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THE IMPACT OF NATURAL FACTORS ON EROSION PROCESSES IN THE BIZDIDEL RIVER BASIN

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Abstract. *This study analyzes the impact of natural factors on erosion processes in the Bizdidel River basin, highlighting the interaction between geomorphological characteristics, soil types, and the climatic regime. The relief is assessed using a hypsometric map, while the distribution of soils is analyzed based on cartographic data processed with the help of QGIS. In addition, the specific climatic conditions of the area are examined, with a focus on the precipitation regime, which influences the intensity of soil erosion. The geomatics methods, such as remote sensing and spatial analysis, employed in this study allow for a detailed characterization of risk factors and the identification of areas with high susceptibility to erosion. By correlating geomorphological parameters with data on soil types and climate, the study provides a comprehensive perspective on the dynamics of land degradation processes. The use of remote sensing data, combined with GIS-based spatial analysis, improves the accuracy of erosion risk assessments.The obtained results contribute to a better understanding of erosion mechanisms and can be used to implement preventive and management measures, supporting sustainable land use planning and conservation efforts. The goal of the research is to determine the vulnerability of the basin to erosion, highlighting the key factors and their impact on land stability, thus providing a solid foundation for future strategies aimed at mitigating the effects of erosion.*

Keywords*: Soil erosion, Bizdidel River basin, GIS, hypsometric map, land degradation, climatic factors, QGIS.*

INTRODUCTION

Soil degradation is a critical environmental issue, impacting agricultural productivity and geomorphological stability across terrestrial ecosystems (BORRELLI ET AL., 2020). In Romania, Subcarpathian regions exhibit pronounced soil challenges due to their complex topography, climatic variability, and land use practices (PANAGOS ET AL., 2015; FAO, 2023).

In Dâmbovița County, the contact zone between the Leaota Mountains and the Dâmbovița Subcarpathians features steep slopes, diverse soils, and a dense hydrographic network (ICPA, 1978). Agricultural activities, often conducted on moderately sloped lands plowing, shape the landscape (RUSU, 2002).

Geomatics technologies, including Geographic Information Systems (GIS) and remote sensing, provide robust tools for analyzing environmental characteristics, enabling detailed spatial mapping (NEARING ET AL., 2017; QGIS DEVELOPMENT TEAM, 2023). Open-source

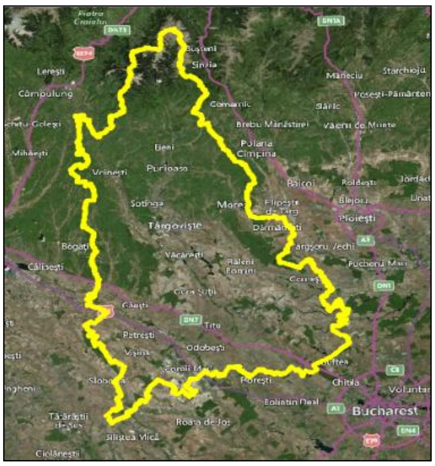

Figure 1 - Dâmbovița county boundary Backgroud Bing maps

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datasets, such as digital elevation models (DEMs), CORINE Land Cover (CLC) maps, and climatic records, support accessible and replicable methodologies (PANAGOS & KATSOYIANNIS, 2019).

This study describes the geomorphological, pedological, and climatic features of the Bizdidel River basin through systematic geomatic data processing and field validation. The methodology aims to provide a comprehensive framework for mapping natural conditions, applicable to other Subcarpathian basins, contributing to informed land management strategies.

MATERIALS AND METHODS

Data Sources

The analysis utilized high-resolution, publicly available geospatial and climatic datasets, validated internationally. For terrain characterization, the ALOS PALSAR digital elevation model (DEM) with a 12.5 m resolution was obtained from NASA's EarthData platform via the Alaska Satellite Facility (ASF, 2023). This dataset supported the creation of hypsometric and slope maps.

Hydrographic and administrative boundaries were sourced from geo-spatial.org, compatible with Romania's Stereo 70 projection system.

