DOBROGEA SOILS - AN ECOSYSTEM APPROACH

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https://doi.org/10.11118/978-80-7509-831-3-0101

Abstract
Soil resources, essential components of natural capital are necessary to analyze from the perspective of sustainable development, due to their role in relations with the components of the environment and with the socio-economic capital of a territory. In territorial planning, the study of soil resources is very important, from the perspective of ensuring ecological and social security. Being vulnerable to degradation processes, when used without observing the protective and conservative conditions, it can be degraded in a short time, and the subsequent recovery is long and expensive. Starting from these considerations, our analysis aims at evaluating the ecosystem services offered by the soils of the Dobrogea Plateau. Ecosystem services are one way to harness biodiversity by looking at what it does and how we value the function that soil performs. They generate a series of services that are essential for our health and well-being. Our study makes use of FAO (FAO and ITPS. 2015. Status of the World's Soil Resources – Main Report) assessments by correlating the soil reference groups according to the WRB with the soil units of the Dobrogea Plateau, a region characterized by the domination of the bio-climatically determined soils, to which various intrazonality situations are added. These include types of food security, climate regulation, water regulation, and socio-cultural services.

Key words: Dobrogea Plateau, soils, and ecosystem services

Introduction

Dobrogea Plateau is the largest part of the historical province of Dobrogea and it consists of three main subunits: the Southern Dobrogea Plateau, the Central Dobrogea Plateau and the Northern Dobrogea Plateau. It is a region with hill relief characterized by the domination of the steppe and forest-steppe soils bio-climate determined, which are added various situations of intrazonality, depending on the rock, excess moisture, salting.

With a total area of 10,350 km2 (4.35% of the country's surface), the Dobrogea Plateau has a varied edaphic coating that made possible a well-defined distribution of different types of crops and the appearance and development of the first human settlements since the Paleolithic.

This work highlights the corresponding links between the different types of soil in this region, the ecosystem services they can offer, and especially the analysis of the cultural and touristic services by identifying archaeological sites on these soils.

Material and methods

1. Study area

Dobrogea Plateau is morphologically characterized by low altitudes (89% of the territory is below 200 m), the relief energy is predominantly below 100 m, and the fragmentation density is 0.5-1 km/km^2.

Localities are focused on the coast, along the Danube and the principal valleys (Ielenicz, 2000). In concert, it is a region full of history, with traces of habitation from antiquity - a series of Greek and Daco-Roman fortresses, with continuity also in the Byzantine era.

2. Data processing

The methodology included a series of stages of data collection, database development, geospatial analysis, and identification of interdependent elements for determining some eco-systemic services in the study area. In addition, GIS and Remote Sensing techniques were used with the help of ArcGIS Pro2.8 and Google Earth Pro applications. The first stage consisted of the recognition and cartographic representation of the main types of soils in the study area. The information available on the Map of Romania's Soils was used, scale 1:200 000, 1963-1994 edition. This assembled vector data was later included in a complex geodatabase. To establish the type of eco-systemic services that each soil group in the Dobrogea Plateau can offer, in the second stage of work, the FAO Report 2015 was interrogated.

