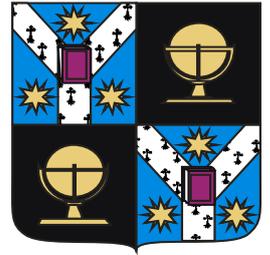


**„ALEXANDRU IOAN CUZA” UNIVERSITY OF IAȘI  
FACULTY OF GEOGRAFY AND GEOLOGY  
DEPARTMENT OF GEOGRAPHY**



**PhD Thesis**

**Geomorphological study of the Bahluiet catchment**

**Coordinator:  
Prof. PhD. Eng. Ioniță Ion**

**Candidate: Popa Ionela**

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## Geomorphological study of the Bahluieț catchment

### Abstract

The present study has in view two main objectives, namely the proper identification and characterization of the main genetic types of landforms and the analysis of land degradation processes.

The paper is divided into six chapters and focuses on the study of the main landforms, the spatial distribution and intensity of land degradation processes and associated controlling factors within the Bahluieț catchment. The final part of the thesis highlights the relationship between the local geomorphology and land use.

Within the first chapter, there are references on the geographical location of the study area, the previous research concerns and the material and methods.

The Bahluieț catchment, located in the Moldavian Plateau, overlaps three distinct relief sub-units: the eastern border of the Suceava Plateau in west, the Coasta Iasilor as the northern border of the Central Moldavian Plateau at south and the Jijia Rolling Plain in the remaining area as the most extended subunit. This leads to a great diversity of physico-geographical conditions where the varied local landforms developed, and having multiple implications on the present-day geomorphological processes. The Bahluieț catchment covers 54,866 ha and from administrative point of view it is entirely located in the Iași County comprising 20 communities.

The present study requires both the Geographical Information System (G.I.S.) approach by using topographic maps at 1:5,000 scale to describe the geomorphometric parameters, and field mapping.

The spatial modeling was performed using TNT Mips software V.6.9., and as a result we have primarily succeeded making of the Digital Elevation Model (DEM) and subsequently a series of useful thematic maps, such as hypsometric map, slope map and exposition map.

Data acquired during field surveys, have been combined with information gathered by using Geographical Information System (G.I.S.) techniques, and correlated with information resulting from the interpretation of orthophotoplans, 2006 edition and with the pedologic studies carried out by the O.S.P.A Iași.

A number of 112 topographic plans at scale 1:5,000 have been digitized in getting the Digital Elevation Model (DEM) in order to obtain a high resolution, very useful in understanding and interpreting the local landscape features.

Chapter II "*General considerations on the origin and evolution of relief*" is devoted to the analysis of natural and anthropogenic controlling factors (climatic, hydrological, pedological, biotic and anthropogenic factors) that have shaped the current landscape and influenced the present day geomorphic processes. The general landforms characteristics are the result of the steady interaction between internal and external factors. However, the current landscape physiognomy of the Bahluieț catchment was mainly due to the sculptural activity of the external factors that have shaped in time the original surface, while the internal factors played a subordinate role.

The geological background of the catchment, represented by the Bessarabian sedimentary layers laid in marine brackish facies, is predominantly clayey-marl with sandy seems, while the typical plateau relief (Coasta Iasilor and the eastern border of the Suceava Plateau) is developed in coastal facies. These sedimentary formations show a gentle dipping of 7-8 m/km to SSE, typical for a general monocline structure (homocline).

Climatically, the study area belongs to temperate continental climate, with average annual temperature of 8.3-9.6°C. The average amount of precipitation in the Bahluieț

catchment varies between 530-700 mm, with higher values in the Coasta Iasilor and Suceava Plateau and smaller ones in the Jijia Rolling Plain.

The natural vegetation comprises two zones, namely: one specific to the Eastern European silvo-steppe zone and secondly the forest area associated to the Central Europe. Accordingly, two main soil classes have been identified. Firstly, the Chernisols class is weighing 60% of the total agricultural land, including mainly Chernozem and Phaeozem soil types and extending in the Jijia Rolling Plain. Secondly, the Luvisols class, with Preluvosol (Entic Luvisol) and Luvosol types, which are prevailing in the higher area, the Suceava Plateau and Central Moldavian Plateau.

The approach developed in Chapter III "*Morphometric and morphographic characterization*" aims to define an image of the general aspect of the landscape. Highlighting the main relief characteristics was possible through several thematic maps, including the hypsometric, slope and the exposure maps. The main morphographic feature of the Bahluiet catchment subscribes to the general pattern of the Jijia Rolling Plain, described by elongated rolling hills. The southern border of the catchment is dominated by the famous Coasta Iasilor, characterized by high relief amplitude and high intensity of the present day geomorphologic processes.

