Assessment and Classification with GIS of Land Use, Capability Classes and Land Types in Kayseri Province of Turkey

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Abstract

This study was carried out to determine land use capability, current land use and subclasses, land types in Kayseri province of Tukey. Arc GIS 10.3.1 program from Geographical Information Systems software was used in classification processes. For spatial analysis, 1/25.000 scaled digital soil maps were used as digital base maps. As a result of classification; The highest land class in Kayseri is VI. class land and its total area is calculated as 9210.79 km^2. Considering the current land use, it is dry marginal agricultural areas with the highest surface area and its total area is 4850.69 km^2. The lowest surface area is the area covered by the vineyards, which is 102.91 km^2. The areas exposed to slope and erosion damage due to soil insufficiency cover an area of 10525.67 km^2. The areas with soil insufficiency with flood damage were seen in an area of 93.32 km^2. The areas with bare rocks and debris are 16789.13 km^2. The areas with river floodplains, reed marshes and coastal dunes with the lowest surface area were observed in an area of 21.76 km^2. As a result of the study, digital base maps were created showing the land use capabilities, current land use, land use capability subclasses and land types of Kayseri province.

Keywords: GIS, Spatial Assessment, Land Use, Kayseri Province, Turkey

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1.INTRODUCTION

Agricultural lands, the formation of which took thousands of years, is the only resource that cannot be produced and is almost impossible to renew. For the development of countries and raising the living standards of people, there is an obligation to use and manage agricultural lands in a sustainable way. Sustainability of soils is possible by examining and monitoring soil resources adequately and defining the characteristics of these areas in the best way (Özyazıcı et al., 2016).

On the other hand, it has become a necessity to know the physical and chemical properties of the soils well and to take the necessary measures according to these properties for the sustainability of our agricultural lands, which are getting narrower and rapidly polluted as a result of industrialization and unplanned urbanization (Taban et al., 2004). In the total area of 510,072,000 km^2 in the world, 148,940,000 km^2 of land is formed, while 361,132,000 km^2 of water is water. Relative to the total area of the Earth, the water area constitutes 70.8%.

Turkey's total surface area is 783,577 km^2, in other words, it is 78 million hectares. When the dam and natural lakes are removed, the remaining area is 769,600 km^2. Mountains cover more than half of Turkey's territory. The remaining part is plain, plateau, rough terrain and flat hills. Turkey's 190,000 km^2 area consists of plains of varying heights, which are covered with alluvial plains. Plateaus cover an area of 80,000 km^2. The sum of the plains and plateaus corresponds to an area of 270,000 km^2, which is 1/3 of the surface area of Turkey. It can be said that there are 370,000 km^2 of plains in Turkey, apart from the mountainous areas, with 100,000 km^2 of rough and flat hills that are relatively easy to cultivate. The total of agricultural lands is 280,000 km^2, that is, around 28 million hectares. Soil resources in Turkey, while the agricultural area is 28.05 million hectares, the irrigable area is 25.75 million hectares. While the dry agricultural area is 7.25 million hectares, the irrigated area is 5.90 million hectares (Anonymous, 2014).

Turkey is not rich enough in terms of soil and water resources. When the data showing the characteristics and distribution of the land capability classes determined according to the interpretations of the soil surveys updated in 1982-1984 are examined; It is seen that the lands that need to be protected constitute approximately one fourth of our country, while the lands suitable for all kinds of agriculture remain only 6.5% (Tomar, 2009). In Turkey, all of the 77 million hectares of country lands suitable for cultivated agriculture have been taken into agricultural use, and even the 5.5 million decares VI. and VII. class lands have been opened for agricultural use (Canpolat, 1981).

The most important problem in the agricultural planning studies carried out to date has been the lack of some national soil data, the lack of updateability or the inability to access the existing data on a regular basis. The European Union, which is in the process of harmonization, has to prepare up-to-date databases that will be integrated into international information systems related to natural resources, especially soil. For this purpose, it is necessary to establish bases and databases of different scales, which will enable the exchange of information on our soil resources at national and international level. With the use of Geographic Information Systems (GIS) and Remote Sensing (UA) techniques; It will also be possible to make quick, accurate and objective decisions in the planning of the management and use activities of agricultural lands (Özyazıcı et al., 2016).

