

RESEARCH ARTICLE

Main Soil Types of the Çoruh River Basin

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ABSTRACT

This study was carried out to determine and evaluate basic soil characteristics and commonly distributed soil types of the Çoruh River Basin. Soil groups commonly distributed within the basin were defined according to the USA Soil Classifications System and topographic maps were produced using the ArcGIS 9.3. The Chestnut-Colored soils (107,838 ha) commonly found in the Çoruh basin are mainly used for cultivated agriculture, orchards, grassland and pasture and even for forest and shrub lands. Entisols and Inceptisols are common in irrigated and grasslands (2,990 ha); Mollisols in pasture lands (15,551 ha); Mollisols and Alfisols in dry and pasture lands (14,794 ha); Podzol characterized Alfisols and Ultisols in irrigated and dry lands, dry horticulture, pasture, shrub and forest lands (55,455 ha); Lithochromic soils in grasslands (81 ha); Aridisols in pasture lands (430 ha); transported Entisols and Inceptisols in dry lands, horticulture and grasslands (1,797 ha) and Alfisols and Mollisols in dry and pasture lands (46,527 ha). Of the total 326,220 ha of cultivated land in the basin; 290,000 ha is suitable for irrigation.

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Introduction

Soil and water are the two most important resources for sustainable development. River basins are not only ideal units for the protection of water resources and ecosystems but also sustainable usage. The most important processes in soil formation are local and regional environmental factors. Soil formation and the development of the soil profile are the product of processes such as fragmentation, leaching, illuviation and accumulation that take hundreds or even thousands of years. In these processes, factors such as climate, properties and mineralogy of the bedrock, relief, organisms, time and their combined effects are determinative. In addition, it is predicted that global climate changes may affect regional landuse deeply (Çepel, 1996; Atalay, 1989). The fertile soil areas are gradually decreasing all over the world. Erosion, contamination, acidification, compaction, loss of

organic matter, salinity lead to degradation of the soil cause loss of biodiversity (Çepel, 2000; Gerrard, 2000).

The Çoruh river basin is an important natural treasure of Turkey. It is selected as one of the hot points of the World among 34 by International Protection Agencies. Great differences in biodiversity and elevation, which reaches up to 3000 m, lead different climates within the watershed. There are a lot of different faunas and floras in different valleys of the watershed. It is estimated that the Çoruh basin contains almost 100 endemic species (Anonymous, 2008).

Soil survey is made by the investigation of terrain, its identification, and classification which is then displayed on the map. For specific use, some soil surveys are made in few hectares or less in width, for accurate and detailed information. Such investigations, including information about soil management and behavior, requires a detailed separation of small and homogeneous areas. Other soil surveys are made

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for large-scaled areas, which show not detailed information. Some soil surveys cannot give the desired information to other users. For the implementation of soil science in various forms, soil maps containing the individual characteristics of soil are needed. Base soil maps are prepared when reviewing the nature of soil formation factors (Anonymous, 1993).

Materials and Methods

The Çoruh river basin is located in the eastern part of the Black Sea Region, which is the wet region (app. 2100 mm per year) of Turkey (MGM, 2020). The Çoruh River is one of the most important hydrological basins of Turkey in which a series of dams and hydroelectric power plants will be established. It is an important gateway that provides a connection not only to the Black Sea to Eastern Anatolia but also Anatolia to the Caucasus. This mountainous region shows the mild Black Sea and harsh continental climate features. This region sorts attention with Çoruh River, steep slopes, and high mountains (2900 m) rising one after another. The Çoruh River has an important place in rafting and skiing. This causes the attention of local and foreign tourists to this region.

The Çoruh River is 431 km in length and its annual average flow volume is 6.3 billion m³. Of the total 431 km, 410 km is in

the boundaries of Turkey and the rest (21 km) is in the boundaries of Georgia (Anonymous, 2005a, 2005b).

The study site is an authentic and natural tourism location with its virgin forests, high mountains, and crater lakes in its peaks and with a wealth of fauna and flora. The study area is an alternative tourism place with its 230-bird species (2 endemics), 2300 plant varieties (550 endemics), natural forests and highlands (Anonymous, 2020b).

