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THE ANALYSIS OF THE GEOMORPHOLOGICAL CHARACTERISTICS WITHIN MILETIN CATCHMENT AREA

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Abstract: The present paper researches the geomorphologic aspects featured in the Miletin catchment area, from Jijia Hilly Plain. For a better understanding of these features we took into consideration the morphometric and morphographic characteristics, the control factors but also the genetic relief types. Miletin valley represents a subsequent valley emphasizing the first order structural asymmetry, where the direction of the river course intersects the geologic strata under a right or acute angle. Although the general orientation of the river course is NW-SE, in reality it develops a zigzag succession of acute subsequent valley-sectors, typical subsequent and even consequent. The left hillside of the main valley, a remnant backslope, is generally-oriented towards south and the right hillside, a remanent cuesta front, is oriented northward. The morphological `anomaly` occurred in this drainage basin is the large extent of the cuesta front, upstream of Prăjeni locality, where more than 50% of Miletin catchment area develops on the right hillside.

Keywords: *Miletin catchment area, morphometric characteristics, structural and sculptural relief, Moldavian Plateau, cuesta landform.*

I. INTRODUCTION

Miletin stream is a right tributary of Jijia river, its catchment area being situated in the northern part of Moldavian Plateau. The limits of the study area are as follows: Sitna catchment area towards NNE, Siret catchment area in the west, Bahlui catchment area in the SW and Jijia catchment area towards south and east (figure no. 1).

From its source to the confluence with Jijia, Miletin valley has a length of almost 93,5 km (68,6 km in straight beeline) and a mean slope of 2,7‰.

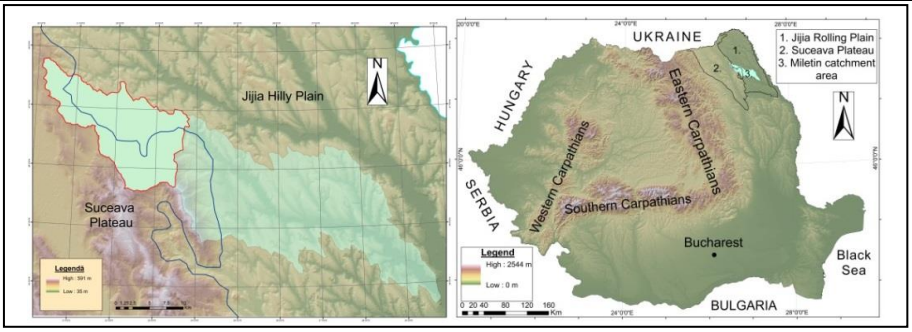

Fig. 1 Geographical position of Miletin catchment area

II. MATERIALS AND METHODS

This study required a series of phases and databases. As concerns the accomplished stages, in the field survey phase we made constant observations, geomorphologic mappings, which constituted the support in identifying the genetic relief types and their subordinated landforms. Another research steps were represented by the processing of the following data:

- Topographic maps (1:5000 scale), realized by the National Agency for Cadastre and Land Registration – N.A.C.L.R. Iași and Botoșani counties, from 1980.
- Geological maps, in 1:50.000 scale (Ionesi, 1994; Ștefan, 1989).
- Pedological studies, in 1:10.000 scale, realized by the Pedology and Agrochemistry County Office of Iași and Botoșani.
- Aerial ortophotos from 2012, National Agency for Cadastre and Land Registration - N.A.C.L.R. Botoșani and Iași counties.

For analyzing and elaborating the thematic geographic maps we used Arc GIS 10.2.2 and TNT Mips software 6.9. Statistical database has been obtained utilizing Microsoft Excel 2010 and contains information about the area occupied by each type of landform, the surface held by each type of soil.

The Digital Elevation Model (D.E.M.) was realized by vectorizing of topographic maps contour lines, 1:5000 scale, using the method of interpolation, thus obtaining a raster of 25 m² cell dimension (5x5 m), by applying the Surface Modelling option.

For the evaluation of control factors we took into consideration the Moldovei Plateau geologic map (Ionesi, 1994), the one of Dealul Mare-Hârlău (Ștefan, 1989) and the pedological studies, from Pedology and Agrochemistry County Office of Botoșani and Iași (P.A.C.O.), of each commune comprised entirely or partially in the Miletin catchment area.

III. RESULTS AND DISCUSSIONS

III.1. Control factors

The geomorphological features of Miletin catchment area represent the result of a long-term interaction between the endogenous factors, namely the geologic factor, and the exogenous factors (climate, hydrography, vegetation, fauna, human intervention).

