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THE ROLE OF THE RELIEF IN THE DEVELOPMENT OF HUMAN SETTLEMENTS IN HUŞI DEPRESSION

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ABSTRACT. – The Role of the Relief in the Development of Human Settlements in Huşi Depression. Human settlements are closely related to the regional physical-geographical framework determined by the geological, geomorphological, hydrological and climatic features that condition the location and evolution of the settlements system. Among the morphometric parameters that characterize local conditions, slopes and altitudes play an important role in the spatial extent of settlements. Slope determines the access, the extension of built space and the drainage inside the area of settlements. An excessively flat land is not able to drain rainwater. The optimum gradient is $1\text{-}2^0$, a value that generally characterizes terraces, plateaus and sculptural interfluves or accumulation glacises. Slopes over 5^0 raise problems in the construction of buildings and access roads, especially on territories with an excessive fragmentation. The altitudinal gradient is also important in the spatial development of settlements, as it implies a significant contrast between the localities situated in the eastern lower part of Depression and those located on the higher western and northern sides. To analyze the spatial evolution of human settlements in the Huşi Depression in relation to slope and altitude were used various editions of cartographic materials covering a period of about 80 years (1920-2010), the years 1950 and 2010 being conventionally selected as reference.

Keywords*: Huşi Depression, relief, slope, altitude, settlements.*

1. INTRODUCTION

The specific natural conditions of Huşi Depression, together with certain social-economic and historical aspects that characterized this region during the recent period, provided a favorable environment for the development of human communities, so that most of the currently existing settlements are documented even from the 14^{th}-15^{th} centuries. Over the time, the succession of several political regimes led to profound legislative changes that had important effects on land utilization and the expansion of settlements. The spatial evolution of the settlements in Huşi Depression experienced the most important transformations during the last century, many of the villages now doubling their surface.

Studies regarding the relief of Huşi Depression can be found in a small number of papers with local coverage, the majority addressing larger areas such as the Moldavian Plateau. Gugiuman (1932, 1938a, 1938b, 1942) conducted a series of studies which

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specifically address the problem of slope processes in Huşi Depression and Bârlad Basin. Among the geomorphological studies with larger extension, which also include the study area, may be mentioned those of Hârjoabă (1962, 1965) and Hârjoabă & Poghirc (1968). One of the most important studies is the monograph of Vaslui County of Gugiuman et al. (1973). Other studies that focused on larger areas, but also make references to Huşi Depression, are those of Paraschiv (1964) and Obreja (1958, 1968) in a series of papers that deal with the problem of valleys and terraces, and that of Rădoane et al. (1990) regarding sediment budgets and gully erosion in the Bârlad basin.

Important contributions to the study of settlements and population of Moldova and implicitly the Depression of Huşi have also been brought by geographical studies regarding the development patterns of the built-in urban settlements or the identification of urban influence areas and urban hierarchies (Ungureanu, 1980), theoretical concerns regarding rural and urban settlements (Şandru, 1978) or the hierarchy of rural settlements (Nimigeanu, 1985; Chiriac, 1978). Other studies are those of Băican (1997) that presents the evolution of the Moldavian territory using maps and census materials from the 18thcentury, or those of Ungureanu (1968, 1985), who captures the evolution of the Romanian population since 1860. Muntele (1998) addressed the issue of reconstructing the population dimension at different moments in the Moldavian history. Among the latest studies are the synthesis of human geography regarding the population, labor and human settlements in transition from Moldova (Ungureanu et al., 2003) and that of Ţurcănaşu (2006) about the evolution and current status of the Moldavian settlement system.

