and higher than 700 m elevation are not suitable for fig production in terms of quality and productivity. Therefore, in Figure 1 the areas suitable for production in terms of elevation were shown with brown color and areas with elevation higher than 700 m were marked with blue. It was determined that cultivating chestnut instead of fig would be more convenient in areas marked with blue.

In Figure 2, at first the map was divided into two as the areas suitable and not suitable for fig cultivation and the areas determined not to be convenient were marked with purple. These areas were calculated by taking the values from Anonymous (2012) into consideration. Determination of areas suitable and not suitable for fig was based on the elevation factor. On the map, the areas at 700 m and higher elevation were indicated as not suitable for fig production. In drawing the map, areas suitable and not suitable for production were tried to be determined by using also other data (slope, direction, soil group). The areas around Beykoy, Ovakoy, Ciftlik villages, Bascayir Creek and Kocak Creek were determined as 1st degree suitable areas. While the areas around Kosk District center, Yavuzkoy, Mezekoy, Uzundere, Bascayir and Karatepe were determined as 2nd degree suitable areas for fig production, areas around Akcakoy, Ilidag, Gondogan and Menteseler were determined to have 3rd degree suitability.

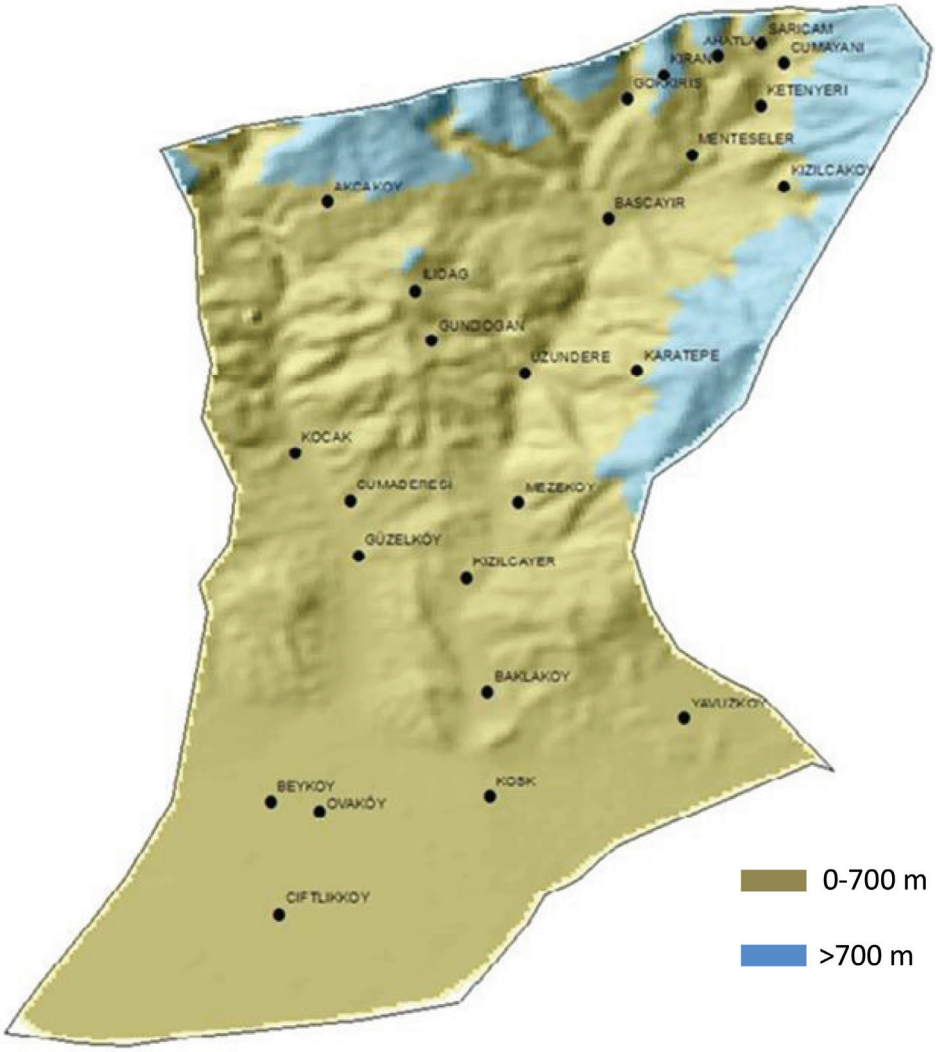

Figure 1. District-base elevations convenient for cultivating figs

Figure 3 presents the elevations suitable and not suitable for chestnut cultivation. According to the elevation criteria on which the study of Ozcagiran et al. (2007) was based, chestnut yield and quality increase at elevations higher than 600 m. From the data obtained from the map, the maximum elevation of the study area was determined to be 1410 m. The areas between 600 m and 1500 m elevation shown in purple in Figure 3 were determined to be suitable for chestnut

cultivation. During the determination of the production areas suitable for chestnut, once again the elevation factor was addressed as the most significant factor.

