Türkiye Tarımsal Araştırmalar Dergisi
dergipark.org.tr/tutad
Research Article
Turk J Agric Res
2022, 9(2): 198-208
© TÜTAD
ISSN: 2148-2306
e-ISSN: 2528-858X
doi: 10.19159/tutad.1076908

A Study of Soil and Land Features with Geographic Information Systems (GIS) Analysis: Iğdır, Türkiye

Mücahit KARAOĞLU*, Erhan ERDEL

Iğdır University, Faculty of Agriculture, Department of Soil Science and Plant Nutrition, Iğdır, TÜRKİYE

Received: 21.02.2022 **Accepted:** 04.08.2022

ORCID ID (By author order)
orcid.org/0000-0002-7388-9192 orcid.org/0000-0002-8011-9452
*Corresponding Author: mücahit.karaoglu@igdir.edu.tr

Abstract: The aim of this study was to determine the soil and land characteristics of the province of Iğdır in Türkiye and to create a database by using geographical data system analysis, which is widely used today. The study area was 3674.42 km^2 and the digital elevation model of the area was created using a 1/25000 scale topographic map from the General Command of Mapping in Iğdır province, and elevation, slope, aspect, and drainage maps were produced. Additionally, by using data and maps from the previous General Directorate of Rural Services and General Directorate of Soil Reform, large soil groups, depth, land use capability classification, problematic soils, water erosion, and wind erosion maps were created, and area calculations were made with ArcGIS Pro 2.5 software. As a result, flat and near flatlands were located in the center, east, and north and mountainous lands with high altitudes were located in the west and south of Iğdır province. Therefore, slopes were steep in the south and west, and low in the central, east, and north parts. The land use capability map consisted of 122040 ha suitable for cultivated agriculture (I-IV class); 211220 ha unsuitable for cultivated agriculture (V-VII class) as grassland; and 29260 ha of non-agricultural land. Land with moderate, severe, and very severe erosion comprised 16.3%, 27.3%, and 25.8%, respectively, of water erosion. Wind erosion affected 36670 ha of land. Iğdır has large diversity and variety in terms of soil and land features, despite its small area.

Keywords: Soil, land use, geographic information systems, erosion, Iğdır

1. Introduction

Against the increasing population, increasing unconscious use (Özyazıcı et al., 2014) and/or accelerated erosion of fertile soil are among Türkiye's most prominent problems. Determining and using the present soil inventory to satisfy the food and other needs of the increasing population is a mandatory task for the longer term in Türkiye, and future generations. Fulfilling this task in the best way will allow the available land to be supported by healthy and reliable foundations (Akgül and Başayiğit, 2005). For accurate and effective planning, it is necessary to define the available natural resource qualitatively and quantitatively, work out the potential, and accumulate data and updated maps by making use of technological developments (Dengiz and Sarıoğlu, 2011a, b).

Soil surveys were launched in 1951 by the pioneer of Turkish soil science, Kerim Ömer Çağlar, and published between the years 1952-1954 as "General Soil Map of Türkiye". For the first time, detailed soil maps at serial and phase levels were prepared for the Çukurova Region in 1956-1958 using 1/10000-1/13000 scale black-and-white aerial photographs (Anonymous, 2012). General Directorate of Soil began the "Enhanced Soil Map of Türkiye" in 1966 in additional detail and completed the map in 1971. The results were published as a "Soil Resource Inventory Map and Report" with a scale of 1/100000 for all of the 67 provinces with a generalized map with a scale of 1/25.000. Between the years 1982-1984, this study was revised with the "Türkiye Soil Potential Studies and Non-Agricultural Purposes Land Use Planning" along with several sector observations, provinces,

and the 1/100000 scale "Provincial Land Assets" was published (Özyazıcı et al., 2014; Başayiğit and Uçar, 2019; Karaca et al., 2019; Mercan and Arpağ, 2020).

The sole data source for Iğdır province soil maps are that 1/100000 scaled provincial inventory and 1/200000 scaled watershed reports were prepared in the early seventies according to the old classification system (Genç and Dengiz, 2015) and only include information about soil depth, slope, erosion degree, drainage, salinity, alkalinity, stoniness, rockiness, land use capability class, subclass, and land use status, and don't have the required data and knowledge for irrigation and drainage projects, salinity reclamation, highway, airport, pipeline, industrial facilities, and therefore the determination of routes and locations of the areas to be opened to new settlements, land consolidation, and environmental impact assessment (Şenol, 2006). Consistent with the Soil Taxonomy detailed soil survey obtained with the newest techniques in Türkiye, with soils classified as unmapped (Özyazıcı et al., 2014), Iğdır territory presents a problem.

Technological advances have influenced and accelerated scientific studies in every field. Especially the utilization of Geographical Information Systems (GIS) has attracted attention in many fields of study. One of these study fields is soil which all living things need. Soil Information Systems, which is described as the creation of maps of soil properties and storage and analysis in the digital environment (Lillesand and Kiefer, 2000; Harmon and Anderson, 2003), was implemented by soil scientists. With the emergence of GIS, significant developments were achieved in many agricultural disciplines like distribution maps of soil characteristics, plant nutrient levels, determination of crop patterns, diseased plant distribution, erosion risk maps, yield estimates, and plant species-optimum land adaptation (Özşahin, 2014; Aydan et al., 2016; Özyazıcı et al., 2017; Dengiz and Özyazıcı, 2018; Başayiğit and Uçar, 2019; Karaca et al., 2019; Mercan and Arpağ, 2020; Yaşar et al., 2020).

Present in every part of daily life, GIS is a computer program developed to store, analyze and present results visually in a database created based on the real coordinate plane (Fitzpatrick and Maguire, 2000; Demirci, 2008). In this study, based on soil and soil conservation studies, 10 maps on location, soil, land use, drainage, slope and erosion of Iğdır province in Türkiye were produced and analyzed.