2. STUDY AREA

The Depression of Huşi is a distinct geographic unit, located in the south-eastern part of the Central Moldavian Plateau, in the subunit of Bârlad Plateau (fig. 1). The Depression is situated on the river Prut, being delineated on the north by Pietrăriei Cuesta, developed on the right side of Moşna River, which continues eastward with Cîlcea Hill. To the west it is limited by the summit of Lohan Hill, south of Drăslăvăţ Cuesta, continued eastwards with the right side of the Voloşeni brook up to Prut River, which forms the eastern boundary of the basin, between Cîlcea Hill (north) and Săratu village (south).

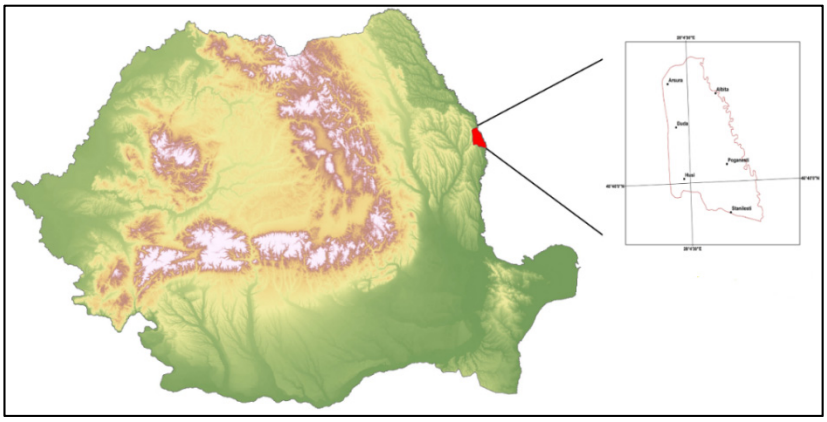

Fig. 1. Location of the Huşi Depression in Romania.

Between these limits the depression has an area of approximately 300 km^2 and it includes the town of Huşi and 18 other villages belonging to several communal territories: Arsura, Duda-Epureni, Stănileşti and Drânceni.

As a controlling factor in the formation and evolution of the landscape, the geology of the depression is of main importance due to the reduced resistance to erosion of the predominantly loamy deposits. These allowed for a fast denudation of the area, leaving as dominant some structural plateaus developed on oolithic limestone. The monocline position of the geological deposits prompted the formation of some subsequent asymmetric valleys.

The mean annual temperature is 9.4^0C. The monthly minimum average is in January (-3.2^0C) and the maximum average in July (20.5^0C). Mean annual rainfall is low (525 mm) and has a torrential regime especially in summer, which is also reflected in the river flow regime.

The overall aspect of the relief of Huşi Depression is of an amphitheater opening to the SE. The western part of the depression is higher, the hills here frequently exceeding the altitude of 300 m. The central part of the basin presents a hilly relief, which decrease in altitude towards Prut River. On the right side of the valley there are some fairly well preserved terrace levels.

3. MATERIALS AND METHODS

In the analysis of the distribution of settlements in relation to altitude and slope we have used cartographic materials covering two time periods: 1920-1960 (for which topographic master plans scale 1:20000 were used) and 2005-2012 (for which orthophotos and recent topographical plans scaled 1:5000 were used). Tables and diagrams obtained from this analysis have used conventionally the year1950 for the first time span and 2010 for the second.

Slopes and altitudes were determined automatically through a process based on the SRTM (Shuttle Radar Topographic Mission) digital elevation model, resampled to a pixel size of 30 m. Slopes were classified into six classes, and elevations into seven classes. Subsequently, using the *Zonal Histogram* module implemented in ArcGIS 10.1, the spatial development of settlements on the depression slope and elevation classes was analyzed for a period covering approximately 70-80 years.