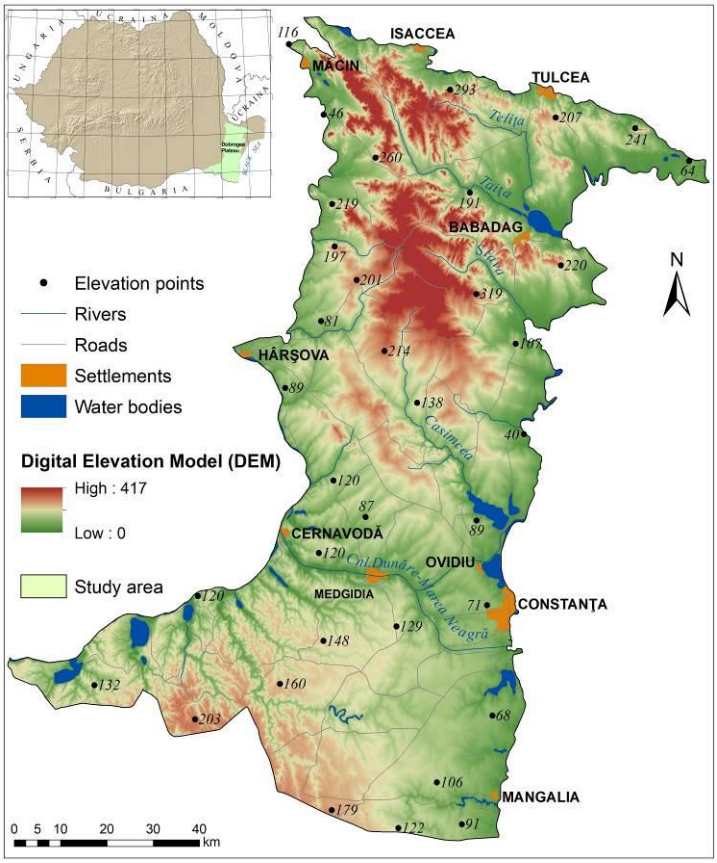

Fig. 1: Study Area. Dobrogea Plateau located in Eastern of Romania

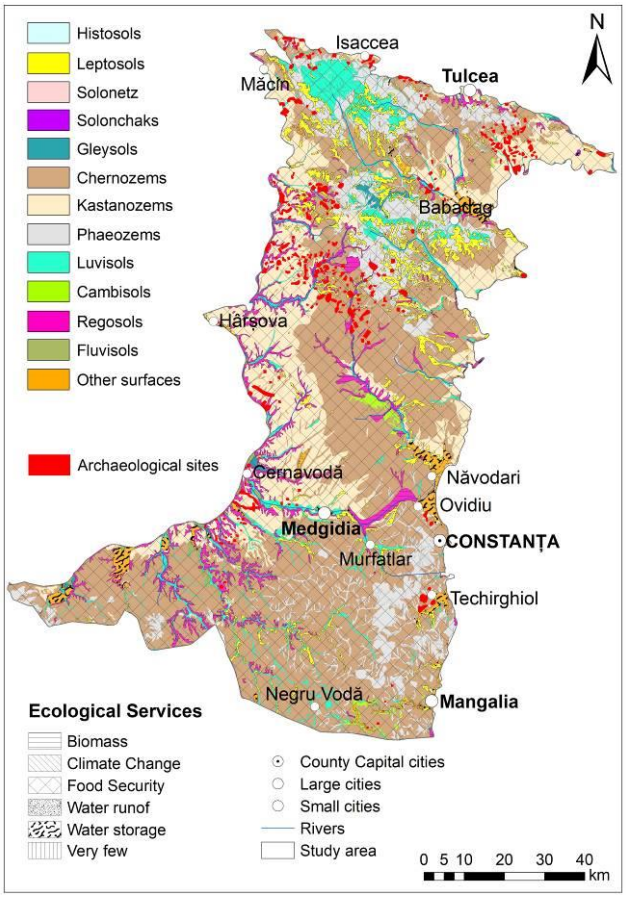

Fig. 2: Map of soil groups, major ecosystem services and archaeological sites

It suggests a generalization of the main soil groups globally and determines which type of soil can provide eco-systemic service.
Conform to this Report, a classification of the principal soil groups in the Dobrogea Plateau and the ecosystem services that can be performed was made. To bring some details about cultural services was an inventory of the archaeological sites and their correlation with the soil groups. Discovery of the archaeological sites was made on aerial images provided by the Google Earth Pro application, with a resolution of 50 m. These images were purchased on June 19, 2021. The result was a map of the ecosystem services offered by the soils.