2. Materials and Methods

2.1. Material

Iğdır province is one of the few provinces within the world in terms of geographical location. It has borders with three countries, Armenia in the north, Nakhichevan in the east, and Iran in the south. The province of Iğdır was within the borders of Erzurum-Kars at the easternmost end of the Eastern Anatolia Region, geographical coordinates are between approximately 39°-41° north latitude and 43°-45° east longitude, and the area is 3674.42 km². The location map is given in Figure 1.

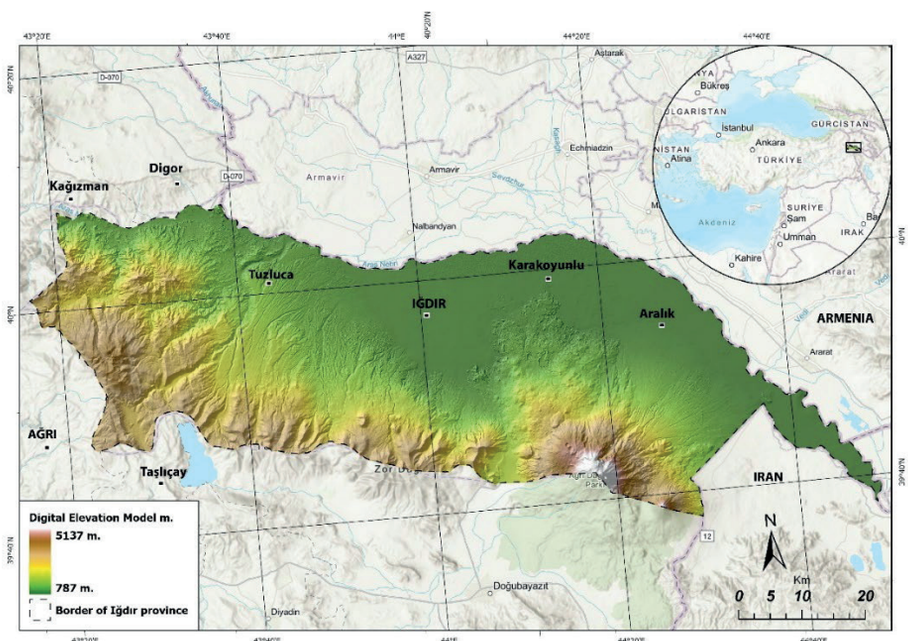

Figure 1. Elevation and location map of Iğdır province

2.1.1. Topography of Iğdır province

There are lowlands in the central, eastern, and northern parts of Iğdır province, with cultivated agriculture (class I-IV) flat and almost flat (0-2°) slope covering an area of 109647 ha and 29.8% of the provincial area. The lands with moderate slope (2-6°) comprise 88371.3 ha (24.05%) (Anonymous, 1998). The western and southern parts of the province of Iğdır are surrounded by Perili, Tekelti, Kızılcaziyaret, Oyuklu, Pamuk, Kocak, Aracık, Big and Little Ağrı mountains and Arpa, Kuzkuzbabadağı and Karakaya hills (Anonymous, 2022). The slopes of these elevations have high altitude values. Accordingly, their slopes are steep (>12°) and they cover an area of 90167.8 ha (24.54%), and are not suitable for cultivated agriculture (class V-VII) (Anonymous, 1998).

2.1.2. Climate of Iğdır

The climate of Iğdır province an Eastern Anatolian type continental climate, with semi-arid, arid, and very arid climates according to different climate classifications (Anonymous, 2021). According to the Frost Calendar of Türkiye (Şimşek et al., 2017), Iğdır province has a vegetation period varying between 137-191 days. The annual mean temperature is 12.1 °C; annual mean soil temperatures at 5, 10, and 20 cm are 15.3, 15.0, and 14.8 °C, respectively. Annual precipitation is 256 mm and the wettest season is spring, with May the wettest month. The average relative humidity is 55.3% and the most humid season is autumn. The annual mean wind value is 1.3 m s^{-1} and the strongest wind period is between March and October. The annual total evaporation amount is 1116.3 mm. This data helps us to estimate salinity, alkalinity, and wind erosion events in Iğdır province.

2.1.3. Maps and digital data

In order to work out the soil, land, and some basic geographical features of Iğdır province, 1/25000 scale topographic map from the General Command of Mapping (GCM), 1/25000 scale land assets map of Kars province, 1/25000 scale digital soil data from the General Directorate of Soil Reform and ArcGIS Pro 2.5 software were used.

2.2. Methods

The 1/25000 scale topographic map from the GCM was digitized and digital elevation data was created within the GIS environment. This map shows the three-dimensional state of the study area. For the obtained maps to give good results visually and topographically, the hill shade data used 65% transparency. Aspect, slope, and drainage maps were produced from digital elevation data. The Iğdır section (existing provincial borders) on maps of the Kars province land assets prepared by the General Directorate of Rural Services were digitized and transferred to the GIS environment and all the features within the maps were created in a GIS environment as an attribute table. Large soil groups, soil depth, land use capability, problematic lands, water and wind erosion maps were prepared by using the attribute table and also using 1/25.000 scale numerical soil data prepared by the General Directorate of Soil Reform. Area distribution and percentage (ratio) calculations for all obtained maps were performed with ArcGIS Pro 2.5 software.

3. Results and Discussion

3.1. Slope map

The slope gradient of the land is an efficient topographic element determining surface cover, land use, depth, erosion and soil properties. When the slope map of Iğdır province (Figure 2) is examined, 29.84% of the entire area is flat and almost flat (0-2°) and these lands formed the center, north, and east parts of the province. These areas are fertile, and in I-III land use capability classes where cultivated agriculture is successfully performed. However, salinity, stoniness, insufficient drainage, and swamp problems are observed in these areas. Lands with very steep slope values (15-64°) are located on the slopes of the mountainous areas in the south and west of the province of Iğdır and cover 17.43% of the provincial land (Table 1). An area of 169423.2 ha (46.11%) with ≥6° slope values is sensitive lands in terms of water erosion.