From a lithological point of view, the sedimentary strata outcropped in the studied region are of Volhinian and Bessarabian age (figure no. 2).

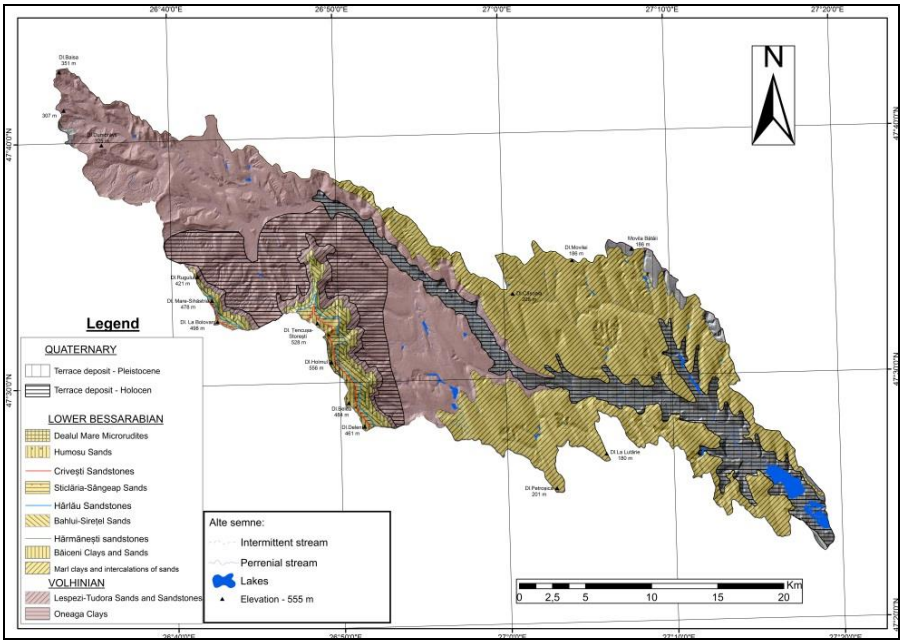

Fig. 2 Geological map of Miletin catchment (processed based on the Moldovei Plateau geological map by Ionesi L., 1994, and Dealul Mare-Hârlău Hill geological map by Ștefan P., 1989)

These layers have been deposited in a brackish water environment, either in marine facies (predominantly clayey deposits) or seashore facies (predominantly coarse deposits containing sand, limestone and sandstones). Geological strata register a slight gradient of 7-8 m/km from NNW towards SSE (Ioniță, 2000b).

In Dealul Mare-Hârlău Hill, excepting the base, Lower Bessarabian has a high content of sand and four different levels of limestoned-sandstones namely: Hărmănești, Deleni, Crivești and Dealul Mare (figure no. 3).

As regards the spatial distribution of the geological formations, the highest percentage hold the volhinian deposits (45,1%), followed at short distance by the bessarabian ones (41,2%). Locally, mostly along the main valley floodplain, develop quaternary formations.

The climate is temperate continental, the temperature descreasing from west to east. Hence, in the north-western part the altitudes around 300-400 m determined a forest climate, more humide and breezy, with precipitations of 600-700 mm/year and mean annual temperatures of 7-8°C. These natural conditions favored the expansion of oak and beech forests (Pantazică, Schram, 1967).

Fig. 3 Calcareous-sandstones of Inferior Bessarabian age in Mare-Sihăstria Hill (425 m alt.), south-west of Oneaga (15th of May 2015)

On the other hand, towards east temperature values increase and, according to meteorological data, are around 9°C. As regards the precipitations, in the westerly sector, at Flămânzi and Cotnari, the mean annual value of precipitations is 604 mm, respectively 524,9 mm. In the eastern part the registered values are: Ripiceni – 452,7 mm, Bivolari – 523,2 mm, Victoria – 502,2 mm (Mihăilă, 2006).

Zonal vegetation includes silvosteppe and beech forests species. The forestland has an extent of 12760,2 ha (18,7% of the entire studied area) and offer the hillslopes a slight protection against the land degradation processes. The fauna also influences the aspect of the terrain by creating pathways. Even if these forms are not

imposing they can affect the stability of the hillsides, especially the ones with role of cuesta front.

The Miletin tributaries are generally short, 4-5 km length, excepting the right streams Chirivoaia, Unguroaia and the left tributaries Valea Rea, Pârâul lui Vasile, Recea which measure between 10 and 13 km in length.

