Assessing environmental limitations of agricultural suitability in Europe's temperate continental climate region: a geospatial evaluation

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#1 Introduction

By the use of geographic information systems, land suitability assessment (LSA) emerges as a powerful instrument for spatially modeling diverse aspects of soil functions. It is a promising method for achieving a sustainable agricultural productivity, for mitigating land degradation, and for facilitating adaptation to climate change.

Within the European Union, a significant portion of soils faces degradation due to unsustainable practices. Soil protection has gained interest in EU policies like the Green Deal, Soil Thematic Strategy, Farm to Fork strategy.

#2 Objectives

The main objective of this study is to provide an enhanced geospatial analysis of the limitations imposed by soil and ecological indicators on the land suitability assessment (LSA) of different crops and land uses found in the temperate continental climate regions of Europe.

This analysis will have the potential to aid the EU 2030 targets, including achieving 75% healthy soils, promoting organic farming, reducing land degradation, boosting SOC.

#3 Study area

Based on the Köppen climate classification, the research was carried out in Central and Eastern European territories with a humid continental climate.

The study region falls under a predominantly warm summer subtype, with small areas under different characteristics.

#4 Data & methods

ROMANIAN METHODOLOGY OF LAND SUITABILITY FOR CROPS AND LAND USE

= ecological method that takes into account the natural conditions of the land, without human interventions

= multiplicative parametric technique composed of a

DATABASE with LAND SUITABILITY RULES

rating for each eco-pedological indicator

0 — 0.2 — 0.8 — 1

not suitable — maximum suitability

PER-PIXEL approach to the entire study area

17 eco-pedological INDICATORS depicted through GEOSPATIAL DATA

ENVIRONMENTAL
e.g. -slope gradient
-water table depth
-landslides

SOIL
e.g. -gleyzation
-soil Ph
-soil pollution

GEOSPATIAL DATA → RECLASSIFIED/ derived from existing datasets → RESAMPLED → aligned to 250 m resolution

17 limitation maps for each crop

#4 Results and Conclusion

The suitability of wheat, pasture, and peach trees is influenced by various factors across the study area.

Water table depth affects suitability, with optimal values between 2-5 m (wheat, peach tree), and 0.7-5 m (pasture); however, significant areas have depths exceeding 5 meters or shallower than 2 meters, leading to decreased suitability.

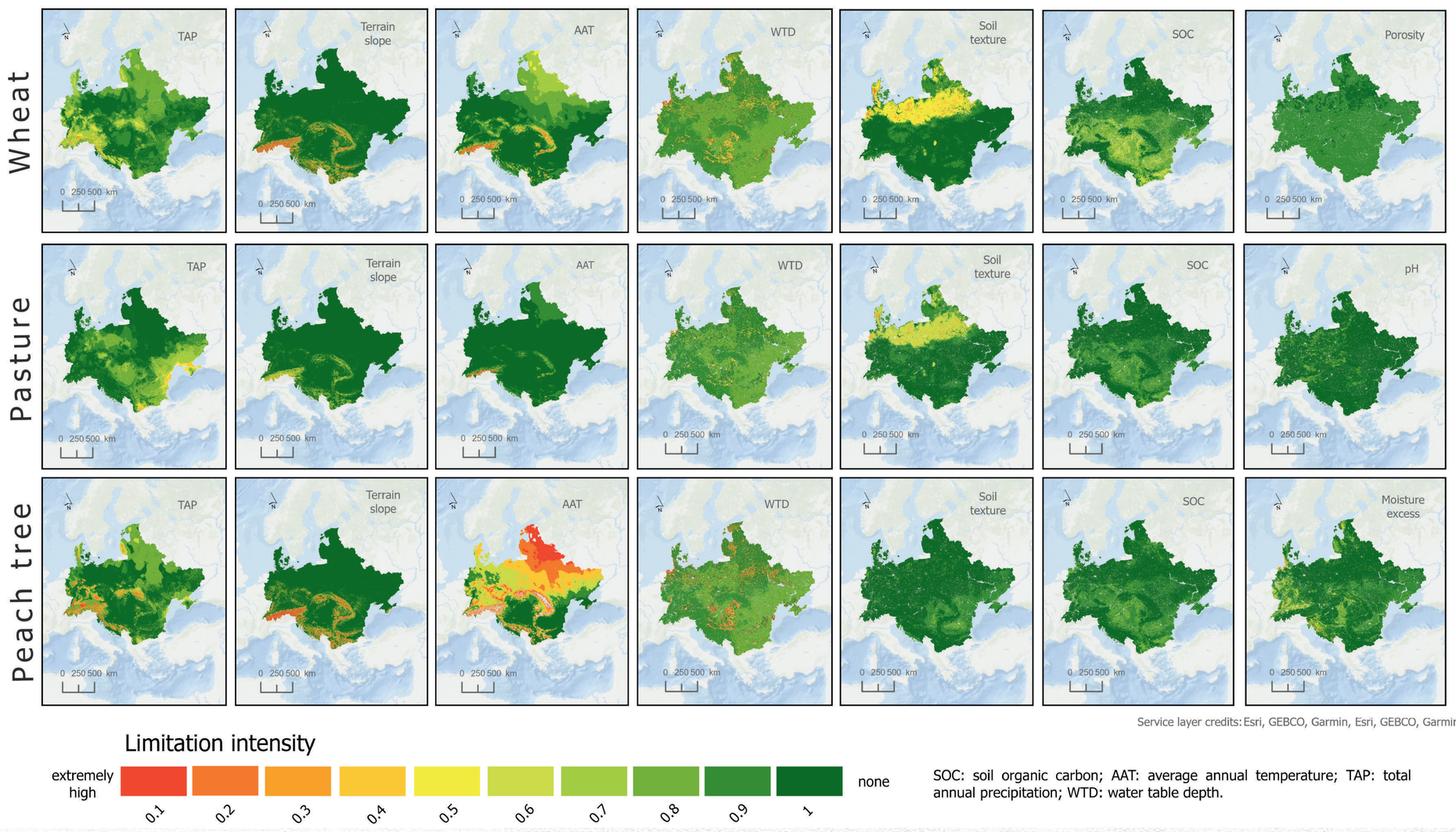
Precipitation patterns also impact suitability, with lower suitability in regions experiencing either inadequate or excessive precipitation.

The suitability is strongly influenced by yearly average temperatures, with optimal values ranging from 8-13°C for wheat, 10-13°C for peach tree, and 6-12°C for pasture, while temperatures vary widely across Europe, characterized by colder regions in the north and limited warmer areas in the south.

Wheat, peach tree, and pasture suitability are optimal on slopes below 10°, with the majority of the study area comprising gentle slopes.

Consequently, only 17% of the area experienced reduced suitability due to a high slope gradient.

SOC levels, impacted by intensive agriculture, limit suitability. For wheat, this decreases suitability to 0.9 over 22% of the area, mainly in the North European Plain and Transylvanian Plateau. Additionally, it drops to 0.8 across 30% of the Europe Central Uplands and Pannonian Basin, and to 0.6 in the Pannonian Basin and Romanian Plain.



SOC: soil organic carbon; AAT: average annual temperature; TAP: total annual precipitation; WTD: water table depth.

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