4. RESULTS AND DISCUSSION

The average slope of the terrain determined for the depression is 3.7^0, with a standard deviation of 3.3^0, and hence most of the values are between 1 and 7^0. The almost horizontal slopes ($<1^0$) and the slowly inclined ones ($1\text{-}2^0$) have a significant share (27.09% and 12.39%) and are specific to the Prut flood plain and terraces as well as to the plateaus or interfluvial summits. The slopes of $2\text{-}5^0$, with a frequency of 31.99%, are generally specific to the slopes conforming to the general monocline structure. They are followed as frequency by the $5\text{-}8^0$ slopes, characteristic for the sides of the symmetric valleys and for the connection areas between slopes and interfluvial surfaces. The $8\text{-}11^0$declivities characterize 8.19% of the area, while those

of 11-15^0 are specific for the heavily degraded slopes, especially those of the cuesta type, landslide escarpments and gully banks. Compared to the distribution of slope classes throughout the depression, it appears that current settlements are developed mainly on the declivity classes of 1-5^0 and 5-10^0, which have the largest share (table 1).

The comparative analysis of the distribution of the built-up areas within the Huşi Depression according to slope classes is shown in table 2 (for 1950) and table 3 (for 2010).

Table 1.

Settlement distribution according to the slope

Location	Surface (ha)	Slope (degrees)		
		Minimum	Maximum	Medium
Ghermăneşti	169.11	0.11	13.68	5.29
Arsura	85.5	0.41	10.78	5.68
Râşeşti	118.62	0.02	6.14	1.26
Drânceni	33.66	0.11	10.79	3.79
Albiţa	7.65	0.07	4.79	1.22
M. Kogălniceanu	23.58	0.33	10.9	5.59
Fundătura	60.21	1.77	16.97	7.25
Pâhneşti	66.69	0.58	10.04	5.43
Duda	157.95	0.22	22.1	5.71
Epureni	101.16	0.96	10.37	6.24
Valea Grecului	82.62	0.02	16.77	4.76
Chersăcosu	30.69	2.67	11.9	6.3
HUŞI	623.88	0.04	13.23	3.61
Stănileşti	160.47	0.02	14.3	3.73
Pogăneşti	62.82	1.28	12.68	5.34

Table 2.

The distribution of the built area (ha) on slope classes (^{0}) in 1950

Slope (^{0})	HUŞI	Arsura	Duda	Epureni	Stănileşti	Drânceni
0-1	24.84	0	0.63	0.09	0.54	0.99
1-2	80.91	0.36	2.25	3.06	2.52	0.63
2-5	176.31	11.16	25.65	15.21	24.57	3.42
5-8	65.16	17.19	52.47	33.57	5.13	5.49
8-11	6.75	1.71	8.01	11.97	0	3.24
>11	1.08	0	0	0	0	0
	355.05	**30.42**	**89.01**	**63.9**	**32.76**	**13.77**

Table 3.

The distribution of the built area (ha) on slope classes (^{0}) in 2010

Slope (^{0})	HUŞI	Arsura	Duda	Epureni	Stănileşti	Drânceni
0-1	31.59	0.09	1.35	0.09	29.16	3.78
1-2	95.58	0.72	6.75	3.24	21.51	6.39
2-5	363.33	30.06	51.93	20.07	65.43	13.95
5-8	116.91	47.16	76.14	58.41	33.3	6.03
8-11	15.3	7.47	17.37	19.35	8.28	3.51
>11	1.17	0	4.41	0	2.79	0
	623.88	**85.5**	**157.95**	**101.16**	**160.47**	**33.66**

In the case of Huşi City it is noted that the largest expansion of built-up areas from 1950 to the present took place on terrains with slopes between 2 and 5^0, of importance also being the slopes between 5 and 8^0.

The localities Duda, Epureni and Arsura, being located under Lohan Cuesta, at the source area of some valleys, had an extension conditioned by this type of relief, so that the built-up areas have advanced on terrains with a greater slope, generally in the range of 5-8^0.

Drânceni village, located on the 20-30 m terrace of Prut, expanded its territory especially along that terrace to the NW and SE, on slopes of 1-2^0.

Locatedat the contact between the right side of the Prut valley and its plain, Stănileşti extended in both directions, both on the floodplain (about 50 ha) and on the slopes (about 40 ha on gentle slopes of 2-5^0 and about 30 ha on steep slopes of 5-8^0).