The main function of information systems is to facilitate the decision-making process and to shorten this process (Yomralıoğlu, 2000). Difference of Geography Information Systems from information systems; The system includes location information in addition to the attribute information of different objects (Sağlam et al., 2004).

Geography Information Systems (GIS) is an information system created for collecting, entering, storing, querying, spatial analysis, displaying and outputting spatially based information (graphics and attributes) in computer environment (Aranoff, 1989).

While GIS was developed mostly for computer aided map assembly in the early 1960s, it has turned into a technology that serves different purposes in many fields today (Yomralıoğlu, 2000).

This study includes important information that will shed light on the strategies that can be formed in terms of agricultural areas and soil fertility related to the soil data of Kayseri province. The spatial distribution of land use capabilities, current land use, land use capability subclasses and land types has been revealed in this research, which is based on the province of Kayseri in the Central Anatolian region.

2.MATERIALS and METHODS

The study area, the province of Kayseri, is located in the Middle Kızılırmak section, where the southern part of the Central Anatolian Region and the Taurus Mountains converge. It is located between 37°45' and 38°18' north latitudes and 34°56' and 36°58' east longitudes. It is surrounded by Sivas in the east and northeast, Yozgat in the north, Nevşehir in the west, Niğde in the southwest, Adana and Kahramanmaraş in the south. The area of the province is 17,109 km² (Anonymous, 2018).

Agriculture; In the economy of Kayseri, it comes after industry, trade and transportation sectors. 671,000 hectares of land is used in agriculture. This amount corresponds to 40% of the provincial territory. 13% of the provincial industry is non-agricultural, 6% is meadow-pasture, 41% is forest heathland. 48% of the agricultural land is reserved for grain cultivation and 42% is left fallow. The remainder is devoted to legumes, industrial crops, oilseeds, tubers, vegetables and fruit growing. 150,000 hectares of 607,000 hectares of irrigable land can be irrigated economically. As the irrigation capacity increases, the productivity in irrigated agriculture will increase 5-6 times, and the construction of irrigation projects continues (Anonymous, 2018).

While the province of Kayseri consists of 16 districts, namely Akkışla, Bünyan, Develi, Hacılar, İncesu, Kocasinan, Melikgazi, Pınarbaşı, Sarıoğlan, Sarız, Tomarza, Yahyalı, Talas, Özvatan, Felahiye and Yeşilhisar, there are also 395 villages connected to the province and district (Anonymous, 2018). The location and location of the province of Kayseri, which is the subject of the research, is shown on the map given in Figure 1.

Figure 1. The location of Research Area in Kayseri Province

Arc GIS 10.3.1 program, one of the Geography Information Systems software, was used in order to classify some land use characteristics of Kayseri province. In addition, the basic base data regarding the razi structure of the province of Kayseri were provided with the help of 1/25.000 scaled digital soil maps. (Anonymous, 2000; Anonymous, 2010).

In the study, all classification processes were evaluated according to the "Soil and Land Classification Standards Technical Instruction" published by the Ministry of Agriculture and Rural Affairs in 2005 (Anonymous, 2005). The numerical layers used in spatial analysis of land use are given in Table 1 and the classification process steps are given in Figure 2.

Table 1. Classification layers (Anonymous, 2005).

Land Use Capabilities	
I	Flat surface, deep, fertile and easily cultivable soils
II	Easily processed, moderate erosion, moderately thick soil
III	Moderate terrain, moderate inclination, excess sand
IV	Bad drainage, bad soil characters, too inclined
V	Good soil cover for grazing and tree felling
VI	It is highly prone and subject to severe erosion
VII	Very batter, stoned, dry, some other unfavorable lands
VIII	Highlands, stony lands, very deep cove

Current Land Use
Forest Areas
Water Surfaces
Settlements
Fruit Trees
Meadow and Pasture Areas
Industry and Mining Areas
Prairies
Dry Marginal Agricultural Areas
Dry Absolute Agricultural Areas
Watery Absolute Agricultural Areas
Vineyards
Watery Marginal Farmland
Juicy Special Product

Land Types
Naked Rock and Rubble
River Floodplains Beds
Reeds Marshes
Coastal Dunes
Other

Land Use Capability Subclasses
Slope and erosion damage
Soil Insufficiency
Wetness , Gizzard Disorder

