

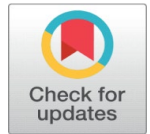
CLASSIFICATION AND MAPPING OF LAND USE AND SOME SOIL PROPERTIES IN KIRŞEHİR PROVINCE, TURKEY



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ABSTRACT

In this study, land use capabilities, land types and other soil properties of Kırşehir province were classified and analyzed. In the study, 1/25.000 scale digital soil maps obtained from the Ministry of Agriculture and Forestry (Turkey) were used. Numerical data were classified using Arc GIS 10.3.1 software, which is one of the GIS software. As a result of the research; In general, It was observed that IV. class lands were formed in the Kırşehir province IV.class lands were found to be 1658.3 km² and it was determined that they cover 25% of the total area. It is seen that soil insufficiency is high in Kırşehir province due to slope and erosion damage. Soil insufficiency due to slope and erosion damage was found to be 3520.7 km² and it was determined that 54% of the total area was exposed to this effect. It has been observed that the land type is generally composed of steppe, bare rocks and rubble. It was determined that the area formed by bare, rocks and debris is 1128.5 km². It has been determined that the stony soil areas are 1094.2 km². As a result of the study, classified map outputs related to land uses and some soil properties were obtained. It will be inevitable that this research will provide important database bases for other studies to be carried out in this region in the future.

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Keywords: Land Use Capabilities, Soil Properties, Classification, GIS Mapping, Kırşehir Province, Turkey

1. INTRODUCTION

Water and soil, which are the main factors in the development of societies, which people have been fighting for ages to find, also caused the collapse and disappearance of many civilizations in the past. Soil is a three-dimensional living entity that covers the outside of the supply, consists of a mixture of various decomposition products of rocks and organic materials, contains a wide world of living things inside and on it, is a stopping place and food source for plants, and contains water and air in certain proportions (Akalan (1977)).

Soil is a resource that takes centuries to form and is impossible to produce. According to Bozyiğit (2020), soil formation is an important part of the stony sphere, which gains importance day by day with its properties, use and protection. Soil is an environment that nourishes and hosts the living things living on and in it, thanks to the nutrients it contains and the cycle of substances that enable the reproduction of these nutrients.



Water and food are an indispensable source of life for all living things. It has been effective in the settlement in terms of agriculture and life source of civilizations from past to present. Therefore, it is important to protect soil resources.

The most important issue in the protection of soil resources potential is to determine the current situation and to determine the attitudes towards forward projection and to put forward the measures that can be taken (Bağdath et al. (2014).

The rapid increase in the population in the world and in our country has been effective in the increase in consumption and the development of the industry. This increase and consumption has been effective in the wrong and unconscious use of natural resources. Since the agricultural sector constitutes approximately 15% of national income, 45% of employment and 14% of exports, it is a social sector as well as an economic one (Tekinel (2004). This rapid increase and the increase in the need for agricultural products, the acceleration of soil erosion as a result of the destruction of forests, the deterioration of hydraulic conditions, the expansion of agricultural areas to the detriment of natural plant communities, excessive grazing, changes in agricultural methods and technology, especially the use of artificial fertilizers and pesticides. The reasons such as the fact that it has been used to a large extent have led to serious deterioration and pollution in the soil ecosystem in many countries (Sönmez (1995). Accordingly, global climate change and global warming also affect the soil structure. As a result of global warming, excessive carbon emissions into the atmosphere and the mixing of toxic gases and precipitation in the form of acid rain affect the soil and plant structure. Especially as a result of acid rains, pH changes will occur in the soil. In addition, increasing urbanization, the increase in the use of pesticides, solid wastes change the soil structure, but also affect the water quality of the underground water resources and the existing water source by infiltration. For this reason, the sustainability of existing soil and water resources is an important factor. For this, detailed soil survey and mapping studies are of great importance in the sustainable use of soil and water resources, in future planning (Anderson et al. (1976).

Soil maps produced as a result of soil survey and mapping studies and related reports form a soil database for users. This database is used in agricultural planning, modeling of environmental impacts, in various engineering branches and in planning and protection of natural resources (Dengiz and Sarioğlu (2011).

Currently, the existing database on soil resources in our country is based on the soil surveys conducted between 1966-1971. The most qualified research on Turkey's soils to determine soil quality and fertility is the "Turkey Soil Productivity Inventory Project (TOVEP)" conducted by General Directorate of Village Services in Turkey (Karaca et al. (2019).