3.2. Aspect map

The aspect map was created by showing the direction values calculated consistent with the north for every cell within the digital terrain model with thematic intervals. For the northern hemisphere, the sloping lands facing south are vital for working areas like agriculture, solar power applications, urban planning, and energy-saving calculations. According to the aspect map (Figure 3) for the province of Iğdır, flat areas comprised 1.11%; southern aspects were calculated as 22.96%. In other words, the most convenient lands for aspect cover an area of 88.439 ha. Most aspects were toward the northeast (21.25%), north (17.18%), east (16.52%), and northwest (12.51%), respectively (Table 2).

3.3. Elevation and Drainage map

Removal of waste or excess water in a region may be vital in terms of both urbanism and agriculture. The importance of drainage increases even more in depression areas like Iğdır plain

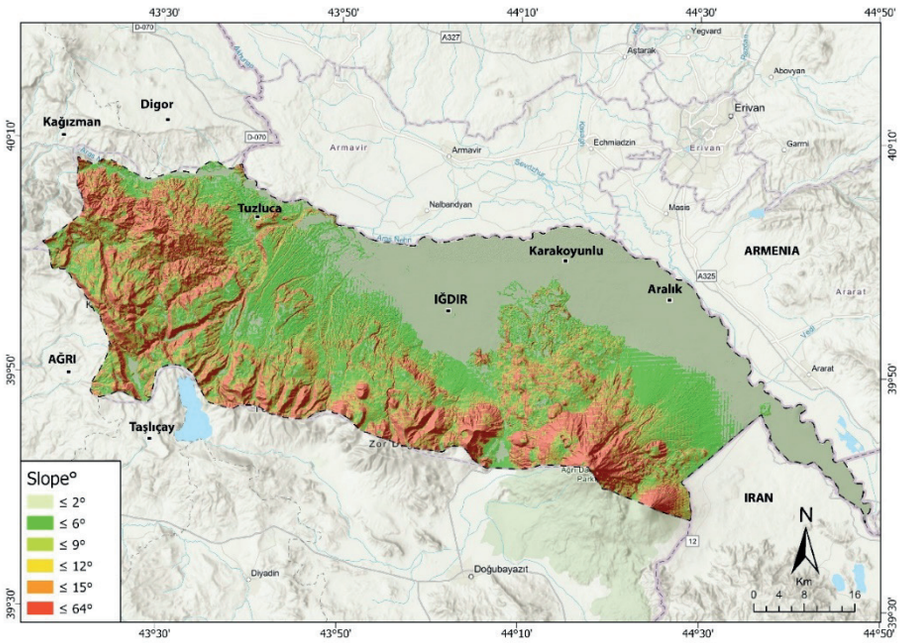

Figure 2. Slope map of Iğdır province

Table 1. Slope distribution of Iğdır province

Slope°	Area		Ratio
	km^2	ha	(%)
0-2	1096.470	109647.0	29.84
2-6	883.713	88371.3	24.05
6-9	445.327	44532.7	12.12
9-12	347.227	34722.7	9.45
12-15	261.282	26128.2	7.11
15-64	640.396	64039.6	17.43
Total	3674.420	367441.5	100.00

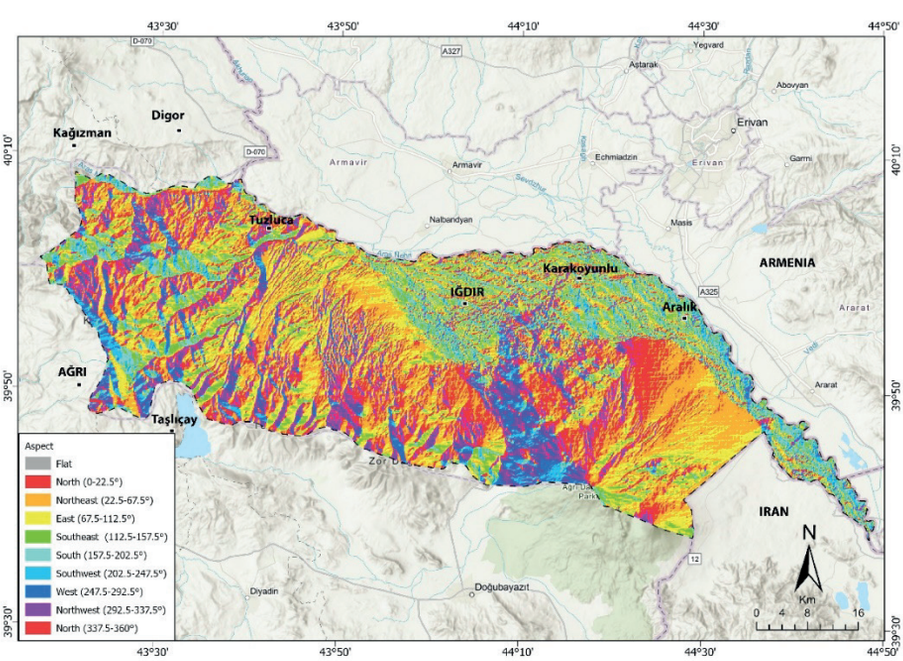

Figure 3. Aspect map of Iğdır province

Table 2. Aspect distribution of Iğdır province

Aspect	Area		Ratio
	km^2	ha	(%)
Flat	40.68	4068	1.11
North	631.60	63160	17.18
Northeast	780.81	78081	21.25
East	607.06	60706	16.52
Southeast	387.52	38752	10.54
South	235.48	23548	6.41
Southwest	220.71	22071	6.01
West	311.05	31105	8.47
Northwest	459.51	45951	12.51
Total	3674.42	367442	100.00

(Figure 4). According to the drainage map, the rivers within the borders of Iğdır province flow in a south-north direction depending on the elevation (from 5137 meters to 787 meters) and consist of seasonal (flood character) rivers. Most of the streams drain their waters into the Aras River and form the lower basins of the Aras River. The flow of the streams is not regular and they mostly have dry stream beds. However, thanks to torrential rains in the spring months and snow and glacier melt, the quantity of flow increases in river beds depending on the season.