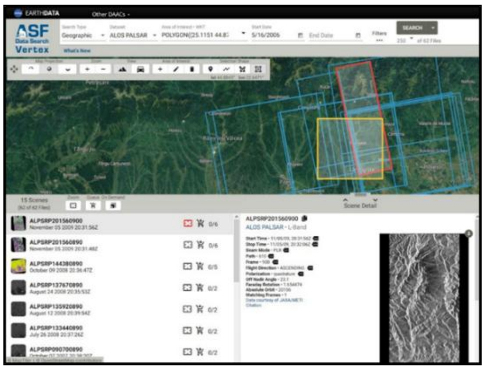

Figure 2 - Download ALOS PALSAR DEM from the EarthData platform - NASA

Land use data were derived from CORINE Land Cover 2018 (CLC), a standardized product from the European Environment Agency (EEA, 2018). Climatic data, including temperature and precipitation time series, was provided by the Romanian National Meteorological Administration and the European Climate Assessment & Dataset (ANM, 2022; ECAD, 2022). Pedological data were based on soil maps from the National Institute for Research and Development in Soil Science and Agrochemistry, interpreted using updated classification methods (ICPA, 1978; PATRICHE, 2023).

Data processing was conducted using QGIS (v.3.28) and ArcGIS (v.10.8), with photogrammetric analysis in CloudCompare to handle raster and satellite imagery.

Geomatic Data Processing Workflow

1. Data Acquisition and Preprocessing

The ALOS PALSAR DEM was imported into QGIS and reprojected to Stereo 70 (EPSG:3844). The resolution was standardized to 12.5 m, with corrections for artifacts and missing values applied using the "Raster Calculator" tool. Vector layers, including the hydrographic network and administrative boundaries, were overlaid on the DEM for topological validation, with manual adjustments to ensure accuracy. Landsat 8 and Sentinel-2 imagery were corrected for atmospheric effects and cloud cover using QGIS tools, enhancing land use analysis.

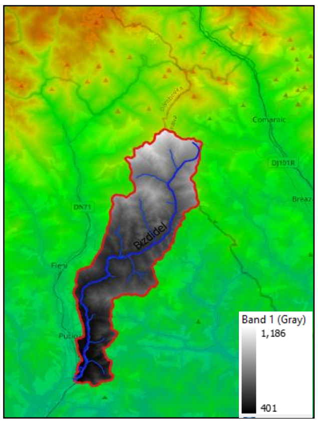

Figure 3 - Digital terrain model - Bizdidel River Basin

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2. Basin Delineation

The Bizdidel River basin was delineated in QGIS using hydrological tools. Flow direction rasters were generated to define the basin boundary up to its confluence with the Ialomița River. The resulting area of 9527 ha was validated against geo-spatial.org vector data, with discrepancies within 0.04% due to DEM resolution.

3. Terrain and Soil Mapping

Thematic maps were created to characterize terrain and soil properties:

Hypsometric map: Altitudes were classified in 100 m intervals (400–1200 m) using the “Reclassify by Table” function, highlighting terrain levels and morphological steps.

Slope map: Generated with the “Slope” function, slopes were categorized as <5° (lower sector), 5–15° (median sector), and >15° (upper sector).

Soil map: ICPA soil maps were clipped to the basin boundary using “Clip Raster by Mask Layer,” with surface areas quantified via “Statistics by Categories” (ICPA, 1978).

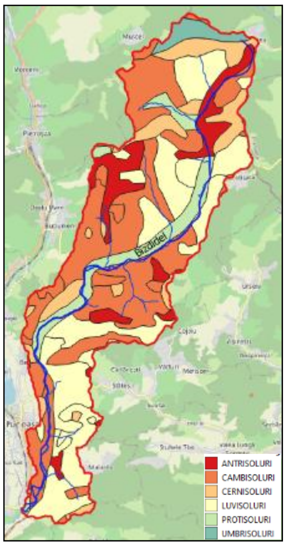

Figure 6 - Soil map

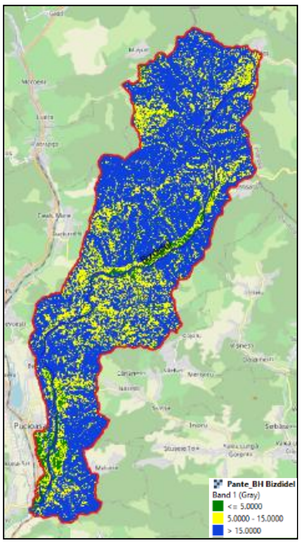

Figure 5 - Slope map

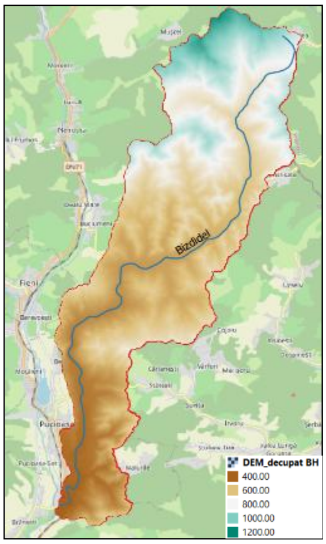

Figure 4 - Hypsometric map

4. Land Use Assessment

The CLC 2018 layer was clipped to the basin boundary and analyzed using the “Raster layer unique values report.” Categories included agricultural land (26%), broad-leaved forest (48%), pastures and natural grasslands (16%), and other areas (10%), such as riparian vegetation and low-density built-up zones (EEA, 2018).