From a hypsometric point of view, the average altitude of the relief reaches 159 m, with peak relief amplitude of 376 m, between the lowest altitude of 56 m, at the junction with Bahlui River and the maximum of 432 m in the Stroești Hill. The average value of the slopes is 13% and most of slope values are between 5-18% (46.5% of total). These values indicate a specific type of land fragmentation which results in the presence of large, quasi-horizontal surfaces flanked by steeper slopes. The Bahluiet Valley is generally a subsequent one, but at catchment scale the northern looking slopes have the greatest development (23.85 %) being followed by the southern facing ones (20%).

Chapter IV "*The main genetic landforms*" highlights the great extension of sculptural (fluvio-denudational) landforms within a general monocline structure. They are weighing 78.7% of the total and are followed by the accumulation landforms (15%) and structural topography (6.1%).

The analysis of the morphometric characteristics and landforms within the Bahluiet catchment showed the asymmetry of some geomorphometric parameters determined by the evolution of the river in the general monocline structure. The main landforms are represented by the hilltops and deluvial slopes. Most of the slopes are actually either cuesta back slopes or cuesta fronts and their facing is strongly connected to the double structural asymmetry in the Moldavian Plateau as described by Ionita (1998, 2000). The dominant cuesta fronts have a general northern orientation controlled by the first order structural asymmetry, while western cuesta fronts are associated to the second order structural asymmetry revealed mostly along the obsequent valleys.

Due to the geological background (lithology), double structural asymmetry and the varied landscape fragmentation, it was possible to differentiate three areas with distinct characteristics within the Bahluiet catchment, namely:

- **The Northern compartment** that occupies 36% of the catchment and entirely located in the Jijia Rolling Plain in the area under the subsequent valleys of Bahluiet and Valea Oilor, downstream of Costești, highlighting the first structural asymmetry. Therefore, their left valley-side is a typical southern facing cuesta backslope, widely extended and mantled by well-developed system of fluvial terraces with the relative altitude up to 105 m. In contrast, the right valley-side is a classic northern looking cuesta front, sparsely dissected (as in Valea Oilor), or heavily cut by right tributaries of the Bahluiet.

- **The Southern compartment** showing the broadest extension and comprising almost half of the catchment. It is stretching primarily in the southern area of the Jijia Rolling Plain

and secondly in the Coasta Iașilor. The younger obsequent valleys such as Sinești Valley, Albești Valley, Goești Valley, Ciunca Valley are emphasizing the second order structural asymmetry, typified by western looking cuesta fronts and eastern facing cuesta backslopes. However, there are also included some subsequent reaches and thus the particular feature of some valleys over here is consisting in a zig-zag pattern. In addition, the Coasta Iașilor from the southern edge of this area is depicting the first order structural asymmetry. The sculptural landforms are extending almost exclusively, while the fluvial terraces are missing.

- **The Western compartment** occupies 8,114 ha, representing 14.7% of the total. This area includes the southeastern border of Suceava Plateau. Its main feature refers to the contrast between the structural plateaus, dissected by small canyons along some valley reaches, and the morphological escarpment, Dealul-Mare Hârlău, north of Cucuteni village.

The present day geomorphologic processes are analyzed in the chapter V. The most characteristic geomorphologic processes, playing an essential role in the morphogenesis of the landforms are soil erosion, landslides, while gully erosion and sedimentation show low intensity.

Soil erosion is ubiquitous, being the process with the highest extension. Therefore, the moderate-excessive eroded soils on the arable land cover 15,244 ha (38% of the total).

Landslides are the most significant geomorphologic process and representing a major threat to agriculture land and human settlements. The slopes subjected to landslides are extending on 19,040 ha, representing 35% of the studied area. Nowadays, most landslides depict high degree of stability due to the drier period of time recorded since 1982, while the active landslides have a reduced incidence. The prevailing clayey lithology with sandy seams favors the occurrence of landslides on large scale. The highest frequency of landslides occurs on steeper slopes, mainly in the shape of cuesta fronts, usually northern and western facing. However, the most imposing landslide development occurs in the southern area of the Jijia Rolling Plain, namely in the southern compartment of the studied area.

The gully erosion shows low incidence due to the predominantly Bessarabian clayey facies and loamy-clayey soils which are more resistant at erosion. These above mentioned factors are triggering an average low rate of sedimentation in reservoirs of  $2 \text{ cm yr}^{-1}$ , after the Chernobyl nuclear accident dated on 26 April 1986.

Chapter VI describes "*The relationship between the geomorphology and land use*". The evolution of the degradation rate was closely related to land use and the dynamics of the land use from the late nineteenth century till the beginning of the XXI century has been analyzed. Agricultural land slightly increased from 42,577 ha in 1894 to 44,645 ha in 1984 and it decreased to 42,003 ha in 2009. Recently, it was noticed the extension of the traditional agricultural system, consisting into small up and down hill plots, resulted from the application of the Land Act no.18/1991. Today, the forest cover is weighing only 12% within the study area. Currently, there are remaining only 392 ha, representing 1.6% of the arable land, under previous soil conservation practices.