

**ALEXANDRU IOAN CUZA UNIVERSITY OF IASI**  
**FACULTY OF GEOGRAPHY AND GEOLOGY**  
**DOCTORAL SCHOOL OF GEOSCIENCES**  
**FIELD OF STUDY: GEOGRAPHY**

**Research on the distribution and typology of gullies in the  
Moldavian Plateau – the sector corresponding to the  
Prut-Barlad hydrographic area**

PhD Thesis Abstract

**Scientific advisor:**

**CONF. UNIV. DR. HAB. NIACȘU LILIAN**

**PhD Student:**

**CODRU IONUȚ-COSTEL**

**Iași, 2025**

The purpose of this thesis is to analyze a phenomenon that represents a major problem for the agricultural activities in the Moldavian Plateau, and beyond. Gully erosion has generated significant issues for agriculture in the Moldavian region of Romania, an important economic sector for the local economy. Over the past centuries, millions of hectares of agricultural land had suffered degradation of their physical and chemical qualities, leading to low productivity far below the typical values of the respective soils. In addition, farmlands have been fragmented by gully erosion, which has generated extra costs due to increased fuel consumption, caused by difficult accessibility of agricultural machines on the affected lands. In extreme cases, many lands have been removed from agricultural use either due to the drastic decline of their productive capacity, caused by the rapid removal of the topsoil, or because of the impossibility to be tilled, because of the gullies that cannot be crossed by agricultural machines or filled by plowing.

Gully erosion in the Moldavian Plateau has previously been studied by geomorphologists such as Maria Radoane and Ion Ionita, who obtained remarkable results using the data and techniques available at the time of their studies. Up to the present, in Romania only one regional scale gully inventory was made. The inventory was made by Maria Radoane and her team in 1999 for the sector between Siret and Prut rivers of the Moldavian Plateau. The main purpose of this study is to update the aforementioned study, by using more advanced data and techniques currently available, which were either inaccessible or did not exist when the first studies on this topic were conducted.

Within this thesis, an inventory of all the gullies from the studied area was made, that was used to study the distribution of gullies in the Moldavian Plateau, one of the most representative areas in Europe regarding gully erosion. The Prut–Bârlad hydrographic area, bounded by the catchments of the Bârlad and Prut rivers and by the direct tributaries of the Siret in the southern plateau (covering approximately 70% of the Moldavian Plateau), was selected for technical reasons, as it is the only sector with the necessary datasets for producing a comprehensive and accurate gully inventory. This inventory was developed using high-resolution LiDAR-derived

Digital Elevation Models, produced in 2012 at the request of the Prut–Bârlad Water Administration (ABA Prut–Bârlad). These models provide a much higher level of detail, enabling a clearer understanding of the processes and patterns observed in the field. These results allow for a more accurate understanding of field realities and provide valuable support to stakeholders aiming to mitigate soil erosion and prevent land fragmentation caused by gully head retreat, thereby contributing both to environmental sustainability and to the socio-economic stability of this vast agricultural region in eastern and northeastern Romania.

Acknowledgment is also given for the access provided to the infrastructure support from the Operational Program Competitiveness 2014–2020, Axis 1, under POC/448/1/1 Research infrastructure projects for public R&D institutions/Sections F 2018, through the Research Center with Integrated Techniques for Atmospheric Aerosol Investigation in Romania (RECENT AIR) project, under grant agreement MySMIS no. 127324, and to the Faculty of Geography and Geology for their support during my doctoral studies. My affiliation with RECENT AIR, as a research assistant, represented a major asset in completing this thesis, by providing the necessary research conditions and access to specialized laboratory equipment.

The inventory of all gullies using a methodology, where topographic openness was used, in this sector is particularly important not only because it represents a novelty in the study of these erosion landforms, but also because it provides the exact location, surface, and shape of each gully. The inventory helps us to better understand the physical characteristics of gullies and the way environmental factors have influenced their distribution, development, density, and volume. The presented inventory has enabled the creation of a solid database that will be used both for analyzing the in-field situation as of 2012, when the LiDAR point clouds for the Prut–Bârlad hydrographic area were created, and for future research aiming to investigate how these erosion landforms evolve and how susceptible lands are to this type of erosion. Moreover, the database can be used by authorized institutions in soil management and conservation strategies, supporting efforts to reorganize and rehabilitate affected areas.

Our analysis revealed the presence of 64,838 gullies within the studied sector of the Moldavian Plateau. The highest densities are located in the Bârlad Plateau, the Covurlui Plateau, and the Jijia Hills. Specifically, the Siret Plateau contains 2,031 gullies, the Jijia Hills 14,156 gullies, the Bârlad Plateau 31,263 gullies, the Huși–Elan–Horincea Hills 2,078 gullies, and the Covurlui Plateau 15,271 gullies.

In terms of gully affected area, the Bârlad Plateau alone accounts for nearly 60% of the 238.6 km<sup>2</sup> affected by gullies, while the Covurlui Plateau, the Jijia Hills, and the Siret Plateau together comprise less than half of the total gully-affected surface in the study area. The 238.6 km<sup>2</sup> affected by gullies represents approximately 1.27% of the total area of the studied sector.

The automatic calculation of the total volume of gullies in the Moldavian Plateau study area with cut and fill method, has revealed that differences between the central-northern and central-southern parts are reflected not only in the extent of affected areas but also in the quantities of eroded soil over time. Out of the total volume of more than 655 million cubic meters, approximately 419 million cubic meters have been eroded from gullies in the Bârlad Plateau, and 121 million cubic meters from gullies of the Covurlui Plateau. The remaining nearly 115 million cubic meters were eroded from gullies of the Jijia Hills, Siret Plateau, and Huși–Elan–Horincea Hills.

In conclusion, it is clear that the typology of gullies in the northern part of the Moldavian Plateau is completely different from the typology of gullies from southern part. In the north, gullies have mostly developed on clayey substrates with high salinity, with relatively small to moderate depths and volumes, while in the south gullies have developed on predominantly sandy and loess-like substrates, with very large depths and volumes. This study has highlighted this aspect, but to reach a solid conclusion regarding the existing typologies, much more detailed research will need to be conducted in the future.