The hydrographic network has been classified using Horton-Strahler hierarchy. Following this analysis the result showed that Miletin river is a sixth order stream. Across the entire catchment area the first order streams register 555 km, the second order 325,3 km, the third order 178,4 km, the forth order 96,9 km, the fifth order 41,3 km and the sixth order 72,3 km.

By processing the database of the pedological studies (1:10000 scale), for agricultural land, have been indexed 8 soil classes and 12 soil types (table no. 1). The soils denominations have been correlated with World Reference Base for Soil Resources, 2006 edition (Florea et al., 2012).

Table 1. The areas distribution of soil classes and types on the agricultural land

Soil class	Soil types	Area (ha)	(%)
CHERNISOLS		**27.927,7**	**58,5**
	Chernozems	25.756,8	54
	Phaeoems	2.170,9	4,5
LUVISOLS		**5.140**	**10,8**
	Luvisols	5.140	10,8
CAMBISOLS		**379,1**	**0,8**
	Eutric	379,1	0,8
HIDRISOLS		**1.227,5**	**2,5**
	Gleysols	1.227,5	2,5
PROTISOLS		**6.996,9**	**14,6**
	Regosols	1.968,5	4,1
	Fluvisols	5.028,4	10,5
ANTRISOLS		**4.521,7**	**9,6**
	Anthrosols	458,9	9,5
	Technosols	6,8	0,1
SALSODISOLS		**513,9**	**1,1**
	Solonetz	285,6	0,6
	Solonchaks	228,3	0,5
VERTISOLS		**1016,7**	**2,1**
	Vertisols	1016,7	2,1
TOTAL		**47.723,5**	**100,0**

The highest expansion belongs to the chernozem class, namely 27.927,7 ha (43,6%) and the secondary extent is registered by the protisols class, with 6996,9 ha (14,6%). Luvisols class occupies only 5140 ha, this fact being strongly connected with the development of the forestland, spreaded mostly in the hilly part of the Miletin drainage area. Cambisols class, represented by the eutricambosols can be found where the parent material resulted from rocks enriched in bases. This type of soil cover a very small area of only 379 ha (0,8%). Antrisols appeared on account of antropic actions and have a scattered extension, occuping 4521,7 ha (9,6%). Gleysols type from the Hidrisols class represent soils saturated in water on a long-term period and are spreaded on the floodplains, in the proximity of the lakes. Salsodisols distinguish by the presence of a salic horizon in the upper section of the soil profile and these soils appear in the middle and inferior catchment area of Miletin river. Ultimately, vertisols represent clayey soils and occupy a surface of about 1016,7 ha (2,1%).

III.2. Morphographic and morphometric characteristics

On the whole, the Miletin watershed morphography stays on two different relief subunits, namely the plateau relief and hilly plain relief. The resulted landforms are the consequence of a long-period of post-sarmatic evolution. After the withdrawal of the Sarmatian Sea has begun the sub-aerial modelling, where a semnificative contribution has had the hydrological factor.

Regarding the ridge lines, we identified two principal ridge lines from which detach more secondary ones.

The Miletin-Siret-Bahlui-Jijioara principal ridge line represents the drainage divide that separates Miletin catchment area from Siret catchment area and Bahlui catchment area. Across this ridge line we find two prominent level oscillations in Dealul Mare (Rugului Hill, Mare-Sihăstria Hill, La Bolovan Hill) and in Dealul Holmul (Țencușa-Storești Hill, Holmul Hill, Belea Hill, Deleni Hill) which have an average altitude higher than 300 m.

The second principal ridge line, Miletin-Sitna, starts in Baisa Hill (351 m) and ends in the proximity of confluence with Jijia river (47 m). It has a mean altitude of 261 m, lower than the one of Miletin-Siret-Bahlui-Jijioara ridge line.

For a better understanding of the morphography we computed also the terrains exposure map from D.E.M. (figure nr. 4).