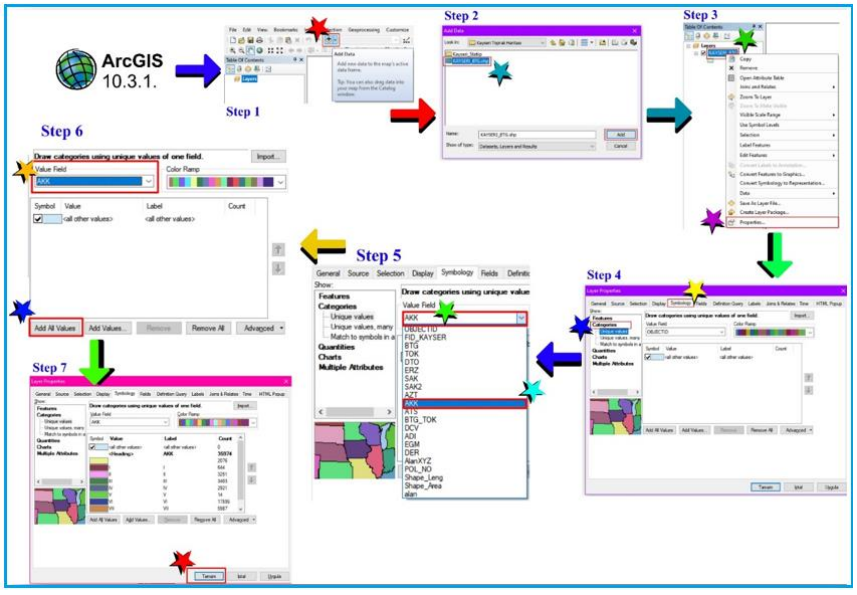

Figure 2. Spatial Analysis Steps in Classification of Land Use Capability

3. RESEARCH FINDINGS

In this research, land use capability classes, existing land uses, land use capability subclasses and land types layers were analyzed by using 1/25.000 scaled digital soil maps of Kayseri province and the results are presented below under headings.

3.1. Spatial Analysis Results of Land Use Capabilities

The distribution of land use capability classes obtained in the spatial analysis results made in the Arc GIS using digital soil maps of Kayseri province is given in Figure 3.

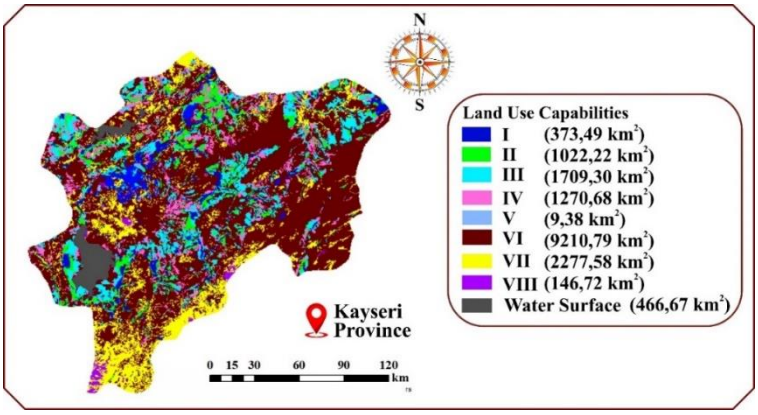

Figure 3. Spatial analysis of land use capability

Class I land in the province of Kayseri is calculated as 373.49 km^2. II. Class land area was determined as 1022.22 km^2 and the area covered by water surfaces throughout the province was determined as 466.67 km^2. VI. Class land covers the largest area and its total area is calculated as 9210.79 km^2.

3.2. Spatial Analysis Results of Current Land Use

The spatial distribution of land use in the results of spatial analysis using digital soil maps of Kayseri province is shown in Figure 4.