Within the scope of this project, the nitrogen, phosphorus and potassium status of the soils, which are the basic plant nutrients, and the organic matter, pH, lime status and texture classes of the soils were examined, and the results were published under the name of "Provincial Fertility Inventory and Fertilizer Needs Reports" with 1/100.000 scale maps. (Özyazıcı et al. (2014). Geography Information Systems (GIS) has an important place in digitizing maps. According to Başıyigit et al. (2008), Geography information systems are capable of displaying the spatial information of the collected data, using graphics and quality information simultaneously, contributing to the solution of management, planning and analysis problems by integrating data from different information sources, providing standardization in

information exchange and combining maps and tables . It will also be effective in using soil data in agricultural production.

Specially in agricultural production, plant pattern estimation in agriculture, yield estimation, determination of meadow and pasture areas, determination of fallow areas, monitoring of plant development, soil classification, irrigation and drainage studies, water resources protection planning, resource estimations related to agriculture and animal husbandry, determination of rural settlements GIS can be used for many agricultural purposes such as (Delibaş et al. (2015).

According to Kılıç et al. (2017), agricultural production, which has a great importance especially in the country's economy, it is thought that the efficiency of plant production will increase with soil maps created and appropriate management plans and fertilization in areas where agricultural production is made.

In this context, by using Arc GIS 10.3.1 software, the digital soil maps of the land and soil characteristics of Kırşehir province were classified by layering the soil map, and the land use capability classes, land use capability subclasses, land types and other soil characteristics related to the study area. has been revealed. In this way, by sharing the research results, it will make important contributions to the investor organizations that will invest in the region and contribute to agricultural production.

2. MATERIAL AND METHOD

This study was carried out in the province of Kırşehir, which is located in the Central Anatolia region in Turkey. Kırşehir province is located in the Central Kızılırmak Section of the Central Anatolia Region. The location of the province is between 38°50' -39°50' north latitudes and 33°30' -34°50' east longitudes, and it is between Nevşehir, Aksaray, Kırıkkale, Yozgat and Ankara and neighboring province borders (Kıymaz (2011).

Kırşehir has a continental climate with cold and snowy winters and hot and dry summers. Kırşehir has a semi-arid climate. The annual average temperature in the province is 11.3 °C, and the annual precipitation is less than 400 mm (Anonymous (2008). There are a total of 6 districts and 189 villages in Kırşehir province (Anonymous (2020). It has a surface area of 6570 km² and its height from the sea is 985 m. The breadth of the province's territory is 8 per thousand of the country's territory, and 2.9% of the Central Anatolian Region. (Anonymous (2008). Kırşehir province has 657679 hectares of land. Of these lands, 454720 hectares (69.14%) are arable land, 132450 hectares (20.16%) are meadow-pasture, 25063 hectares (3.74%) are forests and nurseries, 45446 hectares (6.96%) are unsuitable for agriculture (Anonymous (2007).

It has been determined that 366222 hectares of the 454720 hectares of agricultural land in Kırşehir province is irrigable. In short, although 80.4% of the agricultural land is irrigable, only 6.84% can be irrigated. This indicates the importance of irrigation in our city, where the annual precipitation is around 250-500 mm, but clearly shows the inadequacy in this area (Kıymaz (2011). The location and location of Kırşehir province, which is the subject of the research, can be seen on the map given in Figure 1.