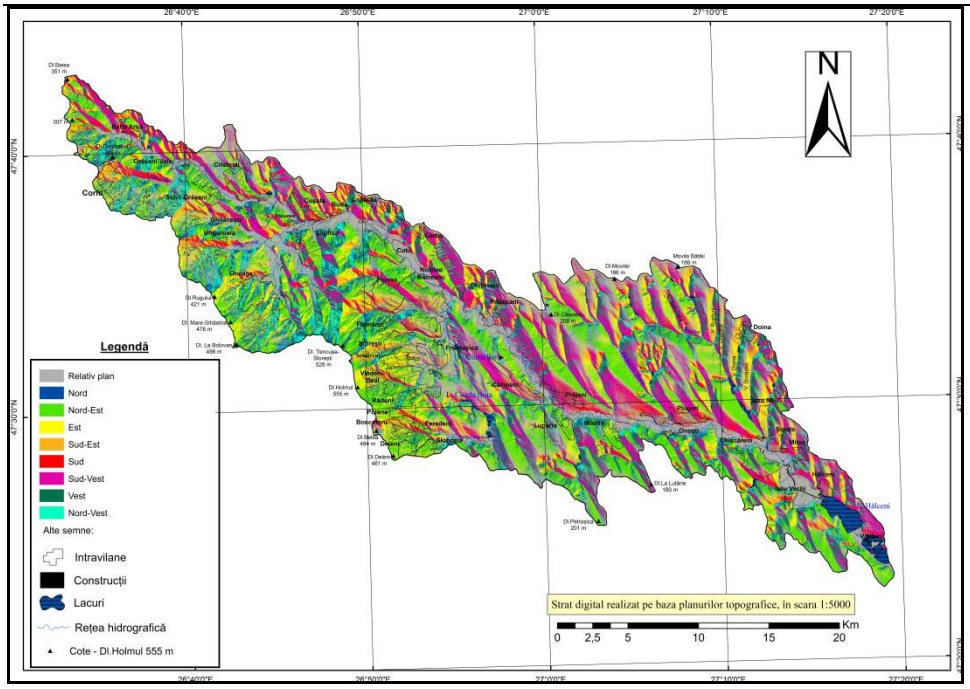

Fig. 4 The terrains exposure map in Miletin catchment area

According to this map the highest frequency holds the north-eastern hillslopes (20,8%), second place the ones oriented towards south-west (14,3%), followed at short distance by eastward and westward terrains, with 11%, respectively 7,4%. Relatively horizontal terrains occupy 25,1% (figure no. 5).

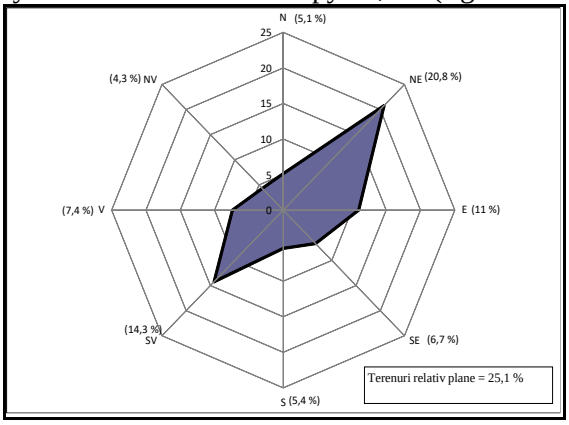

Fig. 5 The diagram of slope aspect within Miletin catchment area

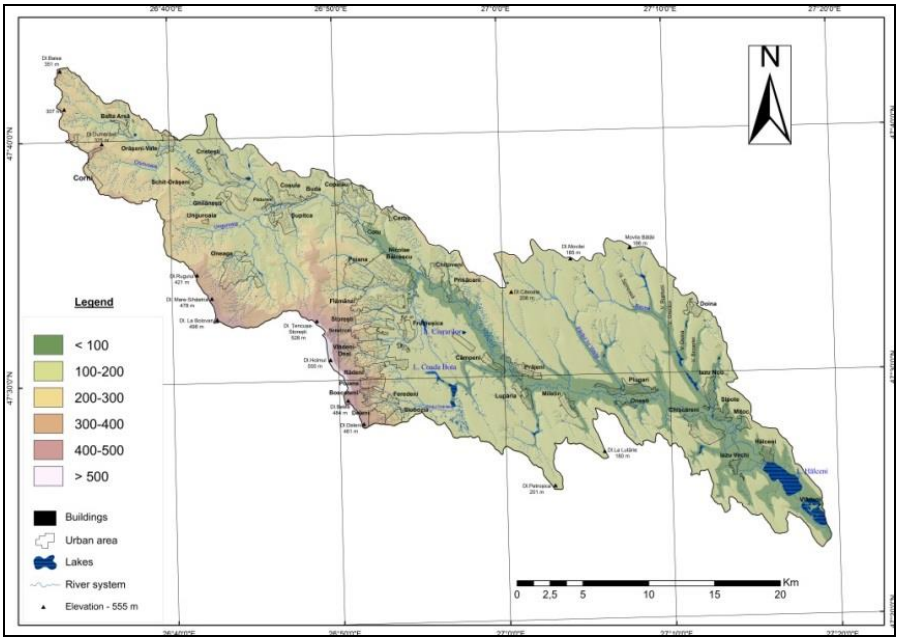

Fig. 6 Hypsometric map of Miletin catchment area

The morphometry has been assessed through the hypsometry map, slope map and relief energy map. Hypsometry map indicates that the maximum altitude is found in Holmul Hill (555 m) and the minimum altitude stands where Miletin joins Jijia (43 m). The average altitude of Miletin catchment area is 165,1 m (figure no. 6).