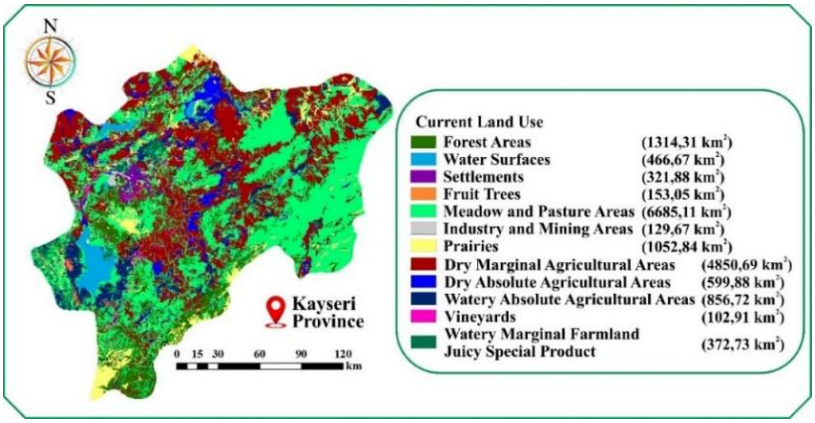

Figure 4. Spatial Analysis of Current Land Use

The surface area covered by forest areas in Kayseri is 1314.31 km^2. Settlements are 321.88 km^2, Fruit trees are 153.05 km^2 Meadows and pasture areas cover an area of 6685.11 km^2. The surface area of industry and mining areas is 129.67 km^2. Steppe areas are 1052.84 km^2, dry marginal agricultural areas are 4850.69 km^2, dry absolute agricultural areas are 599.88 km^2, and irrigated absolute agricultural areas are 856.72 km^2. The surface area of the vineyards has been calculated as 102.91 km^2 and the irrigated marginal agricultural areas and irrigated special crop areas as 372.73 km^2.

3.3. Spatial Analysis Results of the Land Use Capability Subclass

The spatial analysis distributions of the land use capability subclasses obtained in the spatial analysis results using 1/25.000 scaled digital soil maps are shown in Figure 5.

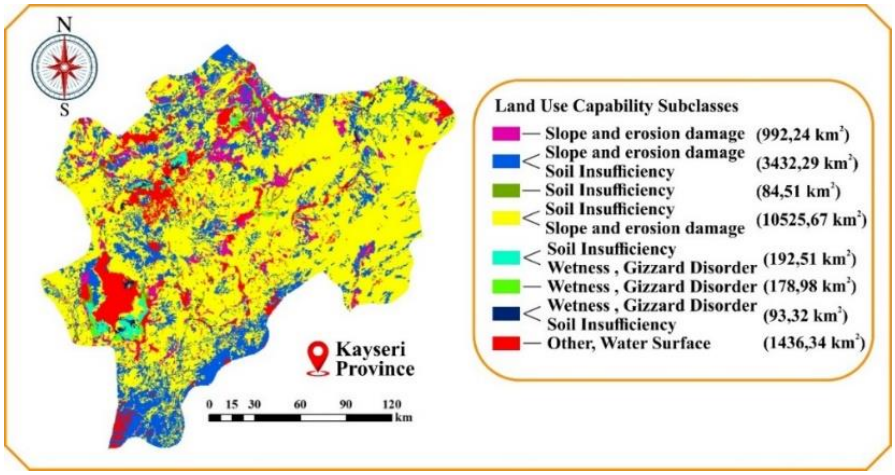

Figure 5. Spatial Analysis of Land Use Capability Subclasses

The areas with slope and erosion damage were determined as 992.24 km^2, the areas with soil deficiency with slope and erosion damage were determined as 3432.29 km^2, and the areas with soil failure were determined as 84.51 km^2. The surface area of the slope and erosion damage class with soil insufficiency is 10525.67 km^2. With soil insufficiency, the surface area of wetness, drainage disorder or flood damage class is 192.51 km^2. The surface area of the flood damage class is 178.98 km^2, and the surface area of the flood damage class is 93.32 km^2. The surface area of other and water surfaces is 1436.34 km^2.

3.4. Spatial Analysis Results of Land Types

The distribution of land types obtained from the spatial analysis results of Kayseri province is shown in Figure 6.

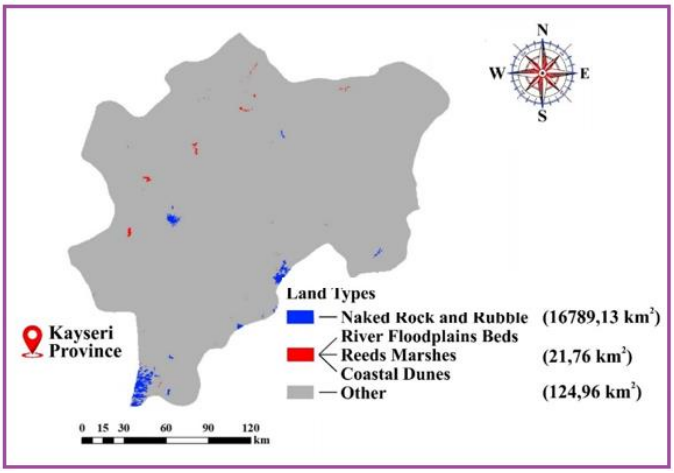

Figure 6. Spatial Analysis of Land Types

When Kayseri province examines the geographical-spatial analysis of land types, the areas with bare rocks and debris are 16789.13 km^2. The surface area of the class, which has river floodplains, reed marshes and coastal dunes, is 21.76 km^2.