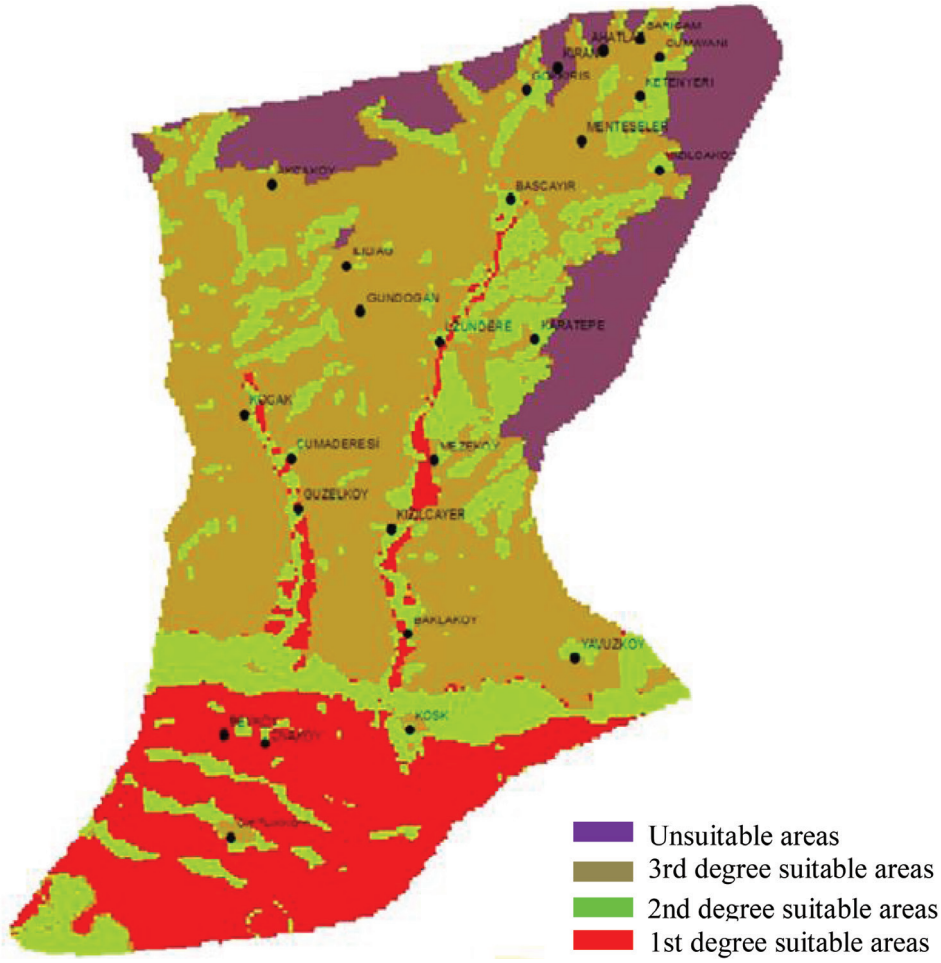

Figure 2. Areas suitable for fig cultivation

Figure 4 was prepared in order to set forth production areas suitable for chestnut more clearly. While the blue areas are suitable for chestnut cultivation, the pink areas are not. These areas were calculated with the use of the values obtained from Ozcagiran et al. (2007). The primary factor is the elevation shown in Figure 3. By adding slope, direction and soil group data on this criterion, 3 degrees of classification was made. Karatepe, Kizilcakoy, Saricam, Cumayani,

Ketentyeri, Ahatlar, Kiran, Gokkiris, Akcakoy villages and their vicinities were determined as the areas suitable for chestnut production.