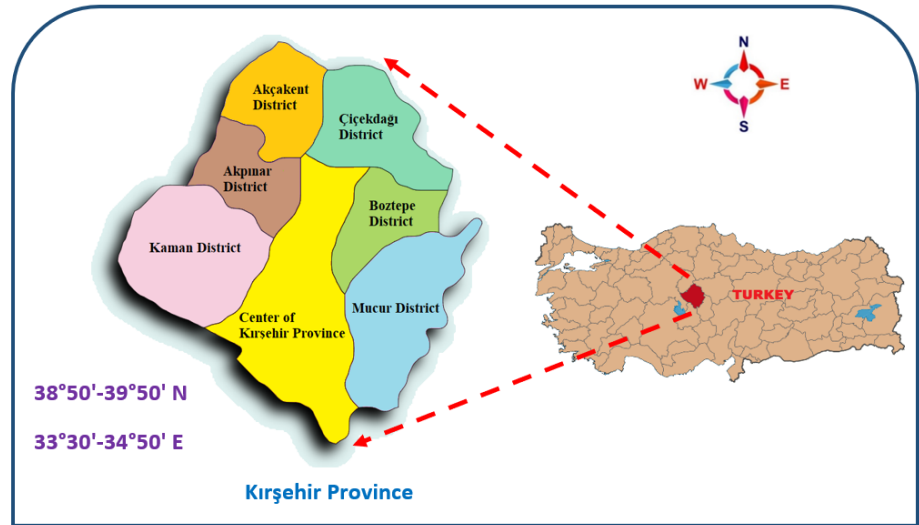


Figure 1 Location of the Research Area

In this study, land use capability classes, land use capability subclasses, land types and other soil properties were classified by using 1/25.000 scaled digital soil maps of Kırşehir province. In this study, digitized 1/25.000 scaled soil maps of Kırşehir province obtained from the Ministry of Agriculture and Forestry were used (Anonymous (2000).

Numerical data were classified as layers using Arc GIS 10.3.1 software (Anonymous, (2010). The classified soil maps obtained were evaluated according to the "Soil and Land Classification Standards Technical Instruction" published in 2005 by the Turkey Ministry of Agriculture and Rural Affairs (Anonymous, (2005). The flow chart of the methodology applied in the study is given in Figure 2.

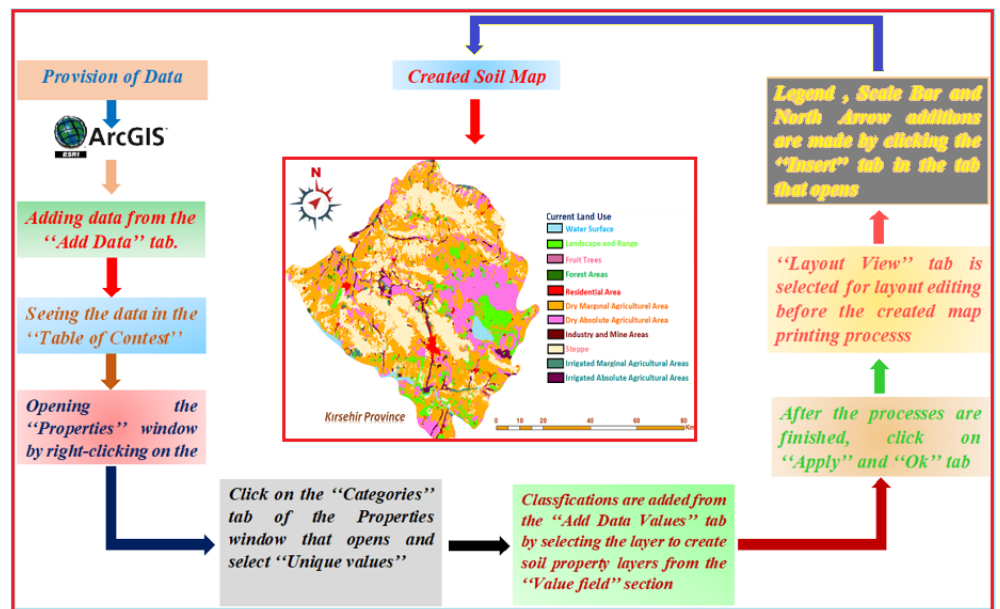


Figure 2 Flow Chart of the Methodology Applied in the Study

Land use capabilities are first class, which can be cultivated in the best, easiest and most economical way without causing erosion. they are among the eighth grade that can be used as a park (Anonymous, (2005)). The land use capability classes and explanations used in classification processes are shown in Table 1.

Table 1 Land Use Capability Classes (Anonymous, (2005))