Results
The first part of this study focused on identifying the ecosystem services offered by the soils of the Dobrogea Plateau In this respect, the soil types from the study area were mapped and correlated with the ecosystem services provided by each of them, according to the FAO Report 2015.

Tab. 1: Generalized ecosystem service rating of specific soil groups (WRB) (processing according to the FAO Report 2015). The share of land with archeological sites. F - Food, CL - Climate, W - Water, CU - Cultural, AS - Archaeological sites

SOILS	**%**	**F** **W**	**CL** **CU**	**SUM**	**MAJOR SERVICE**	**%** **AS**
Histosols	0.03	2 5	5 3	15	Climate Change	0.02
Leptosols	3.02	1 2	1 1	5	Water runof	3.27
Solonetz	0.04	1 1	1 1	4	Very few	0.00
Solonchaks	0.07	1 1	1 1	4	Very few	0.33
Gleysols	0.42	2 3	1 1	7	Food Security	0.60
Chernozems	47.56	5 4	4 1	14	Food Security	38.37
Kastanozems	19.37	3 2	4 1	10	Food Security	34.66
Phaeozems (Halic Phaeozems, Grey Luvic Phaeozems, Endoleptic Phaeozems)	14.85	4 3	4 1	12	Food Security	9.28
Luvisols (Haplic Luvisols, Albic Luvisols, Chromic Luvisols)	5.71	3 2	2 1	8	Food Security	3.45
Cambisols (Eutric Cambisols, Rhodi-eutric Cambisols)	0.51	3 3	2 1	9	Food Security	0.00
Regosols	5.66	2 1	1 1	5	Biomass	8.91
Fluvisols	0.42	4 4	2 2	12	Food Security	0.44
Other surfaces (Stony, Sands, Water bodies)	2,34					0.66

Assessment of soil contribution to types of ecosystem services - food security, climate change, water runoff, and socio-cultural services are estimated on a scale of zero to five for each category referred. Assessments shall be based on the characteristics and quality of the soil measured by: suitability for cultivation, organic carbon content, water retention capacity, and capacity to store archaeological remains.
This analysis resulted that the highest share is held by the Food Security ecosystem services (88.84%). Services are provided in a proportion of 81.78% by Chernozems (47,56%), Kastanozems (19.37%), and Phaeozems (14.85%). The primary ecosystem service is generally the one with the highest score. A particular situation is the case of Gleysols, who have been assigned the Food Security service because they. Those soils are part of the ecological group of chernozem soils (Florea, 2003) which by their fertility are widely used in agriculture, especially for cereal crops. However, with an excess of moisture, they frequently have a high nutrient content, having a high natural fertility potential for meadows. Through dewatering, they can also be harnessed by cultivation. In the same way, in the case of Kastanozems, the higher score attributed to climate services related to the carbon cycle has been overtaken by their role in ensuring food security.

At the same time, if we follow the scores given to the four categories of services, we can see that along with the involvement in food production, the different soils offer services that are well valued and related to water runoff and climate change. Thus, of the total score, about 30% go to services related to food production, but at the same time, services related to water runoff and climate change hold about 30% and 27%, respectively. Cultural services account for about 14%.

Foto 1,2- Left - Enisala Fortress (area with Regosols); Right - Halmyris Fortress (area with Kastanozems). Date: June 17-18, 2019

To bring some details regarding the cultural services, we considered that identifying archaeological sites and their correlation with the soil group represents a necessary stage in this study. More than 275 archaeological sites (23251.71 ha) have been identified on aerial images, most of them located in the central and northern part of the Dobrogea Plateau. After mapping, data were verified with the National Institute of Heritage database and subsequently punctually validated in the field through the campaigns organized in 2021.
The final data were included in the complex database and then correlated with the principal soil groups in the study area. Through the additional value they bring, cultural services can serve to secure the land as a whole in traditional ways of using it. They can foster the development of forms of cultural tourism combined with forms of ecotourism, with little impact on the environment.