5. Field observations and empirical validation

Field surveys in May–July 2023 targeted the basin’s three elevation zones, documenting visible erosion features like gullies and rills. In the upper sector, observations focused on slopes exceeding 15°, noting the absence of permanent vegetation in affected areas. In the median sector, surface erosion was observed in agricultural parcels. Visits to the Aldeni Soil Erosion Control Station (Buzău County) documented stabilization measures, including terracing with slopes of 5–10° and vegetative strips.

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RESULTS AND DISCUSSIONS

Geomorphological and climatic characteristics

The Bizdidel River basin, located in Dâmbovița County's Subcarpathian sector, spans 9527 ha with an elevation range of 400–1200 m. The hypsometric map, derived from the ALOS PALSAR DEM, indicates that 60% of the area lies between 400 and 700 m (median sector), 25% between 700 and 1200 m (upper sector), and 15% at 400 m (lower sector).

The slope map shows 25% of the surface with slopes >15°, concentrated in the upper sector, 40% with slopes of 5–15° in the median sector, and 35% with slopes <5° in the lower sector. Annual precipitation averages 700–800 mm, peaking in May–June, with higher intensities in the upper sector due to orographic effects from the Leaota Mountains (ANM, 2022; ECAD, 2022). These conditions, aligned with the basin's topography, define its environmental profile.

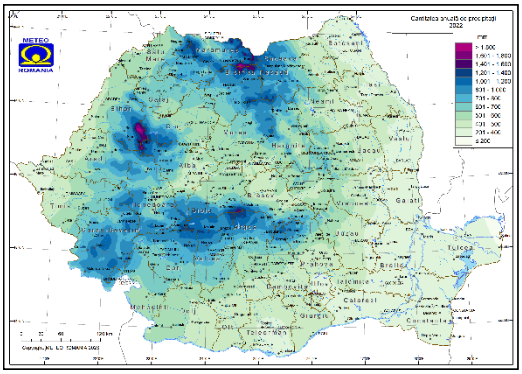


Figure 7 - Annual precipitation amount for 2022
Source: ANM (www.meteoromania.ro)

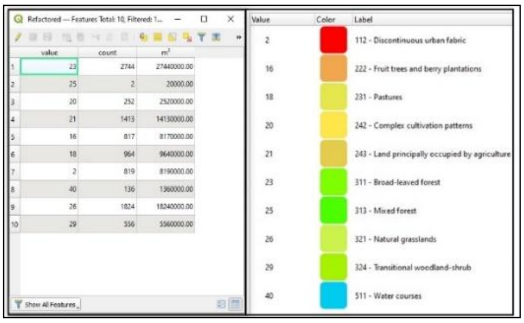
Pedological conditions

Soil maps from ICPA identified six main soil classes (ICPA, 1978). Cambisols (3640.81 ha, 38.22%) and luvisols (2980.75 ha, 31.28%) dominate the upper and median sectors, characterized by clay texture (20–45% clay content) and depths of 30–60 cm (CHIȚU, 2010; PATRICHE, 2023). Chernozems (982.90 ha, 10.32%) occur in the lower sector with gentle slopes, featuring higher humus content (1–3%). Protosols (793.27 ha, 8.33%), anthrosols (892.98 ha, 9.38%), and umbrisols (236.29 ha, 2.48%) complete the distribution, with protosols and umbrisols more prevalent in the upper sector due to shallow development and organic matter accumulation. Soil areas were adjusted to match the 9527 ha basin area, with a 0.014% error due to DEM resolution.

Land use

The CLC 2018 dataset reveals a diverse land use structure influenced by altitude and slopes (EEA, 2018). Categories include:

- Broad-leaved forest (48%), primarily in the upper sector (>600 m), dominated by deciduous species like beech (Fagus sylvatica) and oak (Quercus robur).
- Agricultural land (26%), concentrated in the median sector, including cereal crops and orchards.
- Pastures and natural grasslands (16%), in mid-altitude areas with moderate slopes.