The location of Râşeşti underwent a resembling spatial evolution to that of Drânceni due to its location on similar relief conditions (terrace). Pogăneşti expanded predominantly on the right side of the Prut valley, avoiding the floodplain affected by moisture excess.

The villages Valea Grecului and Chersăcosu, being more recent (they do not appear on the topographical plans prior to the year 1950) were not included in this analysis.

Another aspect must be mentioned in relation to the terrain slopes, namely the problem of landslides as present geomorphological process with negative impact on the development of settlements. Thus, on the strongly inclined slopes, landslides often occur, representing one of the most unfavorable geomorphologic risks affecting rural settlements. Heavily influenced from this point of view is Huşi City, where the deluvial slopes represent about 30% of the built-up area (Ungureanu, 1980). In the case of landslides, local conditions of relief are often inter-related with the geological and hydrographic conditions. Figure 2 presents the development of built areas in relation to declivities for Huşi City and the most important villages, i.e. those which function as commune seat.

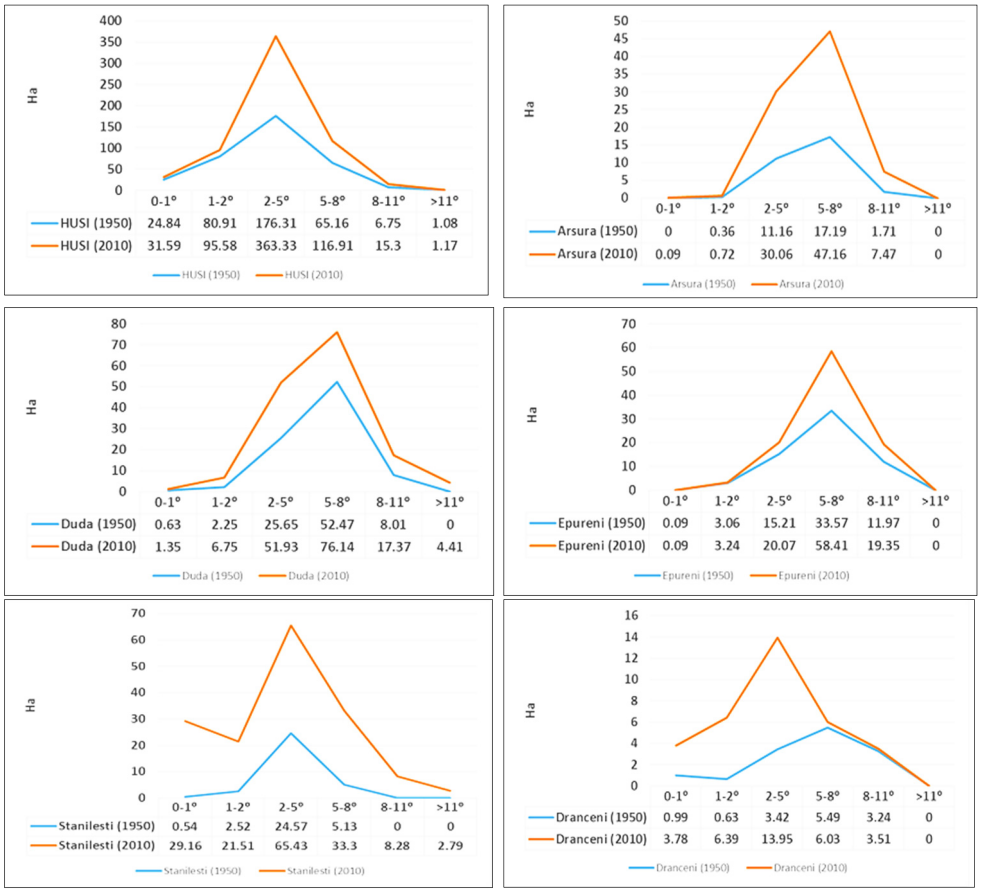

Fig. 2. The evolution of the built-up areas on slope classes (1950-2010).