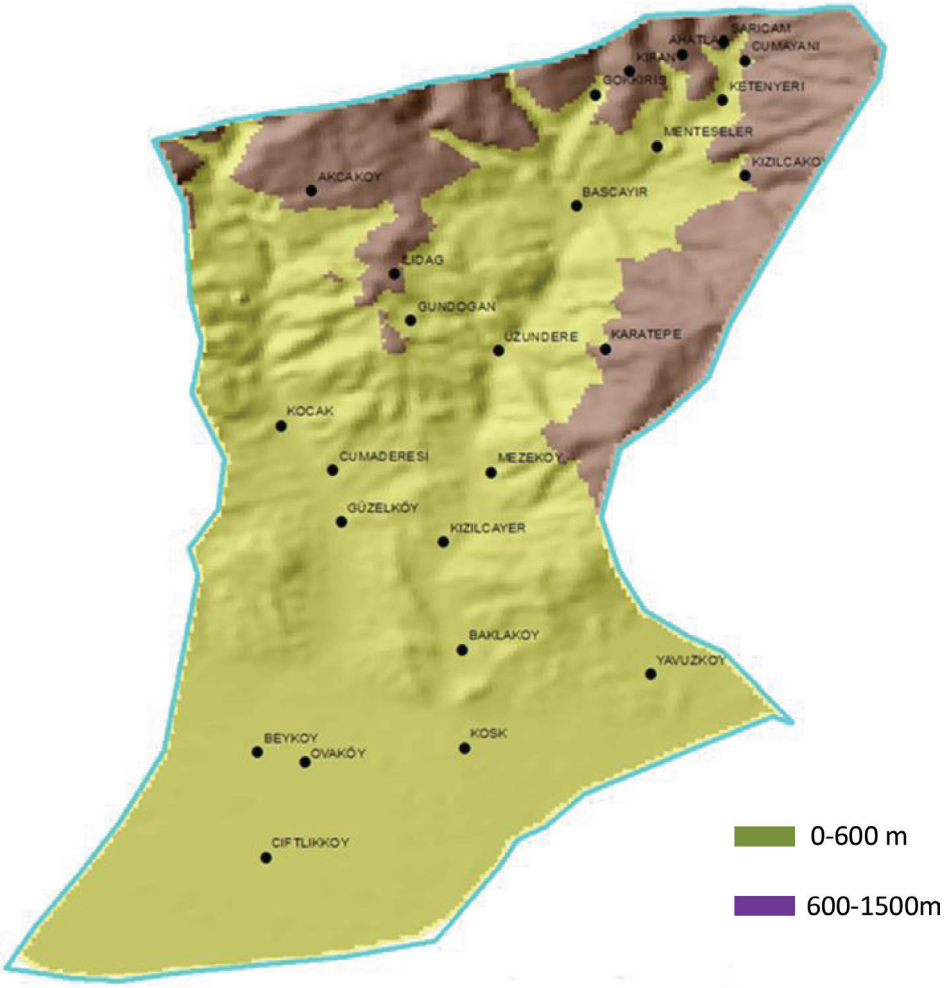

Figure 3. District-base elevations convenient for cultivating chestnut

It was determined that the Kosk district has a 2450 ha of fig production area with 15 kg average yield per tree and 5865 tons of fig production. Chestnut, on the other hand is produced in an area of 1600 ha. Average yield per tree is 50 kg and the total annual production is 4927.5 tons. The production areas determined in conclusion of the study for fig and chestnut are presented in Table 3.