Relating to hypsometry altitude classes, the most expanded class is between 100 and 200 m (63,7%) which emphasizes the prevalence of the landforms particular for the Jijia Hilly Plain, especially towards the eastern part of the territory.

Terrain slope, another important morphometric parameter, influences both the relief genesis and denudational processes dynamics and intensity. In computing the slope map we quantitatively expressed the slope values as a percentage and we obtained a mean value of 9,9% for the entire study area (figure no. 7).

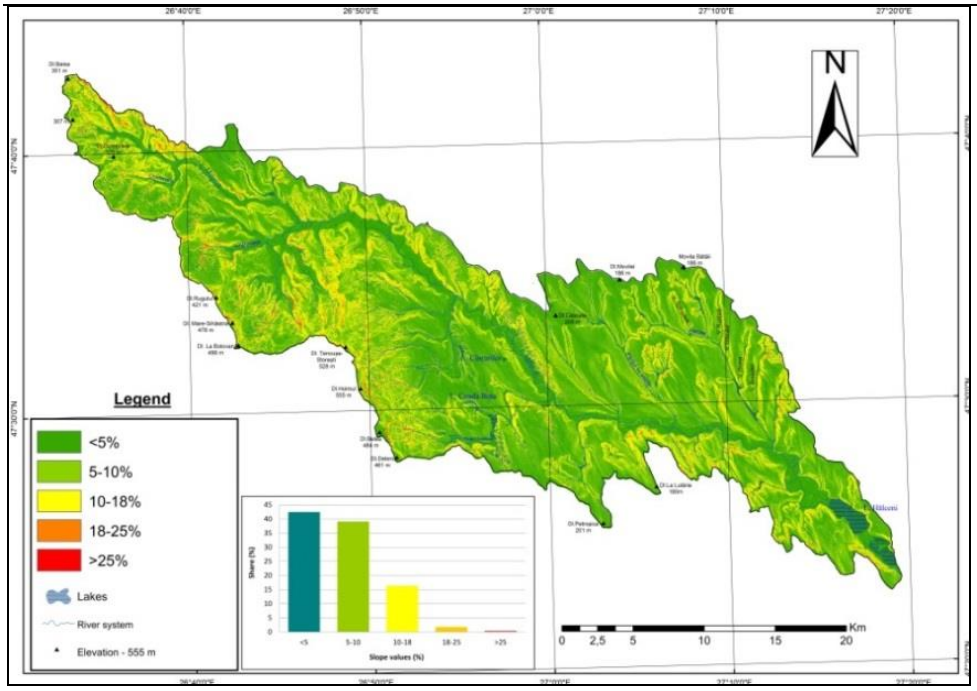

Fig. 7 Geodeclivity map within the Miletin catchment area

The quasi-orizontal and very slight inclined terrains, lower than 5%, occupy an area of 28.975,3 ha (42,%). In this category include the floodplains, structural plateaus, glacis and the ridges. Slight inclined surfaces (5-10%) hold 26.677,8 ha (39,1%) and are typical for backslopes, largely extended cuesta fronts and for hilltops. Moderate sloping terrains (10-18%) usually characterize the cuesta fronts and the backslopes. They encompasses an area of 11.157,7 ha (16,4%) and can be utilized as agricultural land. Between 18 and 25% are developing strongly inclined surfaces with an area of 1184,6 ha (1,7%). Terrains very strongly inclined (>25%) hold the smallest area, namely 206,1 ha, and are typical for local sectors across the cuesta fronts, where the land degradation processes reach an advanced intensity. On these surfaces prevail the sheet erosion, linear erosion and landslides, very often being utilized as grassland or forestry plantations.

Relief energy on the entire studied region has values between 0 and 195 m. The lowest amounts register on the floodplains and on the ridges, while the highest values appear in the proximity of Țencușa-Dealul Holmului secondary hilltop (figure no. 8). Relate to the relief energy classes, the class interval 60–90 m comprises 41,7% of the Miletin watershed.