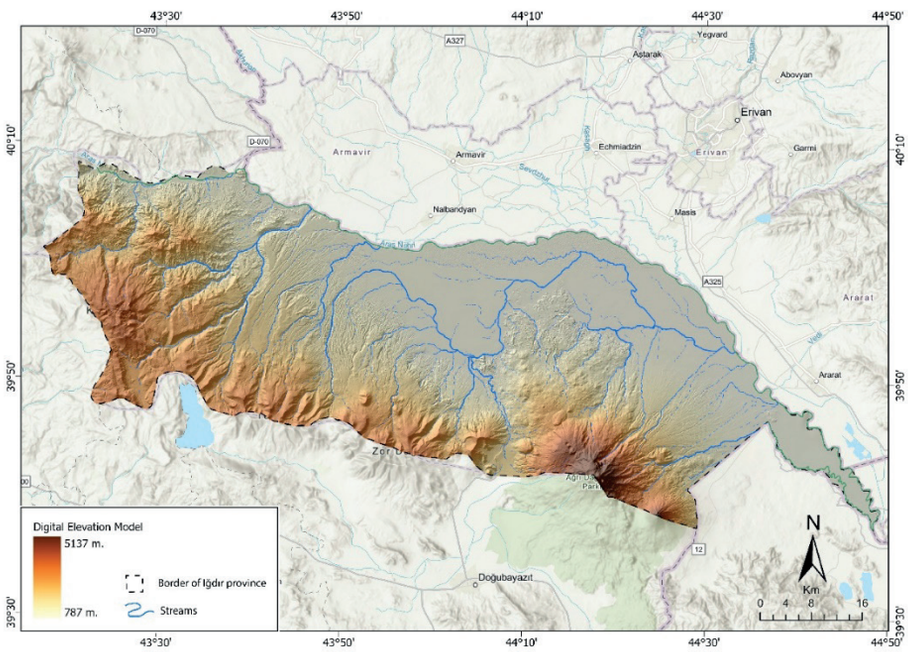

Figure 4. Elevation and drainage map of Iğdır province

3.4. Large soil groups map

Depending on factors such as the main material, climate, geology, volcanism, and topography, different large soil groups formed in the province of Iğdır (Figure 5). The most common large soil groups are basaltic soils with heavy clayey, low fertile, no calcareous, neutral, or moderate quality characteristics covering 173330 ha (47.2%). Young alluvial soils with mineral layers formed on sedimentary deposits, which are important for agriculture, were in second place with an area of 76260 ha (20.8%). Hydromorphic soils have the smallest area of the large soil groups at 670 ha (0.2%) with poor drainage and are considered pasture. The typical soil for arid and semi-arid climates, with natural vegetation consisting of grass and shrubs, rich in calcium and nutrients, well-drained, and moderate organic matter content, brown soils cover an area of 50130 ha (13.6%). Bare rock and rubble cover an important area within the provincial borders of 26742 ha (7.3%). The distributions of other large soil groups and uses are shown in Table 3.

3.5. Soil depth map

Sufficient soil depth is among the foremost important physical and structural features of soils in terms of proper plant root development, ideal populations of living creatures within the soil, retaining plant nutrients and water within the soil, and maintaining the water/air ratio. The soils of Iğdır province mostly have shallow depths and cover an area of 159757 ha (43.48%). The area of deep soils was determined as 88677 ha (24.13%) and very shallow areas as 40942 ha (11.14%) (Table 4, Figure 6).

The area covered by Lithosolic soils on steep slopes with hard rock or stony base material, with no or little profile development, more coarse-

textured, poor natural vegetation, and limited agriculture was calculated as 13.117 ha (3.57%). In Table 4, other depth groups, areas covered and rates are given.

In terms of land use capability classification, very shallow soils are V-VIII; shallow soils are III-IV; moderately deep soils are II-III; and deep soils correspond to classes I-II (Akalan, 1983).

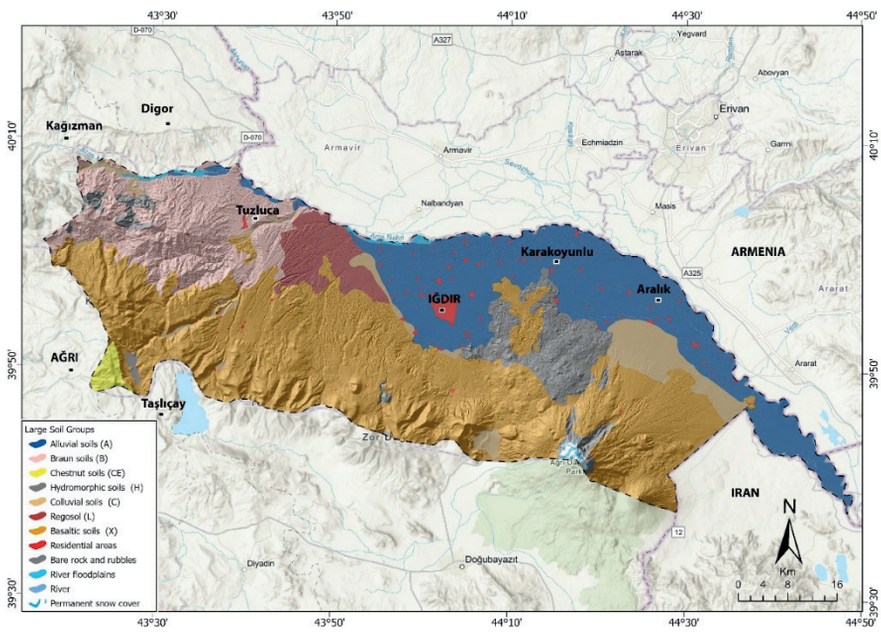

Figure 5. Large soil group map of Iğdır province

Table 3. Large soil groups of Iğdır province

Large soil groups		Area		Ratio
		km^2	ha	(%)
X	Basaltic soil	1733.30	173330	47.2
A	Alluvial soil	762.60	76260	20.8
B	Brown soil	501.30	50130	13.6
K	Colluvial soil	187.30	18730	5.1
L	Regosol	114.60	11460	3.1
CE	Chestnut soil	26.80	2680	0.7
H	Hydromorphic soil	6.70	670	0.2
	Bare rock and rubbles	267.42	26742	7.3
	River floodplains	13.70	1370	0.4
	Permanent snow cover	11.40	1140	0.3
	Residential	39.70	3970	1.1
	River	9.60	960	0.3
Total		3674.42	367442	100.0