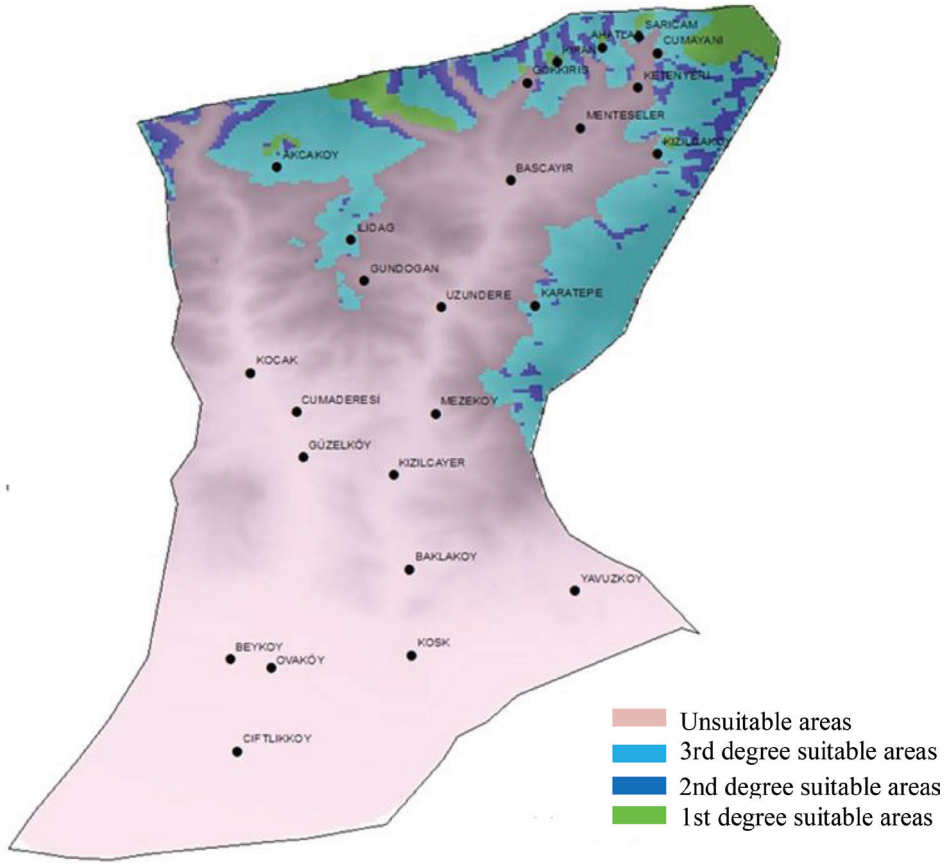

Figure 4. Areas suitable for chestnut cultivation

In the study area, the areas suitable for fig and chestnut production were determined to be approximately 13885.8 ha and 3430.7 ha respectively. Each product was divided into 3 groups according to the degree of suitability. Areas with 1st, 2nd and 3rd degree of suitability were calculated in accordance with the examined criteria. In addition to the area that is currently used for fig production (2450 ha) there is an 11436 ha area that is suitable, yet not utilized. Instead, mostly olive production is carried out in this area.

The area suitable for growing figs is 13885.8 ha. This constitutes 86.1% of the total area of 16127.4 ha. Yet, in the current state fig production is carried out only in an area of 2450 ha (15.2%). In other words, it is possible to cultivate figs in 86% of the study area. The area where chestnut production is carried out

is 1600 ha (9.9%). However, it was determined that chestnut production can be carried out in an area of 3430.7 ha (21.28% of the total area).

Table 3. Production areas determined for chestnut and fig production in Kosk District (ha)

	Chestnut	Fig
1st degree suitable areas	345.9	3303.7
2nd degree suitable areas	482.1	3295.1
3rd degree suitable areas	2602.6	7286.9
Total suitable areas	3430.7	13885.8
Unsuitable areas	12690.2	2241.5

CONCLUSIONS

In order to enhance the contribution of fig – a fruit Turkey has a large share in export both in dried and fresh state – to the national economy and to raise farmers' income level, it is necessary to encourage further cultivation of fig and direct farmers to fig production instead of alternative products. Most of the areas suitable for chestnut production are forestlands. There are orchards arranged with oak and chestnut trees with oak being predominant. Chestnut population in these areas should be increased. Cultivation area of this product that has many fields of use needs to be extended. Directing farmers to products that are storable in medium term with a broad market and high income is important both for the national economy and the farmers.

In recent years, certified saplings were distributed in the study area. It is essential to ensure that such activities will continue in the following years. Furthermore, trainings promoting the conversion of olive gardens into fig orchards in areas suitable for fig production should be carried out in farmer meetings. The main reason necessitating this convertion is the fact that, since olive gardens in the study area are established on steep slopes their culture related maintenance and disease and pest control cannot be carried out properly. Olive and olive oil yields in the olive gardens established on flat or mildly sloped fields of the Mediterranean and the Southeastern Anatolia Regions are considerably high due to the convenient means for keeping the gardens, harvesting products and fighting against diseases and pests. In the study area, however, due to the inconvenient

conditions of the field olive yields are low and harvest costs are high. Accordingly, the desired level of olive yield cannot be obtained from the olive gardens in the study area.

The prevalence of chestnut growing culture in the study area, the areas proximity to the market (Izmir and Izmir Port) and the high level of yield obtained with low maintenance increase the importance of chestnut orchards for the area. In addition, the facts that the area is rich in terms of chestnut diversity, the field is mostly sloped, the winds are mixed and insect population in the area is dense enhance pollination and constitute the optimum chestnut growing environment. However, instead of these two products, the local farmers mostly plant olive, apple, pear, cherry and walnut trees, all of which have different forms of growing, in the area and thereby occupy the area where chestnut and fig can easily grow. In order to increase the number of chestnut orchards in the area, establishment of collection (mixed) type of orchards has to be stopped. In any case, the return of the trees other than chestnut trees in such orchards is quite low. Therefore, it is considered that the removal of oak trees will be convenient in order to improve and enhance chestnut production in the area.

Both of the products examined in this study are suitable for processing and belong to the Turkish cuisine and Turkish culture of food. They are in high demand in foreign markets. The number of the countries that can compete with Turkey in terms of fig production is especially very limited, and there is a significant difference in production amounts between Turkey and the country following it. It is considered that a greater contribution to the national economy and to farmers' income can be achieved by further increasing this production, encouraging farmers to produce quality products and promoting the product both domestically and internationally.

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