Topography

The Çoruh River basin is located in the Northern Anatolia orogenic belt. It is located between Eastern Black Sea Mountains in the north-northeast towards of Çoruh River and Mescit-Yalnızçam mountains in the northeast-southwest direction of Çoruh River. These mountains are generated with especially deep pressures and side pressures towards the South (Figure 1). Thus, this mountain has large domes toward east-west and its elevation reaches up to 4000 m towards the east (Kaçkar Mountain, 3937 m). Basis of these mountains are consisting of metamorphic rocks, micaschist, quartzite, granite, and schist belonging to the Paleozoic period. These are commonly found in the North of Soğanlı Mountains, Artvin, and down Çoruh (Atalay et al., 1985).

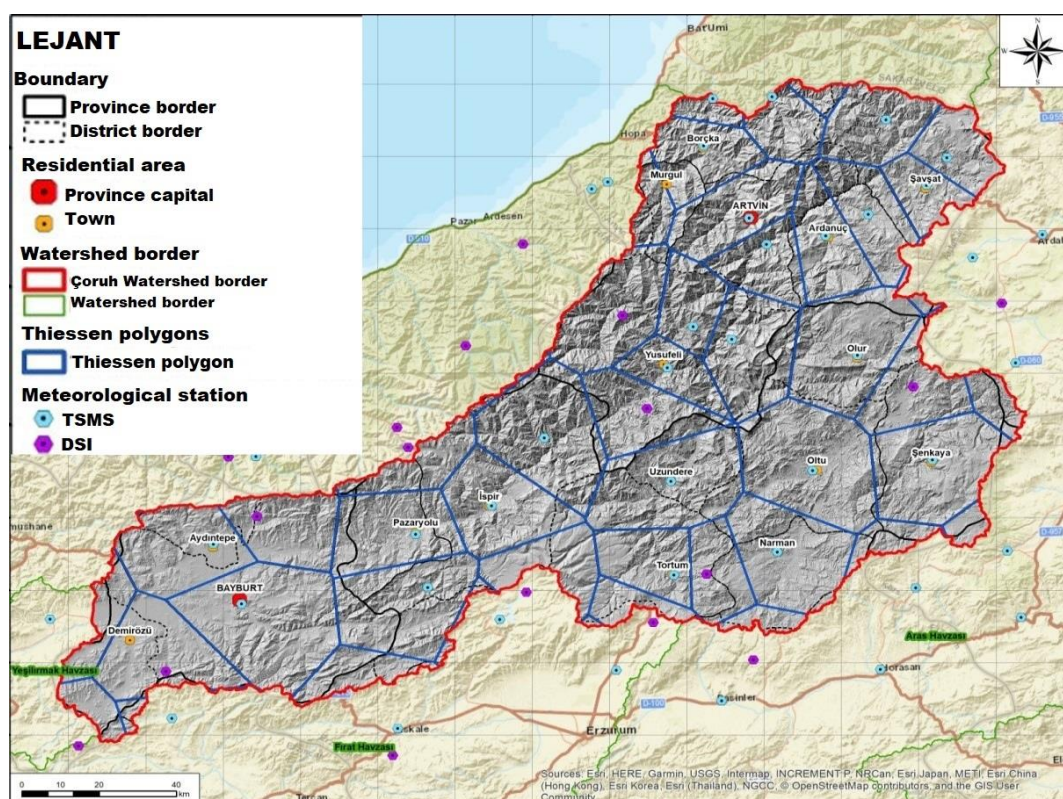


Figure 1. Study area (Anonymous, 2020a)

Geology

The Çoruh Basin geology has been prepared by the general directorate of mineral research and exploration (MTA, 2020). All sedimentary, magmatic and metamorphic rocks have surfaced in the Çoruh Basin from Paleozoic to the present day. In the Çoruh Basin, sedimentary, magmatic and metamorphic

rocks formed during the Paleozoic time were identified. The geological formations in the Çoruh Basin are as follows from old to young; Paleozoic Aged Geological Formations, Mesozoic Aged Geological, Formations, Tertiary Aged Geological Formations, Quaternary Aged Geological Formations (Figure 2) (Anonymous, 2019).