Table 4. Soil depth classes of Iğdır province

Soil depth (cm)		Area		Ratio
		km^2	ha	(%)
d1	Very shallow (0-20)	409.42	40942	11.14
d2	Shallow (20-50)	1597.57	159757	43.48
d3	Moderately deep (50-90)	307.71	30771	8.37
d4	Deep (90+)	886.77	88677	24.13
L	Lithosolic	131.17	13117	3.57
	Bare rock and rubbles	267.42	26742	7.28
	River floodplains	13.70	1370	0.37
	Permanent snow cover	11.43	1143	0.31
	Residential	39.65	3965	1.08
	River	9.57	957	0.26
Total		3674.42	367442	100.00

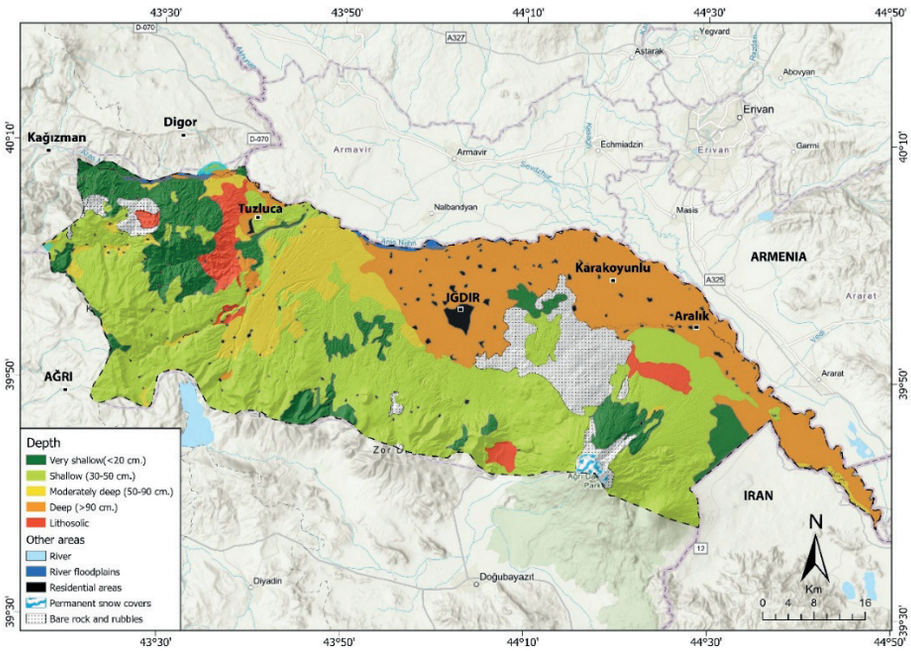

Figure 6. Soil depth of Iğdır province

3.6. Land use capability map

According to the land use capability map (Figure 7), the total area of the land (class I-IV) suitable for cultivated agriculture in Iğdır province was determined as 122040 ha (33.21%) (Table 5). The ratio was very low. In other words, only one-third of Iğdır soils are cultivated and covered areas with a slope of 0-15° (Figure 2). Considering the risk of water erosion in lands with a slope of ≥6°, cultivation should be treated more sensitively. Lands that are not suitable for cultivated agriculture (class V-VII) covered an area of 211220 ha (57.49%) (Table 5). These had slopes of ≥15° (Figure 2); shallow and very shallow depth (Figure 6); and moderate, severe, and very severe erosion. To reduce the water erosion effect, it is necessary to protect the existing vegetation and increase the cover percentage. The cheapest way to do this is to avoid overgrazing. The area of land unsuitable for agriculture (class VIII) was calculated as 29.260 ha (7.96%).

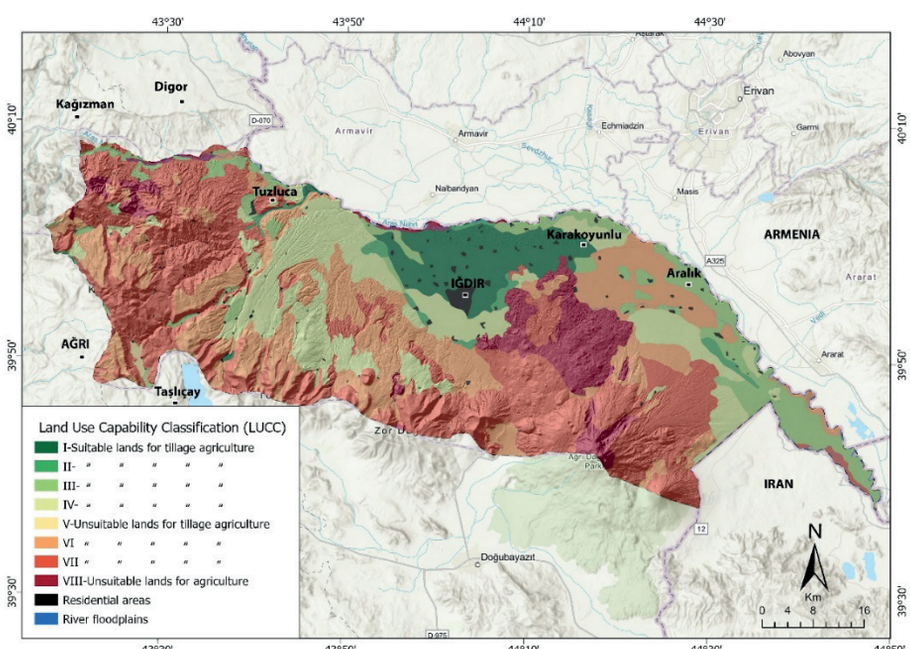

Figure 7. Land use capability map of Iğdır province

Table 5. Land use capability of Iğdır province

Classes	Area		Ratio
	km^2	ha	(%)
I	251.50	25150	6.84
II	47.40	4740	1.29
III	329.10	32910	8.96
IV	592.40	59240	16.12
V	6.70	670	0.18
VI	815.60	81560	22.20
VII	1289.90	128990	35.11
VIII	292.60	29260	7.96
Residential	39.65	3965	1.08
River floodplains	9.57	957	0.26
Total	3674.42	367442	100.00