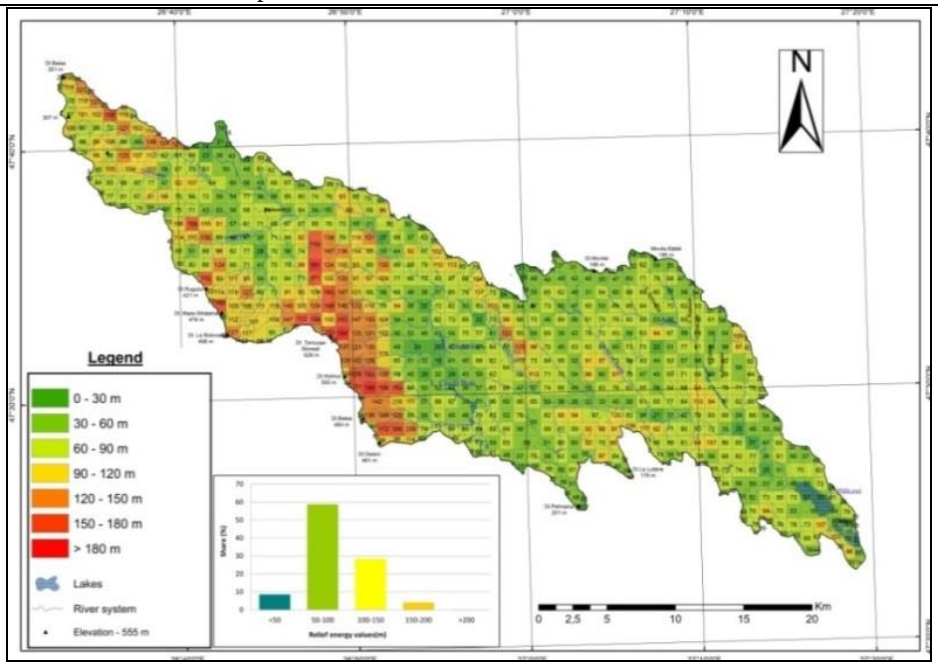

Fig. 8 Relief energy map within the Miletin catchment area, drawn based on square method

III.3. The genetic relief types and the main landforms

The main relief types developed in the Miletin catchment area are: structural-lithological relief, sculptural relief in a general monocline structure and depositional relief (figure no. 9 and table 2).

Structural relief is represented by the structural plateaus and appear, furthermore, as erosion remnants. We find them on the principal ridges, still on the secondary ones (figure no. 10).

The geological formations composed of tougher rocks (sandstones, limestones, microrudites) represent the structural plateau, which extend from Siret valley towards east. Dealul Mare Microrudites form on the superior part of Holm Hill, 555 m (Ungureanu et al., 1998).

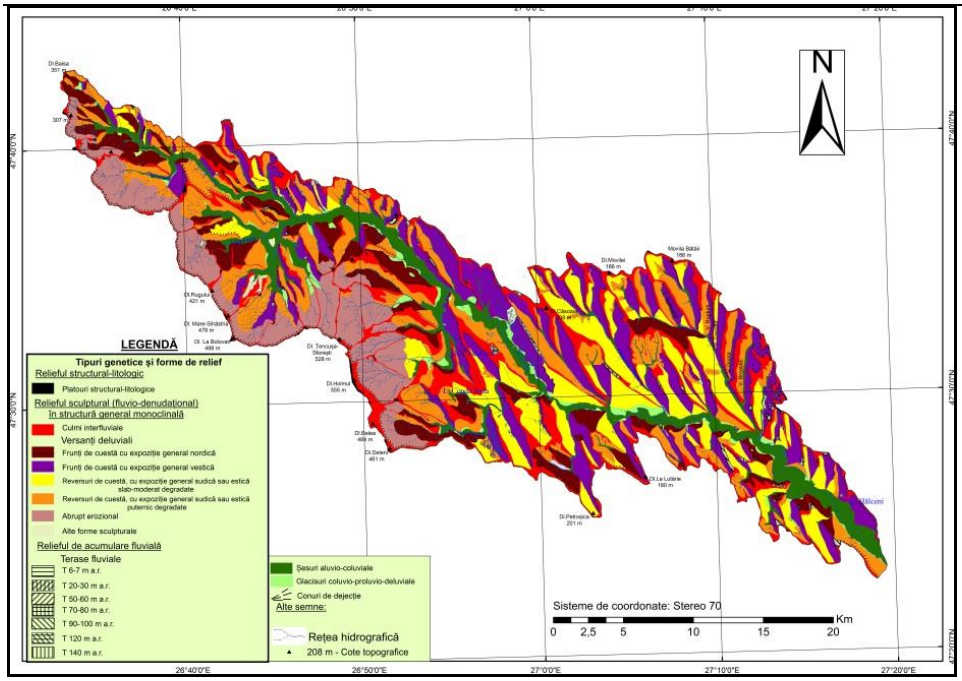

Fig. 9 Geomorphological map of Miletin catchment area

Table 2. The areas and the percentage of the main landforms within Miletin catchment area