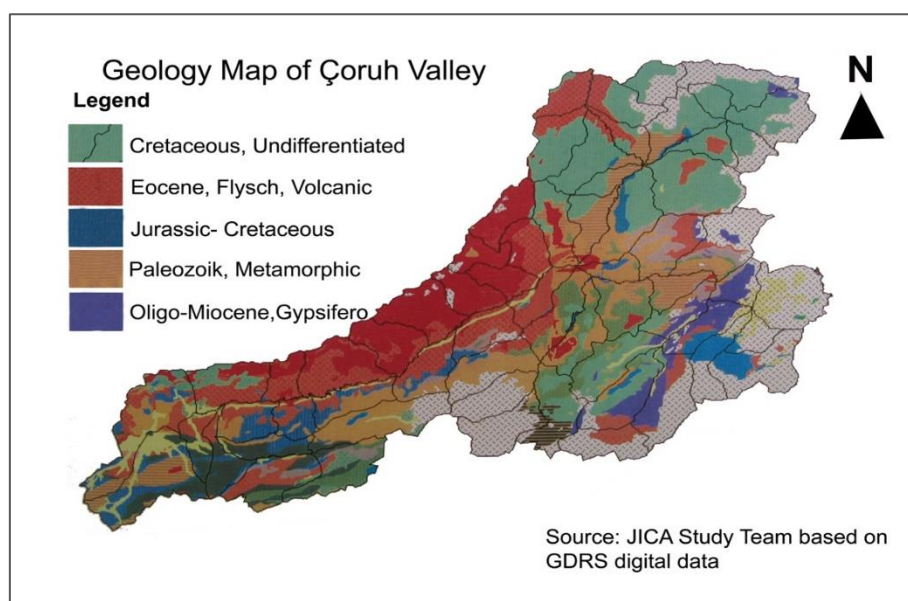


Figure 2. Geologic map of the Çoruh river basin

Climate

The Çoruh Valley is the drainage basin of the Çoruh River in Northeast Anatolia. It covers approximately 2.5% of Turkey's total land. The mean annual precipitation is 560 mm. Because of its location, it shows the climate of both the Black Sea and Eastern Anatolia (Acar, 1997).

Moist air pass through North of the Black Sea is significantly blocked by the Eastern Black Sea Mountains located in the North of the Çoruh basin. Mescit and Yalnızçam mountains block air to pass from south to north. Because of the characteristics of the basin, mild climate divers into continental climate through inland. Aridity increase through inland. While annual precipitation is 2754 mm in Hopa-Kemalpaşa, it decreases down to 1250 mm in Borçka (Çoruh Basin entrance), 689 mm in Artvin, 446 mm in Ardanuç, 295 mm in Yusufeli, 440 mm in İspir and 353 mm in Oltu. Thus,

annual rainfall decreases through inland and mild climate divers into a continental climate (Yukseket al., 2001; MGM, 2020).

Slope and Soil Erosion

The Çoruh basin requires specific soil management features modified with varying intervals and frequency. Soil and climate dynamics of the basin mainly affect geology, topography, and erosion. Different agricultural activities are possible within the basin (from horticulture to legumes, legumes, livestock grazing, and tourism to forestry).

The basin area has mountainous and steep geomorphology. Among the slope groups, the most area covers 30% + slope groups (158,288ha). In other words, 57.33% of the study area has a very high slope. At the same time, the 20-30% slope group covers the second largest area (Figure 3).