Refactored — Features Total: 10, Filtered: 1...

	value	count	m²
1	23	2744	27440000.00
2	25	2	20000.00
3	20	252	2520000.00
4	21	1413	14130000.00
5	16	817	8170000.00
6	18	964	9640000.00
7	2	819	8190000.00
8	40	136	1360000.00
9	26	1824	18240000.00
10	29	556	5560000.00

Show All Features

Value	Color	Label
2		112 - Discontinuous urban fabric
16		222 - Fruit trees and berry plantations
18		231 - Pastures
20		242 - Complex cultivation patterns
21		243 - Land principally occupied by agriculture
23		311 - Broad-leaved forest
25		313 - Mixed forest
26		321 - Natural grasslands
29		324 - Transitional woodland-shrub
40		511 - Water courses

Figure 8 - The report generated in QGIS showing the areas (m²) associated with each CLC 2018 code

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- Other areas (10%), including riparian vegetation along the Bizdidel River (e.g., willow and alder) and low-density built-up zones.

Relevant CLC codes are 311 (broad-leaved forest), 231 (pastures), 222 and 242 (fruit tree plantations and complex cultivation patterns), and 112 (discontinuous urban fabric). Data were extracted using QGIS's "Raster layer unique values report," showing agricultural areas aligned with the median sector's moderate slopes.

Data Validation and Empirical Verification

Field surveys in May–June 2023 across the basin's elevation zones confirmed the spatial data. In the upper sector, gullies (0.5–1 m deep) and rills were observed on slopes >15°, particularly in non-forested areas. In the median sector, surface erosion features appeared in agricultural parcels, with visible soil displacement on slopes of 5–15°. Visits to the Aldeni Soil Erosion Control Station (Buzău County) documented stabilization measures, including terracing (slopes of 5–10°) and vegetative strips with willow (Salix spp.) and alder (Alnus spp.), reinforcing the applicability of the processed data. Processing in Stereo 70 with a 12.5 m resolution ensured consistency with ICPA maps and geo-spatial.org vectors. Additionally, cross-referencing the field data with satellite imagery validated the accuracy of land use classifications, particularly for agricultural and forested areas.

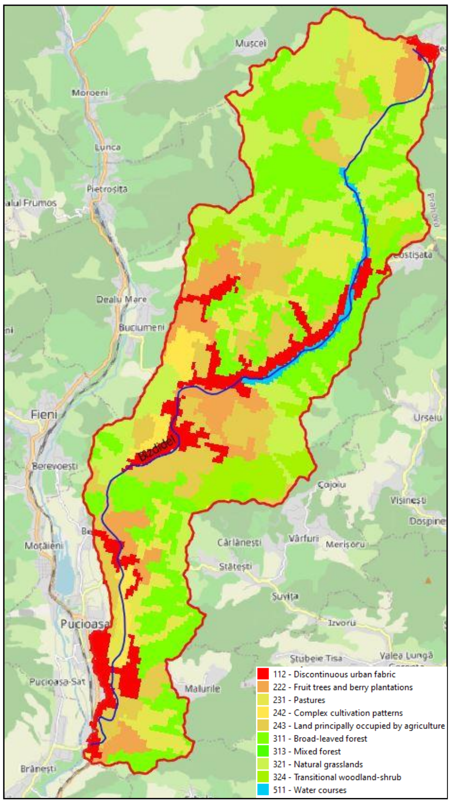

Figure 9 - Land use map in the Bizdidel basin (CLC 2018)

CONCLUSIONS

The methodology, based on raw data processing through geomatics techniques, provided a comprehensive description of the Bizdidel basin's geomorphological, pedological, and climatic characteristics. The workflow—data acquisition, preprocessing, thematic map generation, and field validation—established a detailed framework for mapping natural features. Using open-source datasets (ALOS PALSAR DEM, CLC 2018) and GIS tools like QGIS, this approach is replicable in other Subcarpathian basins with similar morphological and climatic conditions .

The study supports detailed environmental mapping, contributing to sustainable land management strategies in Romania's Subcarpathian regions. The integration of pedological data from ICPA maps allowed for a precise classification of soil types, enhancing the understanding of soil distribution across the basin's elevation zones. Field observations further confirmed the spatial patterns identified through GIS analysis, ensuring the reliability of the

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thematic maps generated. The use of Stereo 70 projection system maintained consistency with national standards, facilitating comparisons with other regional studies. This methodological framework provides a robust foundation for future environmental assessments in similar Subcarpathian landscapes.

ACKNOWLEDGMENT

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