Relief type	Landforms	Area (ha)	(%)
Structural-lithological relief		**155,7**	**0,2**
	Structural-lithologic plateau	155,7	0,2
Sculptural relief in general monocline structure		**58336**	**85,5**
	Interfluvial Hilltops	***9.465,6***	***13,9***
	Deluvial slopes	***48.694,1***	***71,4***
	Erosion front	7.636,6	***11,2***
	Cuesta fronts	*19.524*	*28,6*
	Cuesta fronts oriented westward	12.993,7	19,1
	Cuesta fronts oriented northward	6.530,3	9,6
	Backslopes	*21.533,5*	*31,6*
	Slight-moderate degraded backslopes	9.101,3	13,3
	Severe degraded backslopes	12.432,2	18,2
	Other sculptural landforms	**176,3**	**0,3**
Depositional relief		**9.709,8**	**14,3**
	Floodplains	7.788,6	11,4
	Glacises	1.277,1	1,9
	Alluvial cones	112,2	0,2
	River terraces	531,9	0,8
	Total	***68.201,5***	***100,0***

As already above mentioned the sculptural relief is predominant and comprises: the hilltops, the deluvial slopes, both with role of cuesta front and backslope.

Fig. 10 Slight-moderate degraded backslopes on Pâraielor Hill (23rd of June 2014)

The monocline structure of the geological strata, with a general gradient on the NNW-SSE direction, has enabled the exogeneous factors to shape representative landforms for the Moldavian Plateau, namely the cuestas. This landform comprises two important morphological elements, the cuesta front and the cuesta backslope (Donisă et al., 2009).

Ioniță (2000b) established two types of structural asymmetry, responsible for the development of cuesta fronts, generally facing north or west.

Cuesta fronts, generally oriented northward or westward, lie on the edges of geological layers, hence have high slope values and are intensively affected by land degradation processes. In terms of vegetation, the cuesta fronts are covered in pastures and forestland. The fronts facing north occupy an area of 6.530,3 ha (9,6%), while the ones westerly oriented encompass 12.993,7 ha (19,1%).

The backslopes conforms with the lithologic strata dipping, thus are slightly inclined compared with the cuesta fronts. We divided the backslopes into two main categories, based on the intensity of land degradation processes, and we obtained: strongly degraded backslopes with an area of 12.432,2 ha (18,2%) and slight-moderate degraded backslopes which cover 9.101,3 ha (13,3%). Arable lands characterize the most part of these landforms (figure nr. 10).

The morphologic „anomaly" that occurs in Miletin drainage basin is that the total area occupied by backslopes has 21.533,5 ha (31,6%) whereas the cuesta fronts

register a larger extent, namely 19.524 ha (28,6%). The explanation behind this phenomenon is framed by two geomorphologic facts. First one is that upstream of Prăjeni locality, the right hillside of Miletin catchment area, a cuesta front oriented northward, is wider than the left hillslope, a backslope facing south. On one hand, this happens due to the presence of calcareous-sandstone layer, where the cuesta front is shaped, and on the other hand because of the Sitna river homoclinal evolution, towards south, to the detriment of Miletin backslope.The ample northern cuesta front enabled the development of a series of obsequent tributaries, with extended drainage areas. Downstream Prăjeni, the morphological asymmetry becomes normal. The Miletin backslope has a large extent compared with the area occupied by the cuesta front. Nevertheless, the area of the backslopes remains still inferior to the one of cuesta fronts. The second reason for this geomophological fact stands in the fragmentation of Miletin backslope, downstream Prăjeni, which determined the appearance of second structural asymmetry.

Depositional relief has a percentage of 14,3% (9.709,8 ha) of the total studied area and is represented by: floodplains, river terraces, glacis and alluvial fans.

The most recent landforms, the floodplains, are of Holocen age (Donisă, Boboc, Ioniță, 2009). In the sector Orășeni-Bosânceni, on the edge between Sucevei Plateau and Jijia Rolling Plain, the main valley has the form of a trough peripheric depression. Although we are in the upper course of the main river, in this section, the floodplain width is about 1 km and, downstream Cristești, surpasses 1 km (Pantazică and Schram, 1967).