Land Use Capability Classes	Explanations
I. Class	It is a land containing flat or nearly flat, deep, fertile and easily cultivable soils where conventional agricultural methods can be applied. First lands irrigated in places where there is little rainfall are those that have less than 1% slope, deep, loamy structure, good water holding capacity, moderately permeable soils.
II. Class	The differences of this from first-class terrain may be one or more of the limiting factors, such as mild inclination, moderate erosion exposure, moderately thick soil, occasional moderate flooding and moderate wetness that can be easily isolated.
III. Class	Moderate tendency, sensitivity to erosion, excessive wetness, shallow soil, presence of base stone, excess sandiness or graveliness, low water holding capacity and low productivity are the properties of this class.
IV. Class	Especially land suitable for permanent allocation to the meadow class is. Excessive slope, erosion, bad soil characteristics and climate are factors limiting agriculture to be made on this class of soils.
V. Class	Since it is not suitable for cultivation, it is allocated to long-lived plants such as meadows and forests. One or more factors prevent cultivation, stoniness and wetness. Grazing and cutting of trees are done with the condition of maintaining a good ground cover.
VI. Class	It is a land that requires moderate measures even when used as a forest or a meadow. It is very inclined and exposed to severe erosion.
VII. Class	It is very inclined, eroded, stony and defective, and includes shallow, dry, marshy or some other unfavorable soils. It can be used as a meadow or a forest provided that much attention is paid. If the vegetation on it decreases, erosion becomes very severe.
VIII. Class	It contains features that prevent cultivation and use as meadow or forest. These include marshland, desert, terrains containing very deep cavities, and high mountainous, overly defective, stony lands.

The existing negative impacts on the land of the subclass of land use capability, which is below the land use capability, are classified. The classification was evaluated as slope and erosion damage, soil insufficiency, stony, drainage disorder and flood damage and climate limitations.

Land types have been revealed according to the physical structure of the land. In addition, other soil properties and physical factors of soil structure were evaluated. The layers used in the evaluation and classification are shown in Table 2, Table 3.

Table 2 Classification of Land Types (Anonymous, 2005)

Land Types
Naked Rock and Rubble
River Flood Beds
Coastal Dunes
Black Dunes
Reeds
Lands Covered with Permanent Snow

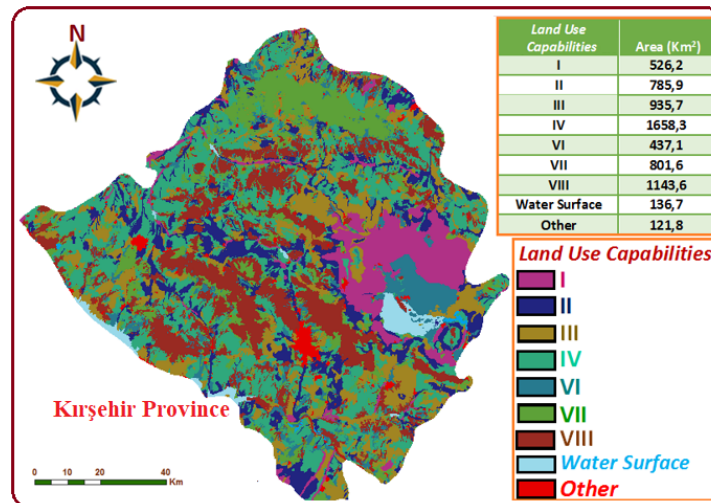
Table 3 Classes of Other Soil Properties (Anonymous, 2005)

Other Soil Properties	
Slightly Salty	Stony
Salty	Rocky
Alkali	Poorly Drained
Slightly Salty-Alkali	Bad Drained
Salty-Alkali	

3. RESEARCH FINDINGS

3.1. SPATIAL ANALYSIS OF LAND USE CAPABILITIES

The 1/25.000 scale digital soil maps of Kırşehir province were classified using Arc GIS 10.3.1 software and the Spatial Analysis of Land Use Capabilities map of the study area is given in Figure 3.

**Figure 3** Spatial Analysis of Land Use Capabilities

Covering the largest area in Kırşehir province, IV. class lands and the total area covered by these lands is 1658.3 km². These lands correspond to 25% of the total area.

IV. Class land is the land class that is particularly suitable for permanent allocation to pasture. Occasional field crops may also be grown. Excessive slope, erosion, bad soil characteristics and climate are the limiting factors for agriculture to be made on this class of soil. It is poorly drained soils with poor drainage. They are not subject to erosion, but they are not suitable for growing many crops because they dry out suddenly in the spring and their productivity is low. In semi-arid regions, it is generally not possible to apply rotation systems containing legumes on fourth class lands due to climate (Anonymous, 2005).

I. Class lands are 526.2 km², II. Class lands cover an area of 785.9 km². First class land; It is a land containing flat or nearly flat, deep, fertile and easily cultivated soils where conventional agricultural methods can be applied. There may be little water and wind erosion on this class of land. Soils have good drainage and are not subject to flood damage. They are suitable for hoe plants and other intensively grown crops. I. class lands irrigated in places with low rainfall are lands with less than 1% inclination, deep, loamy structure, good water holding capacity, moderately permeable soils (Anonymous, 2005).