3.7. Problematic lands map

Knowing the problems of agricultural lands in a region is important in terms of correct planning and conducting proper cultivation. Such work will save time and resources. The map showing various land problems in Iğdır province is shown in Figure 8 and the distributions and ratios of problematic areas are shown in Table 6. Stoniness affected 185345 ha (50.44%) area and covered half of the provincial area. There is a stoniness problem in all class III agricultural lands (Figure 7). Salinity is another important and pending problem of agricultural lands in Igdır province, and a total area of 48624 ha (13.23%) is faced with salinity problems of varying degrees. There are different degrees of salinity problems in class II-IV lands in the northeast and near Dilucu.

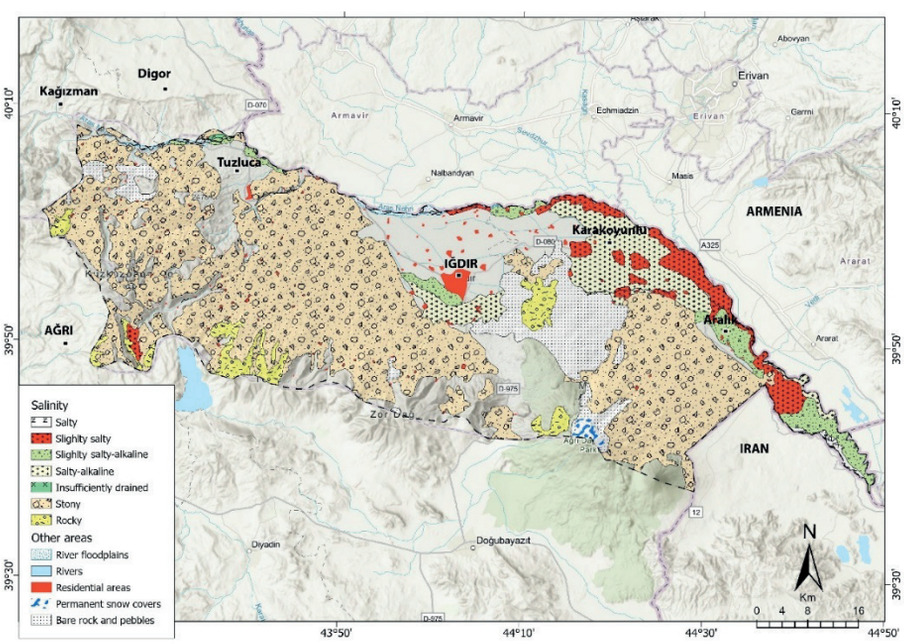

Figure 8. Problematic lands map of Iğdır province

Table 6. Problematic lands of Iğdır province

Problems	Area		Ratio
	km^2	ha	(%)
Slightly salty	131.25	13125	3.57
Slightly salty-alkaline	114.80	11480	3.12
Salty	8.07	807	0.22
Salty-alkaline	232.12	23212	6.32
Rocky	119.18	11918	3.24
Stony	1853.45	185345	50.44
Insufficiently drained	1.42	142	0.04
Total	3674.42	367442	100.00

3.8. Water erosion map

According to the water erosion map of Iğdır province (Figure 9), there is no or very little water erosion in 77780 ha (21.20%) area. Severe erosion affects 100.446 ha (27.34%) and very severe erosion affects 94904 ha (25.83%) of land. Moderate erosion was the least common erosion degree within the provincial borders and affects 60035 ha (16.34%) of land (Table 7). The absence or very little water erosion in Iğdır plain, which consists of class I-IV lands (Figure 7), is a positive situation in terms of soil and agriculture. However, moderate erosion in class III and IV lands reaching the plain from the west and south and with 6-9° slope (Figure 2) is a situation that requires protection measures.

3.9. Wind erosion map

The wind erosion area located in the Aralık district of Iğdır province, is the second largest wind erosion area in Türkiye (Figure 10). In addition, as a result of a case study, it was determined that the vicinity of Iğdır Airport was also a wind erosion field (Karaoğlu et al., 2018). The effective area of the Aralik wind erosion field, which was shown to be the 1st erosion field in Table 8, was given as 28248 ha (7.69%). This value shows the total potential area. The active area where continuous erosion events occur includes the part that reaches the Iran border in the eastern part and covers 13554.2 ha (3.69%) (Özdoğan, 1976). The area with 0-2° sloping lands in this active region, which are most suitable for wind erosion, is 3289 ha (0.89%) and the area of lands with a slope of 2-6° is 3.923 ha (1.07%).