Discussion

Ecosystem services are a way to enhance biodiversity by looking at what it does and how we value the function of soil. They produce a range of essential services for our health and well-being. To provide a framework for how ecosystems provide services to human lives, the terms "Ecosystem approach" and "Ecosystem services" are used. The 'ecosystem approach' is intended to help policymakers take complete account of ecological systems and their associated biodiversity. "Ecosystem services" describe the processes and functions provided by the natural world, which are used by humanity for its well-being. (FAO Report, 2015).
The solification was influenced mainly by temperate-continental climate conditions of the steppe and forest-steppe very good for agricultural use (Oprea, C.R. et. all, 2019). The primary ecosystem service is Food Security, which is connected with the decomposition and cycle of organic matter, nutrient regulation, and food production. It is added with scores close in value, equally valuable services related to the regulation of water and climate - clean air and water, gas exchange, and carbon sequestration.
Although the cultural services amount to about 14% of the total score, they have an essential role being able to offer alternatives for the sustainable development of the region so that the decisions regarding the use and management of the land and its resources must favor practical long-term solutions, to the detriment of those in the short term or which may lead to the degradation or destruction of soil resources. Therefore, under The World Soil Charter (FAO Report, 1981), land use for non-agricultural purposes must be organized in such a way as to avoid as much as possible the occupation or permanent degradation of good quality soils. The morphological characters described above to which optimal wind conditions are added were favorable elements for the installation and expansion of wind farms. In addition to the obvious advantages, there are also some problems, including removing fertile soils from the set-aside of some. These aspects are visible, especially at the locality level, among the most affected being Cogealac-Fantanele, Chirnogeni, Casimcea, etc. (Oprea, C.R. et. all, 2019).

Conclusion

The inventory of archaeological sites concerning soil groups opens up interesting discussions. The analysis of cultural services - cultural, spiritual values (for example, the traces of the Paleo-Christian basilicas of Halmyris and Niculițel - whose foundations are preserved in Kastanozems) and recreational - can be deepened. By capitalizing on them in ecotourism programs, and cultural tourism, to be organized in environmentally friendly ways, benefits can be brought to local communities, tourism activities spreading outside the area of maximum concentration, which is the Black Sea coast. In the region, especially in the northern half, where archaeological sites predominate, there are also soils with total scores for lower ecosystem services, ranging from 4 to 8, with scores for Food Security being mostly 1 or 2. Thus, through the cultural services, Leptosols, Solonchaks, Gleysols, Luvisols, and Regosols increase their value, the archaeological sites totaling within these groups 16,56%. In the situation of soil groups Chernozems, Kastanozems, Phaeozems with high scores, these tourism activities can contribute, as we have shown in the above lines, to securing land in flexible ways of use, optimized coexistence between alternative forms of valorization and traditional forms linked to the natural valence of soils.

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Souhrn

Ekosystémové služby představují způsob, jak zvýšit biologickou rozmanitost tím, že se podíváme na to, co dělá a jak oceňujeme funkci půdy. Produkují řadu služeb nezbytných pro naše zdraví a pohodu. Naše studie využívá hodnocení FAO (FAO and ITPS. 2015. Status of the World's Soil Resources - Main Report) tím, že korelovala referenční skupiny půd podle WRB s půdními jednotkami na Dobrudžské vrchovině. Jedná se o region nacházející se na jihovýchodě Rumunska, který je na severu a západě rámován Dunajem, na východě deltou Dunaje a Černým mořem a na jihu hranicí s Bulharskem. Jedná se o region s vynikajícím zemědělským potenciálem a větrnými zdroji a cenným turistickým potenciálem, který se však zužitkovává zejména pouze na pobřeží Černého moře. Jedná se o typy potravinové bezpečnosti, regulace klimatu, regulace vodních zdrojů a kulturních služeb.

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