CONCLUSION and RECOMMENDATIONS

In this study, analyzes of land use and land types of Kayseri province were carried out. In the analyzes made, the land uses, land use tribes subclasses and land types and existing land uses of the province of Kayseri were spatially analyzed. As a result of the study, a database on land uses was created in the GIS. The schematic view of the created database is shown in Figure 7.

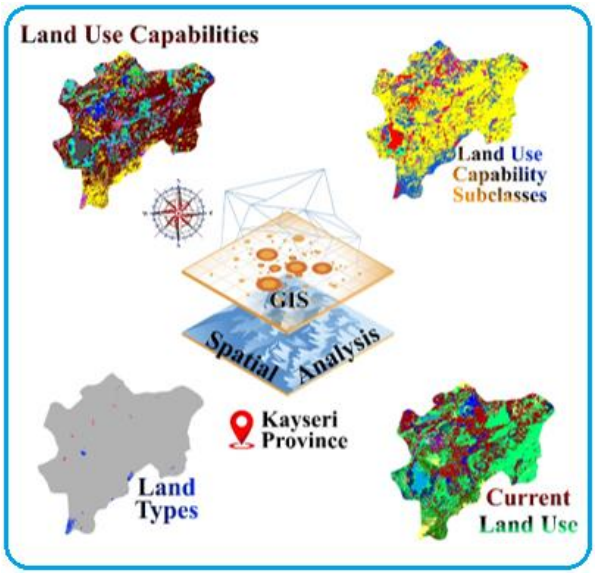

Figure 7. Kayseri Province Land use and land types database

The lowest surface area of land use capability of the province of Kayseri, Class V land area was seen as 9.38 km^2. The highest VI. class land area is calculated as 9210.79 km^2. Considering the current land use, the surface area of dry marginal agricultural areas with the highest surface area is 4850.69 km^2. The lowest surface area is the vineyards and the surface area is 102.91 km^2.

The area with the highest surface area according to the subclass of land use capability is the areas exposed to soil failure, slope and erosion damage. The lowest surface area is the soil failure class with flood damage and its surface area is 93.32 km^2.

The areas with bare rocks and debris cover an area of 16789.13 km^2. The surface area of the class, which has the lowest surface area, river floodplains, reed marshes and coastal dunes, is 21.76 km^2.

This and similar studies are frequently encountered in the literature. For example, studies have been carried out in the provinces of Niğde, Nevşehir, Kırşehir and Kayseri to evaluate the land and soil characteristics in the GIS environment. In the aforementioned studies, 1/25.000 scale digital soil maps were used and Arc GIS program, which is one of the Geography Information Systems software, was used effectively in these studies. (Bağdatlı and Arslan, 2020; Bağdatlı and Can, 2021a; Bağdatlı and Arslan, 2021; Bağdatlı and Ballı, 2021; Bağdatlı and Can; 2021b; Bağdatlı and Arıkan, 2021; Bağdatlı and Öztekin, 2021).

As a result of this research, a database of land use in Kayseri province was created. It will be inevitable that the results obtained will make important contributions to the investor organizations that are or will display agricultural activities in the region.

REFERENCES

Anonymous 2000. Sayısal Toprak Haritaları, Mülga Köy Hizmetleri Genel Müdürlüğü, Ankara (in Turkish)

Anonymous 2010. Arc GIS 10.3.1 software, ESRI Environmental System Research Institute, Redland, CA, USA

Anonymous 2005. Toprak ve Arazi Sınıflaması Standartları Teknik Talimatı, https://www.mevzuat.gov.tr/MevzuatMetin/1.5.5403.pdf (Access Date: 16.04.2020) (in Turkish)

Anonymous 2014. Türkiye Toprak Su Kaynakları, http://www.dsi.gov.tr/toprak-ve-su-kaynaklari, Erişim Tarihi (08.04.2020) (in Turkish)

Anonymous 2018. Kayseri İli Hakkında, ,https://kayseri.csb.gov.tr/ilimiz-hakkinda-i-768 Erişim Tarihi (11.04.2020) (in Turkish)

Aranoff S. 1989. Geographical Information Systems: A Management Perspective", WDL Publications, Ottawa, Canada.