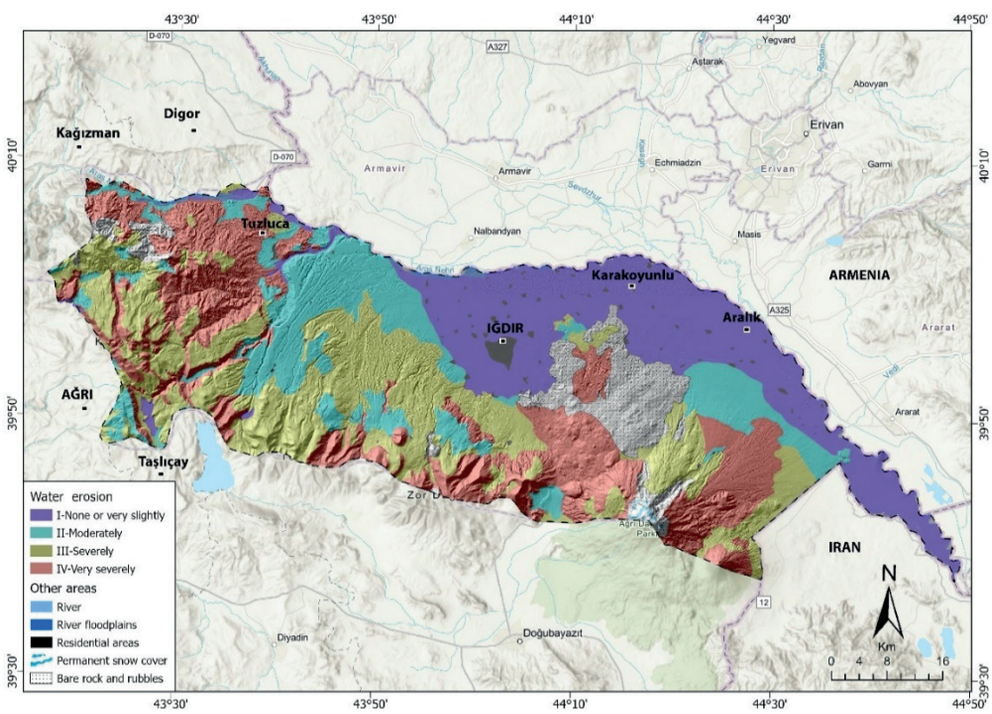

Figure 9. Water erosion map of Iğdır province

Table 7. Water erosion severity of Iğdır province

Erosion severity		Area		Ratio
		km^2	ha	(%)
1	No or very little	778.80	77880	21.20
2	Moderate	600.35	60035	16.34
3	Severe	1004.46	100446	27.34
4	Very severe	949.04	94904	25.83
	Residential	39.65	3965	1.08
	River	9.57	957	0.26
	Bare rock and rubbles	267.42	26742	7.28
	Permanent snow cover	11.43	1143	0.31
	River floodplains	13.70	1370	0.37
Total		3674.42	367442	100.00

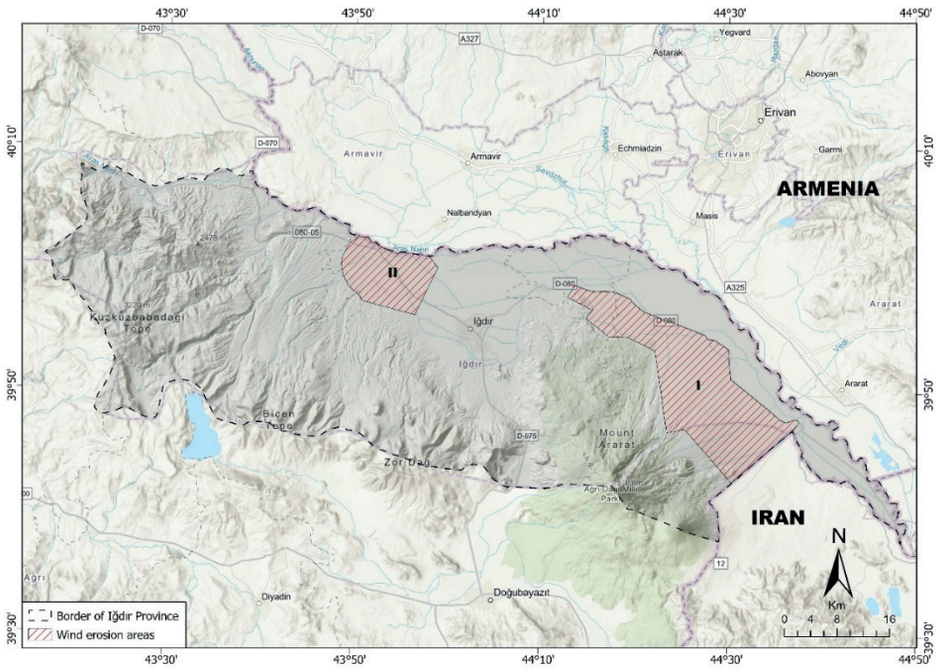

Figure 10. Wind erosion map of Iğdır province

Table 8. Wind erosion fields of Iğdır province

Erosion field	Area		Ratio
	km^2	ha	(%)
I Aralık	282.48	28248	7.69
Active	135.54	13554	3.69
0-2°	32.89	3289	0.89
2-6°	39.23	3923	1.07
II Airport	84.22	8422	2.29

4. Conclusions

In the lands of Iğdır, there are few areas suitable for cultivated agriculture due to topographic conditions and wind erosion events occurring in some of the flat and low-slope lands. It was determined that most of the lands are sensitive to water erosion and need special precautions on account of the slope, shallow soils, and inefficiency. Therefore, determination of the characteristics of land and soil resources and mapping studies are a necessity to perform more detailed and functional plans for important issues such as agricultural activities, and land or basin planning studies to be implemented in these areas. For this reason, the analysis of our land and soil resources with numerical and visual data will make significant contributions, as in this study.

Throughout history, the economic prosperity of states has been dependent on the wealth of natural resources and effective use of these resources. Societies gained efficiency to the extent that they know the land they live in, and they developed accordingly. In this study, studies related to the soil in the past period and current land cover studies, including topography features, were analyzed by digitizing in the GIS environment. In this way, data that are difficult to understand in two dimensions became much more understandable with the help of the third dimension.

Declaration of Author Contributions

Conceptualization, Material, Methodology, Investigation, Data Curation, Formal Analysis, Visualization, Writing-Review & Editing, *M. KARAOĞLU*; Data Curation, Formal Analysis, Visualization, *E. ERDEL*. All authors declare that they have seen/read and approved the final version of the article ready for publication.

Funding

This research received no external funding.

Declaration of Conflicts of Interest

All authors declare that there is no conflict of interest related to this article.