Across the Miletin floodplain, the deposits are of alluvial origin. The sediments accumulated along the tributaries floodplains (Unguroaia, Chirivoaia) are represented by alluviums, colluviums and prolluviums.

In the Miletin catchment area the glacises develop on the hillslopes base. Together with the backslopes, gently tilted, glacises are considered to meet the best natural conditions for crops. Glacises are divided in: deluvial glacises, colluvial, prolluvial or mixed glacises.

Alluvial cones comprises 112,2 ha (0,2%) and are formed at the end of the torrent channels.

IV. CONCLUSIONS

The relief aspect from studied area is typical both for plateau relief and for the rolling plain relief, representing the result of a long-term post-sarmatic evolution.

The most extended hypsometry interval class is between 100 and 200 m (63,7%) which highlights the predominance of rolling plain relief, especially in the easterly half-part of the territory.

Sculptural relief, in general monocline structure, has the largest extent, and is represented by hilltops, cuesta fronts, backslopes which are the typical for this region. The backslopes have a 31,6% percentage of the total area, while the cuesta fronts occupy 28,6%.

Cuesta fronts, generally oriented northward or westward, lie on the edges of geological layers, hence have high slope values and are intensively affected by land degradation processes. In terms of vegetation, the cuesta fronts are covered in pastures and forestland. The fronts facing north occupy an area of 6.530,3 ha (9,6%), while the ones westerly oriented encompass 12.993,7 ha (19,1%).

The backslopes conforms with the lithologic strata dipping, thus are slightly inclined compared with the cuesta fronts. We divided the backslopes into two main categories, based on the intensity of land degradation processes, and we obtained: strongly degraded backslopes with an area of 12.432,2 ha (18,2%) and slight-moderate degraded backslopes which cover 9.101,3 ha (13,3%). Arable lands characterize the most part of these landforms.

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References

Băcăuanu, V.: Moldavian Plain. Geomorphological study, Romanian Academy Publishing House, Bucharest, 1968.

Donisă, I., Boboc, N. and Ioniță, I.: Geomorphologic dictionary with corresponded terms in english, french and russian, „Alexandru Ioan Cuza" University Publishing House, Iași, 2009 (In Romanian).

Florea, N. and colab.: Romanian System of Soils Taxonomy (R.S.S.T.), National institute for research-development in pedology, agrochemistry and environment protection, Bucharest, 2012 (In Romanian).

Ionesi, L.: The geology of platform relief units and Northern Dobrogea orogen.Technical Publishing House, Bucharest, 1994 (In Romanian).

Ioniță, I.: Applied geomorphology. Land degradation processes of hilly regions. „Alexandru Ioan Cuza" University Publishing House, Iaşi, 2000a (In Romanian).

Ioniță, I.: Cuesta landform in the Moldavian Plateau, Corson Publishing House, Iaşi, 2000b (In Romanian).

Mihăilă, D.: Moldavian Plain – Climatic study. PhD thesis."Ștefan cel Mare" University Publishing House, Suceava, 2006 (In Romanian).

Pantazică, M. and Schram, M.: Contributions to the hydrological research within Miletin catchment area, Hidrobiologia Publishing House, Bucharest, 1967 (In Romanian).

Ștefan, P.: The geology of Dealul Mare-Hârlău region and the perspectives regarding mineral resources.PhD thesis, „Alexandru Ioan Cuza" University Publishing House, Iași, 1989 (In Romanian).

Ungureanu, I. and Nimigeanu, V.: Present-day aspects regarding the geographical space organisation. Scientific papers of „Dimitrie Cantemir", 7 issue, "Al. I. Cuza" University, Iași, 1986 (In Romanian).

Ungureanu, I. : The geographical landscape dynamics of Suceava Plateau, Faculty of Geography and Geology, Geography Department, "Al. I. Cuza" University, Iași, 1998.

*** Geological map of Dealul Mare-Hârlău, in 1:50000 scale, Ștefan P., 1989.

*** Geological map of Moldavian Plateau, in 1:100.000 scale, Ionesi L., 1994.

*** Topographic plans, in 1:5000 scale, N.A.C.L.R. Iași and Botoșani.

*** P.A.C.O. Botoșani: Pedological studies, in 1:10000 scale for communes Bălușeni, Copălău, Corni, Coșula, Cristești, Curtești, Flămânzi, Frumușica, Hlipiceni, Lunca, Prăjeni, Răuseni, Todireni, Vlădeni, Vorona.

*** P.A.C.O. Iași: Pedological studies, in 1:10000 scale for communes Deleni, Fântânele, Gropnița, Hârlău, Plugari, Scobinți, Șipote, Vlădeni.

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