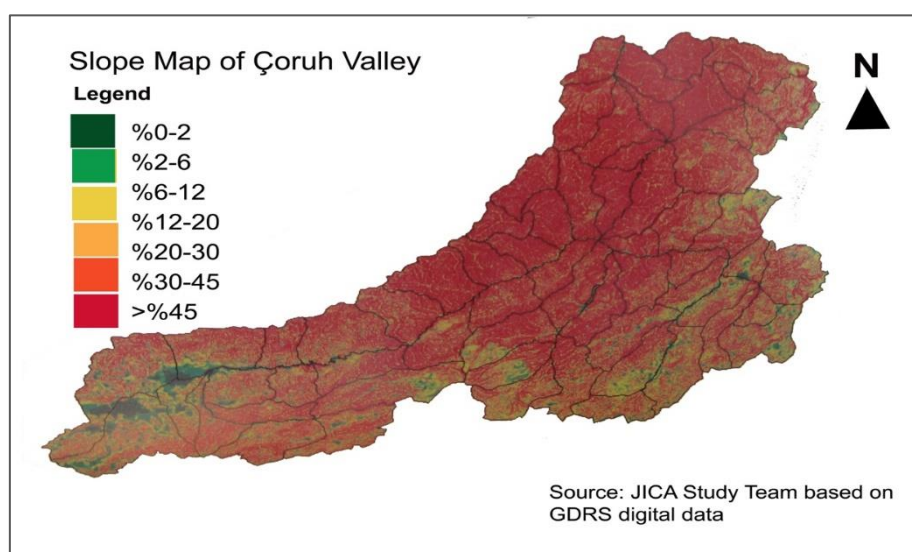


Figure 3. Slope map of the Çoruh river basin

In the Çoruh basin, 20-30% and 30% + slope groups cover 74.62% of the total area. It can be said that the most important factor for erosion is the slope due to the basin has a steep and

very steep slope. The fact that the degree of slope is very high across the basin has greatly increased the risk of water erosion (Figure 4).

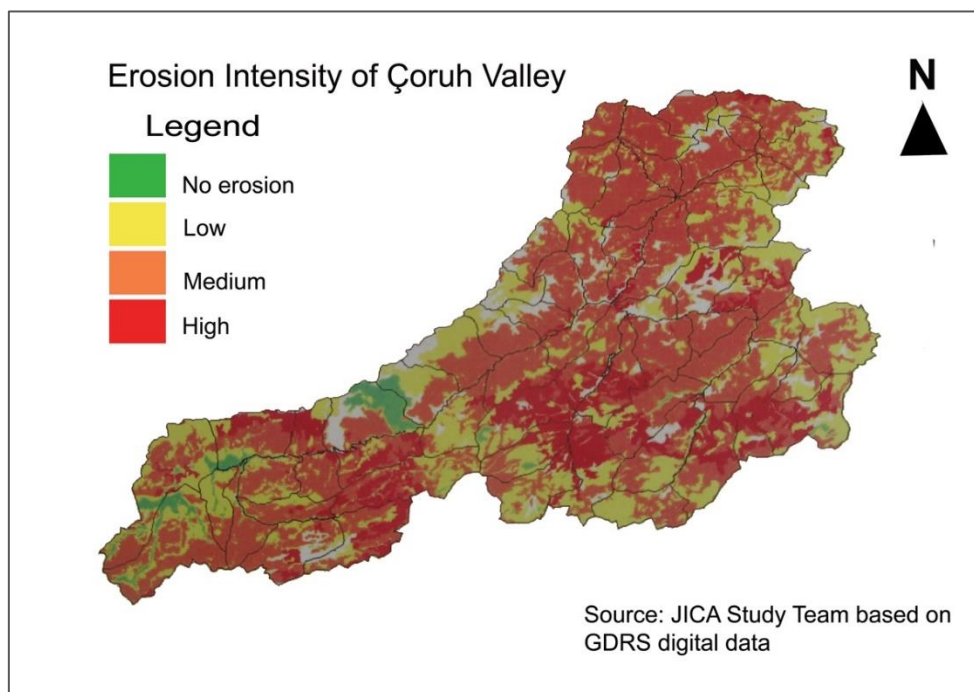


Figure 4. Soil erosion map of the Çoruh river basin

Results and Discussion

Soil Properties

The Çoruh River basin is mostly covered by Chestnut-Colored soils (107,838 ha). This group is mainly seen in agriculture, horticulture, and grass-pasture lands and forest and shrublands. Entisols and Inceptisols are commonly seen in irrigated and grasslands (2,990 ha); Mollisols in pasture lands

(15,551 ha); Mollisols and Alfisols in dry and pasture lands (14,794 ha); Podzol characterized Alfisols and Ultisols in irrigated and drylands, dry horticulture, pasture, shrub and forest lands (55,455 ha); Lithochromic soils in grasslands (81 ha); Aridisols in pasture lands (430 ha); transported Entisols and Inceptisols in drylands, horticulture and grasslands (1,797 ha) and Alfisols and Mollisols in dry and pasture lands (46,527 ha). Of the total 326,220 ha of cultivated land in the basin; 290,000 ha is suitable for irrigated agriculture (Table 1).