References

Akalan, İ., 1983. Soil and Water Conservation. Ankara University, Agricultural Faculty Publication, No: 873, Textbook No: 238, 2nd Edition, Ankara, Türkiye. (In Turkish).

Akgül, M., Başayiğit, L., 2005. Detailed soil survey and mapping of Süleyman Demirel University farming land. *Süleyman Demirel University Journal of Natural and Applied Sciences*, 9(3): 1-10. (In Turkish).

Anonymous, 1998. Land asset of Kars Province. Publications of the General Directorate of Rural Services, Ankara, Türkiye. (In Turkish).

Anonymous, 2012. Soil Survey and Mapping Workshop Final Report. 30-31 August, Sandıklı, Afyon, Türkiye. (In Turkish).

Anonymous 2021. Climate Classifications. General Directorate of Meteorology. (https://www.mgm.gov.tr/iklim/iklim-siniflandirmalari.aspx), (Accessed: 15.12.2021). (In Turkish).

Anonymous, 2022. Geography of Iğdır Province. SERKA Development Agency. (https://www.serka.gov.tr/bolgemiz/Iğdır/Iğdır-cografya/), (Accessed: 05.01. 2022). (In Turkish).

Aydan, C., Sabah, L., Yaman, N., Keser, K., 2016. Geology Applications with Open-Source Coded Geographic Information Systems. TMMOB Chamber of Geological Engineers Publications, No: 128, Ankara, Türkiye. (In Turkish).

Başayiğit, L., Uçar, G., 2019. Evaluation of the land characteristics ve soil properties of Kars province using by geographical information systems. *Kafkas University Institute of Natural and Applied Science Journal*, 12(1): 15-27. (In Turkish).

Demirci, A., 2008. GIS for Teachers. Fatih University Publication, No: 41, İstanbul, Türkiye. (In Turkish).

Dengiz, O., Özyazıcı, M.A., 2018. Multi-criteria land assessment for determination of rice growing suitability sites. *Journal of Soil Science and Plant Nutrition*, 6(1): 19-28. (In Turkish).

Dengiz, O., Sarıoğlu, F.E., 2011a. GIS analyses for topographic properties with some land properties and land use in Samsun province. *Journal of Agriculture Faculty of Ege University*, 48(1): 55-60. (In Turkish).

Dengiz, O., Sarıoğlu, F.E., 2011b. General distribution of potential agricultural areas of Samsun province and the importance of soil survey and mapping. *Anadolu Journal of Agricultural Sciences*, 26(3): 241-253. (In Turkish).

Fitzpatrick, C., Maguire, D.J., 2000. GIS in Schools: Infrastructure, methodology and role. In: D.R. Green (Ed.), *GIS: A Sourcebook for Schools*, Taylor & Francis, pp. 61-62.

Genç, Z., Dengiz, O., 2015. Determination of physiographic factors and some physico-chemical soil properties and mapping in Madendere watershed. *Turkish Journal of Agricultural Research*, 2(1): 28-39. (In Turkish).

Harmon, J.E., Anderson, S.J., 2003. The Design and implementation of Geographic Information Systems. John Wiley & Sons. Inc. Hoboken, New Jersey.

Karaca, S., Sarğın, B., Türkmen, F., 2019. Investigation of some land and soil properties by geographical information system analysis: Van province land and soil properties. *Turkish Journal of Agricultural Research*, 6(2): 199-205. (In Turkish).

Karaoğlu, M., Şimşek, U., Erdel, E., Tohumcu, F., 2018. A case study: Wind characteristics of Iğdır province in terms of wind erosion and introduction of second wind erosion area. *Fresenius Environmental Bulletin*, 27(11): 7460-7469.

Lillesand, T.M., Kiefer R.W., 2000. Remote Sensing and Image Interpretation. 4th Ed., New York USA, John Wiley & Sons Inc.

Mercan, Ç., Arpağ, S., 2020. The evaluation of soil and land characteristics by using geographic information system analysis: Mardin province lands, Turkey. *Turkish Journal of Agricultural Research*, 7(1): 23-33. (In Turkish).

Özdoğan, N., 1976. Main Measures to be Taken in Wind Erosion and Wind Erosion Sites. General Directorate of Earth Water General Publication No: 306, Ankara, Türkiye. (In Turkish).

Özşahin, E., 2014. Using GIS-based RUSLE model in erosion risk assessment in Tekirdağ province. *Journal of Tekirdag Agricultural Faculty*, 11(3): 45-56. (In Turkish).

Özyazıcı, M.A., Dengiz, O., İmamoğlu, A., 2014. Determination of some land and soil characteristics of Siirt province with geographic information system analysis. *Turkish Journal of Agricultural Research*, 1(2): 128-137. (In Turkish).

Özyazıcı, M.A., Dengiz, O., Özyazıcı, G., 2017. Spatial distribution of heavy metals density in cultivated soils of Central and East Parts of Black Sea Region in Turkey. *Eurasian Journal of Soil Science*, 6(3): 197-205.

Şenol, S., 2006. Soil Conservation and land use law should not be left unattended. *TMMOB Chamber of Agricultural Engineers Publications*, 76(77): 70-73. (In Turkish).

Şimşek, O., Nadaroğlu, Y., Yücel, G., Yıldırım, M., Erciyas, H., 2017. Frost Event and Turkey Frost Calendar (3rd Edition). Publications of the General Directorate of Meteorology, Ankara, Türkiye. (In Turkish).

Yaşar, M., Turgut, Y.Ş., Koca, Y.K., 2020. General evaluation of some soil characteristics of the Muş province using GIS (Geographical Information System) technique. *Journal of Social Sciences of Mus Alparslan University*, 8(UMS'20): 81-90. (In Turkish).

CITATION: Karaoğlu, M., Erdel, E., 2022. A Study of Soil and Land Features with Geographic Information Systems (GIS) Analysis: Iğdır, Türkiye. *Turkish Journal of Agricultural Research*, 9(2): 198-208