II. class land is good land that can be easily cultivated only by taking some special precautions. Differences from first class land may be one or more of the limiting factors such as light inclination, moderate erosion, moderately thick soil, occasional moderate flooding, and moderate wetness that can be easily isolated (Anonymous, 2005).

3.2. SPATIAL ANALYSIS OF LAND USE CAPABILITY SUBCLASSES

1/25.000 scaled digital soil maps of Kırşehir province were classified using Arc GIS 10.3.1 software and spatial analysis of Land Use Capability Subclasses are given in Figure 4 as map output.

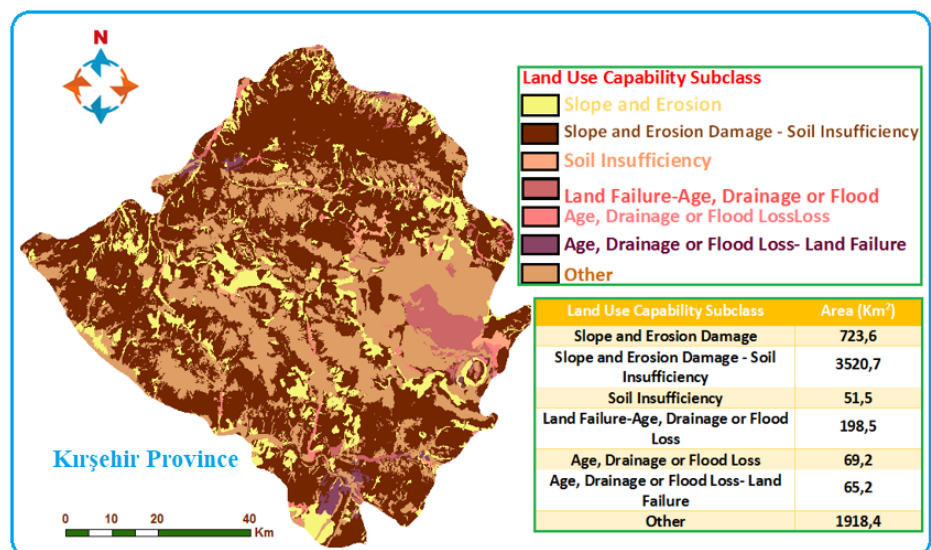


Figure 4 Spatial Analysis of Land Use Capabilities Subclasses

In Kırşehir province, there is a general lack of soil, slope and erosion damages. Soil insufficiency, slope and erosion damage constitute 54% of the total area with an area of 3520.7 km². Only slope and erosion damage has an area of 723.6 km², which corresponds to 11% of the total area.

In general, it is observed that soil insufficiency and slope and erosion damage are high in Kırşehir province. It has been determined that there are areas with lump deficiency in an area of 51.5 km² in the study area.

3.3. SPATIAL ANALYSIS OF LAND TYPES

Kırşehir province was analyzed as a research area as a result of classification made with the help of Arc GIS 10.3.1 software using 1/25.000 scaled digital soil maps and the results are given in Figure 5.

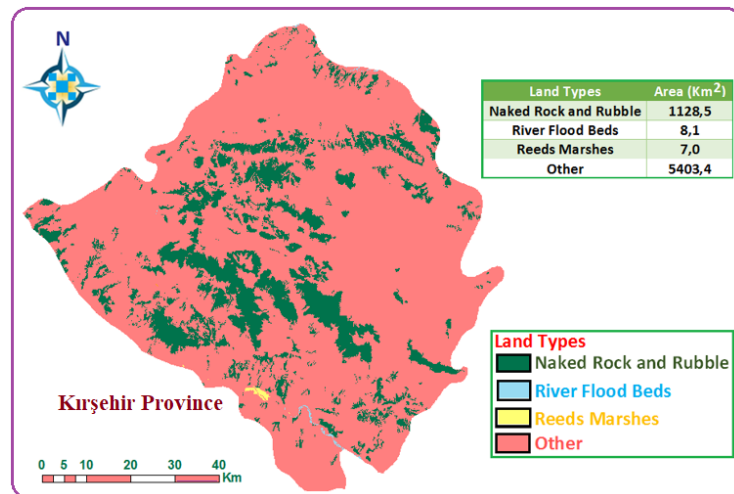


Figure 5 Spatial Analysis of Land Types

As a result of the data obtained from the current land type of Kırşehir province, the data were classified using Arc GIS 10.3.1 software and a map was created. As a result of this map created, the current surface area of Kırşehir province was determined as 6547 km². In addition, it is observed that most of the existing land type of Kırşehir province consists of bare rocks and rubble. Bare and rubble areas have an area of 1128.5 km². It constitutes 17% of the total area. In addition, it is concluded that other (settlement, industry, water surface, etc.) areas on the map created have an area of 5403.4 km² (Anonymous, (2005)).