Table 1. Soil groups and land use classification (Özgül et al., 2008)

B.T.G / M.A.K	Agriculture			Horticulture		Pasture	Grace	Forest	Shrub	Area (ha)
	Irrigated	Irrigated (inadeq.)	Dry	Irrigated	Dry					
Alluvial	X			X		X				2990
Basaltic							X			15551
Brown			X				X			14794
Brown forest	X		X		X		X	X	X	55455
Chestnut	X	X	X	X	X	X	X	X	X	107838
Redish Mediterranean						X				81
Redish brown							X			430
Colluvial			X		X	X				1797
High mountains grass			X				X			46527

The Çoruh River basin has special status due to its topography, land characteristics, and climate. Soil properties show great variations in short distances throughout the basin because of different soil formation factors. The Podzolization process is seen with continental climate properties. Erosion, transportation, and accumulation process continue. With these properties, Çoruh Basin has specific properties among the

basins in Turkey. These dynamic characteristics make it compulsory to assess this basin.

Considering the widespread soil formation processes in the basin and the important characteristics of the soils, the natural vegetation cover and the current usage qualities of the soils can be qualified as a natural result of topographic and climatic conditions. Important soil catenae related to the main

material and topographic change also spread in the basin (Şimşek, 1999).

There are 9 different great soil groups in the basin and the most abundant soil group consists of Chestnut soils (Profile I) and Brown Forest Soils (Profile II) groups (Anonymous 2000b).

Defined Soil Properties

General characteristics of two soil profiles developed on cereal-fallow land use and alluvial main material are given in Tables 2 and 3.

It has been observed that the soils commonly found in the basin are thin and medium textures, their pH is neutral and slightly alkaline, their organic matter content is close to each other in horizons, the lime content is medium in chestnut soils and low in brown forest soils (Table 4) (Anonymous, 1993).



Figure 5. A view of soil profile I



Figure 6. A view of soil profile II

Table 2. Soil profile I

Coordinates: 40° 50'13" E, 40° 25'12" N	Elevation: 1247 m
Position: Deposits range	Topography: Slightly sloping
Slope: 2-6%	Parent Material: Alluvial
Land Use: Cereal-Fallow	Vegetation: Barley stubble
Erosion: 0	Drainage: Good
Stoniness: 0	Water Table: Not seen

Table 3. Soil profile II

Coordinates: 40° 50'27" E, 40° 25'12" N	Elevation: 1247 m
Position: Deposits range	Topography: Slightly sloping
Slope: 2-6%	Parent Material: Alluvial
Land Use: Cereal-Fallow	Vegetation: Barley stubble
Erosion: 0	Drainage: Good
Stoniness: Slight stone	Water Table: +130 cm

Table 4. Some physical and chemical properties of soils in the study site

Profile	pH		CaCO ₃ %	OM %	EC mmhos cm ⁻¹	CEC cmol _c 100gr ⁻¹	Clay %	Silt %	Sand %	Tex. Class	Bulk Den. gr/cm ³
	1:2.5	Sat. Ex.									
1-1	7.81	7.80	3.75	1.54	0.180	38.22	43.84	17.90	38.26	C	1.12
1-2	7.75	7.74	2.98	1.73	0.265	33.04	42.14	35.22	22.64	C	1.35
1-3	7.70	7.74	2.55	1.16	0.200	41.22	46.44	35.30	18.26	C	1.18
2-1	7.90	8.02	1.17	1.21	0.170	30.50	26.86	45.15	27.99	L	1.05
2-2	7.83	8.10	1.23	1.18	0.145	32.50	36.83	28.50	34.67	CL	1.12
2-3	7.80	7.85	1.90	1.07	0.250	33.34	34.95	28.63	36.42	CL	1.02

Conclusion

Due to the lack of land suitable for mechanized agriculture, mixed cultivation practices should be considered with greenhouse production. These areas should be selected according to the soil properties of land and it should be decided whether organic or sustainable agriculture is going to be made. These agricultural practices are in the effect of seasonal climatic parameters. Therefore, agricultural productivity will be in a high range in the Çoruh Basin. From the soil map, it is seen that agricultural lands are small and apart from each other. Thus, these lands are not suitable for

integrated agricultural practices. From the land use and soil properties, it can be said that flora is directly affected by topography and climate.

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