Bağdatlı M. C. & Arslan O. 2020. GIS Mapping of Large Soil Groups, Current Land Use, Soil Depths and Slopes, Soil Erosian in Kırsehir Province of Turkey, *World Research Journal of Agricultural Science (WRJAS),* 8(1):265-277

Bağdatlı M.C. & Can E. 2021a. Spatial Evaluation of Land and Soil Properties in the Example of Nevşehir Province, Turkey, *International Journal of Engineering Technologies and Management Research (IJETMR), 8(7):90-103,* doi:10.29121/ijetmr.v8.i7.2021.1007

Bağdatlı M.C. & Arslan O. 2021. Classification and Mapping of Land Use and Some Soil Properties in Kırşehir Province, Turkey, *International Journal of Engineering Technologies and Management Research (IJETMR), 8(8):81-93,* doi: 10.29121/ijetmr.v8.i8.2021.1022

Bağdatlı M.C. & Ballı Y. 2021. GIS Mapping of Land Slopes, Soil Depths, Erosian Classes, Large Soil Groups and Some Soil Properties: A Case Study of Kayseri Province in Turkey, *Universal Journal of Agricultural Research, 9(5):166-175,* doi:10.13189/ujar.2021.090503

Bağdatlı M.C. & Can E. 2021b. Spatial Analysis of Soil Resources Potential by Using Geography Information Systems (GIS): A Case Study from Thrace Region, Turkey, *International Journal of Innovative Research and Reviews (INJIRR),* 5(2): 45-50

Bağdatlı M.C. & Arıkan E.N. 2021. Assessment of Some Land Properties by Using GIS in Niğde Province of Turkey, *International Journal of Recent Development in Engineering and Technology (IJRDET),* 10(11):1-9

Bağdatlı M.C. & Öztekin M. E. 2021. Determination of Land Use Capabilities by GIS Analysis in Nigde Province, Turkey, *Eurasian Journal of Agricultural Research (EJAR), 5(2):121-129,* ISSN: 2636-8226

Canpolat O. 1981. Türkiye Topraklarının Tarımsal Kullanıma Uygunluk Bakımından İncelenmesi. *DSİ Toprak ve Su Kaynaklarının Geliştirilmesi Konferansı Bildirileri,* Cilt 1, s. 326-336, Ankara. (in Turkish)

Sağlam A., Düzgün H.S.B. & Usul N. 2004. Çanakkale Savaşlarına Farklı Bir Yaklaşım: Coğrafi Bilgi Sistemlerinde Gelibolu 1915, Çanakkale Araştırmaları Türk Yıllığı - The Turkish Yearbook of Gallipoli Studies, Çanakkale Onsekiz Mart Üniversitesi Atatürk ve Çanakkale Savaşları Araştırma Merkezi, Sayı 2, Sayfa:117-133, Çanakkale (in Turkish)

Özyazıcı M.E., Dengiz O., Aydoğan M., Bayraklı B., Kesim E., Urla Ö. ,Yıldız H. & Ünal E. 2016. Orta ve Doğu Karadeniz Bölgesi Tarım Topraklarının Temel Verimlilik Düzeyleri ve Alansal Dağılımları, *Anadolu Tarım Bilim. Dergisi, s.136-14* (in Turkish)

Taban S., Çıkılı Y., Cebeci F., Taban N. & Sezer S.M. 2004. Taşköprü Yöresinde Sarımsak Tarımı Yapılan Toprakların Verimlilik Durumu ve Potansiyel Beslenme Problemlerinin Ortaya Konulması, *Tarım Bilimleri Dergisi, 10(3): 297-304.* (in Turkish)

Tomar A. 2009. Toprak ve Su Kirliliği ve Su Havzalarının Korunması, *TMMOB İzmir Kent Sempozyumu,* Page 333 – 345 (in Turkish)

Yomralıoğlu T. 2000. Coğrafi Bilgi Sistemleri Temel Kavramlar ve Uygulamalar, *Akademi Kitabevi,* 2. Baskı. (in Turkish)