3.4. SPATIAL ANALYSIS OF OTHER SOIL PROPERTIES

Spatial Analysis of the other soil properties created using Arc GIS 10.3.1 software of 1/25.000 scaled digital soil maps of Kırşehir province is given in Figure 6.

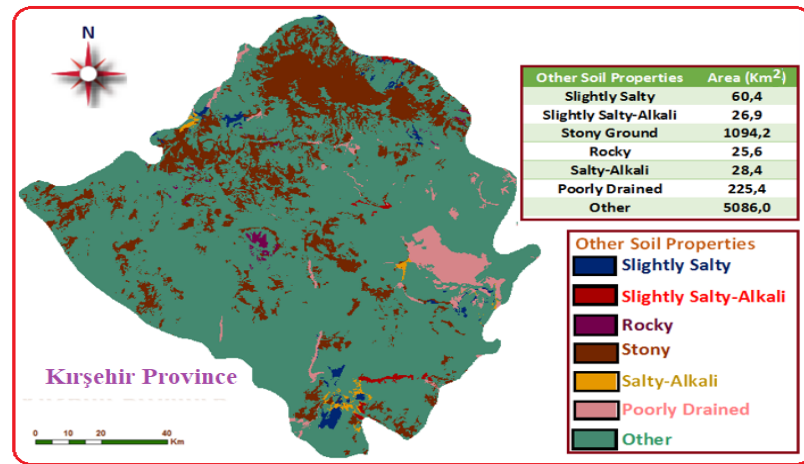


Figure 6 Spatial Analysis of Other Soil Properties

Most of the soil properties of Kırşehir province consist of stony areas. The stony areas are mostly seen in the northern part of the province. As a result of the analysis, the stony area was found to be 1094.2 km². This situation constitutes 17% of the total area. Along with stony areas, 225.4 km² was found in areas with insufficient drainage and it was determined that it corresponds to 3% of the total area. Excessive stonyness is seen as erosion damage. This situation will be especially effective in the emergence of restrictions in agricultural production.

4. CONCLUSION AND RECOMMENDATIONS

Today, the population is increasing rapidly. Negative effects occur in parallel with the rapidly increasing population. These negative effects directly affect the basic elements necessary for vital activities and the importance of these elements is increasing day by day. These effects also negatively affect the soil. In terms of soil characteristics, the region where they are located bears traces according to the geographical structure. Therefore, soil features have different regional traces and it is important to map an area in order to comment on it. Today, digital maps are of great importance in the creation of soil maps. Geography Information Systems are of great importance in the creation of digital maps.

GIS is a system consisting of hardware, software, methods and personnel working for this purpose, covering the modeling, processing, analysis, presentation according to the purpose of use, in short, the data used in planning and management (Uzun (2012)).

There are different methods in the creation of soil maps in the world and in our country. Soil surveys have been completed in all agricultural areas in the USA, 91% of private areas and 76% for the whole country. Published reports are generally in the scale of 1:15,840 or 1:24,000 and contain quite comprehensive information. There is a similar situation in European countries (Bathgate and Duram (2003)).

Mapping studies in Turkey were given to the General Directorate of Soil-Water with the law numbered 7457, which entered into force on 28.02.1960. After that, the General Directorate of Soil-Water took over the task of creating maps by classifying the lands of Turkey and coordinating the studies carried out at the

country level on this subject, and the General Directorate of Rural Services with the abolition of this directorate.

By the General Directorate of Soil and Water, the entire country's lands were examined and mapped between 1966-1971 using 1/25.000 scale topographic maps. Only soil depth, slope, degree of erosion, drainage, salinity, alkalinity, stony, rocky, land use capability class, subclass and land use status can be obtained from these maps (Dengiz and Sarioğlu (2011)). According to Akbaş and Yılmaz (2004), they stated that these maps could not be used in detailed studies and plans because the information they provided was not sufficient and up-to-date. These maps created an important basis for data acquisition in Geography Information Systems (GIS).

Digitization of maps is of great importance in Geography Information Systems. It provides classification of information, predicts results from objects and events, and stands out in strategic planning by using databases for query purposes and statistical analysis with the help of digital smart maps. (Yomralioğlu (2000), Akbaş et al. (2008)). The maps produced by digitizing the maps are used as a base. Various GIS programs are used to digitize maps.

It is important to establish the existing land use plans of the regions. Land Use Plans; Based on soil and land surveys, local, regional and national scale agricultural, forest and pasture lands, lands limited by special law, industrial housing and tourism areas, infrastructure areas for economic and social purposes, different land use types and current use types and sustainable land They are the plans created from maps and reports showing the management styles (Akten (2008)). Digitization of topographic maps is of great importance in the creation of land use plans.

As a result of this study, the land use capabilities of Kırşehir province and some soil properties were classified using Arc GIS 10.3.1 software and the analysis results were shared as map outputs. In the study, stratified classifications of 1/25.000 scaled digital maps obtained from the Ministry of Agriculture and Forestry were made using Arc GIS 10.3.1 software. In classification, land use capability classes, land use capability subclasses, land types and other soil properties were analyzed. The maps obtained were evaluated according to the "Soil and Land Classification Standards Technical Instruction" published by the Ministry of Agriculture and Rural Affairs (Turkey) in 2005. The land use potential of Kırşehir province is shown in Figure 7.

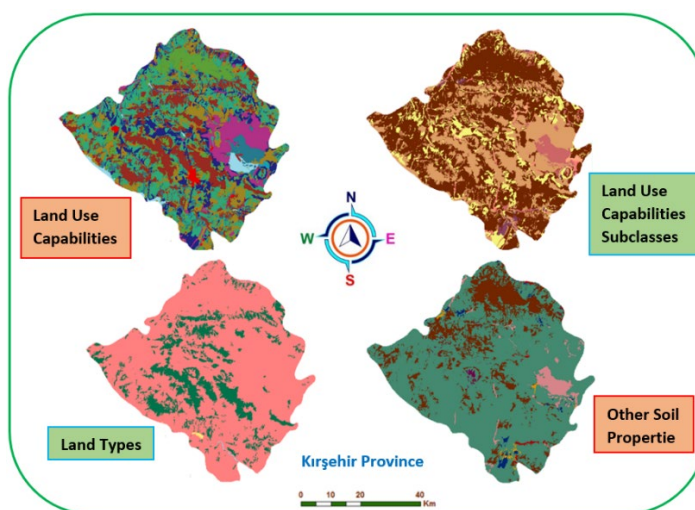


Figure 7 Land Use Capabilities and Other Properties of Kırşehir Province

The land use capabilities of Kırşehir province were analyzed and classified in 9 categories. According to the classification made, the largest area is 1658.3 km², IV. class lands were observed. The fourth class lands constitute arable lands with tillage. Class I land 526.2 km², II. class land, 785.9 km², III. class land 935.7 km², VI. class land 437.1 km², VII. class land 801.6 km², VIII. class land was found to be 1143.6 km². For this reason, according to the total area IV. class land to 25% of the total area, VIII. 18% of class land, III. Class Agricultural land is 14%, VII class land is 12%, and the remaining 30% is other land classes. In general, 18% of the territory of Kırşehir province is unsuitable for agriculture. Although 59% of the rest is agricultural land suitable for tillage agriculture, 23% of it consists of lands unsuitable for tillage agriculture.

When the land use subclass of Kırşehir province is examined, it is concluded that the soil insufficiency due to slope and erosion damage is quite high. Soil insufficiency due to slope and erosion damage was found to be 3520.7 km². 54% of the total area was exposed to this effect due to soil insufficiency due to slope and erosion damage. When the current land type is examined, it is concluded that 1128.5 km² area consists of bare rocks and rubble. In addition, when the other soil characteristics were examined, it was concluded that 1094.2 km² area was stony soil.

In this study, the soil potential of Kırşehir province was tried to be determined by using the Geography Information Systems. According to Kıymaz (2011) it has been determined that there has been no previous study on soil structure, recreation and general soil structure such as total salt, lime and organic matter amount in Kırşehir province. For this reason, in the light of the data obtained, it will be inevitable that this study will provide infrastructure support to the investor institutions in the region. This study will be a guide for similar studies by transferring it to users in the digital environment and creating a database, thus setting a precedent for the study.

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