The second morphometric parameter analyzed in this paper in relation to the spatial development of settlements is altitude. Muntele (1998) assigns the altitudinal gradient an important role in the structuring of settlements. In the author's opinion, the altitudinal gradient is manifested with different intensities from one region to another in historical Moldova. In the space between Prut and Siret rivers, the altitudinal gradient manifests in two-way, from some favored areas such as contact depressions to the open steppe fields or the higher wooded areas. In the virtue of historical inertia and although not that obvious, these contrasts remain until today.

In terms of altitude, the Depression of Huşi has the form of an amphitheater, with altitudes decreasing from west and north (over 300 m) to south-east (11 m in the Prut valley, on the downstream limit of the basin). To characterize the altitude of the relief, we used the hypsometric map with an altitude difference among classes of 50 m, which displays the main elevations of the basin.

Analyzing the location of the main settlements in the depression (Huşi, Ghermăneşti, Duda, Arsura) in relation to their position on altitudinal classes, it was found that larger settlements (Huşi, Ghermanesti) occupy in a percentage of over 50 % altitudes of 100-150 m. For comparison, Duda developed in a higher percentage (60 %) in the range of 150-200 m, while Arsura is located 77% in the 200-250 m altitude class.

In the case of Huşi, a significant weight is held by the altitude class of 50-100 m, which corresponds to the old center of the locality, in this altitudinal span being located the old residential and commercial - industrial city. The proportion of the altitude classes reflects the polynuclear structure of the town, with an old center with acompact appearance and a spatial evolution through the incorporation of neighboring villages. Currently, the built-up area of Huşi expanded inclusively in the vineyard area around, to higher altitudes of 150-200 m where there are numerous scattered houses.

Table 4 shows the distribution of build-up area on altitudinal classes in 1950, while table 5 presents the situation of 2010. Figure 3 shows evolutionary aspects for Huşi and the commune seats within the depression.

Table 4.

The distribution of the built area (ha) on altitudinal classes (m) in 1950

Altit. (m)	HUSI	Arsura	Duda	Epureni	Drânceni	Stănileşti
0-50	0	0	0	0	13.77	28.62
50-100	209.34	0	0	0	0	4.14
100-150	141.48	0	1.89	34.2	0	0
150-200	4.23	6.48	68.04	29.7	0	0
200-250	0	22.32	18.9	0	0	0
250-300	0	1.62	0.18	0	0	0
300-350	0	0	0	0	0	0
	355.05	**30.42**	**89.01**	**63.9**	**13.77**	**32.76**

Table 5.

The distribution of the built area (ha) on altitudinal classes (m) in 2010.

Altit. (m)	HUSI	Arsura	Duda	Epureni	Drânceni	Stănileşti
0-50	0	0	0	0	30.78	149.22
50-100	266.31	0	0	0	2.88	11.25
100-150	328.59	0	39.33	49.32	0	0
150-200	28.98	15.48	94.14	51.84	0	0
200-250	0	60.3	19.8	0	0	0
250-300	0	9.72	4.68	0	0	0
300-350	0	0	0	0	0	0
	623.88	**85.5**	**157.95**	**101.16**	**33.66**	**160.47**

In the period under review, it appears that the villages of Drânceni and Stănileşti extended up to altitudes of 50-100 m. In the first case, the location of Drânceni on the Prut terrace of 15-30 m (similar to Râseşti) allowed the development of the village on this terrace. In the case of Stănileşti, the village has spread mainly near the right side

slope of Prut valley and in a lesser extent in the upper third of it. Ghermăneşti village has expanded eastward at lower altitudes, on the interfluvial ridges bordering the valley of Luncani and descending slightly to the valley of Prut.

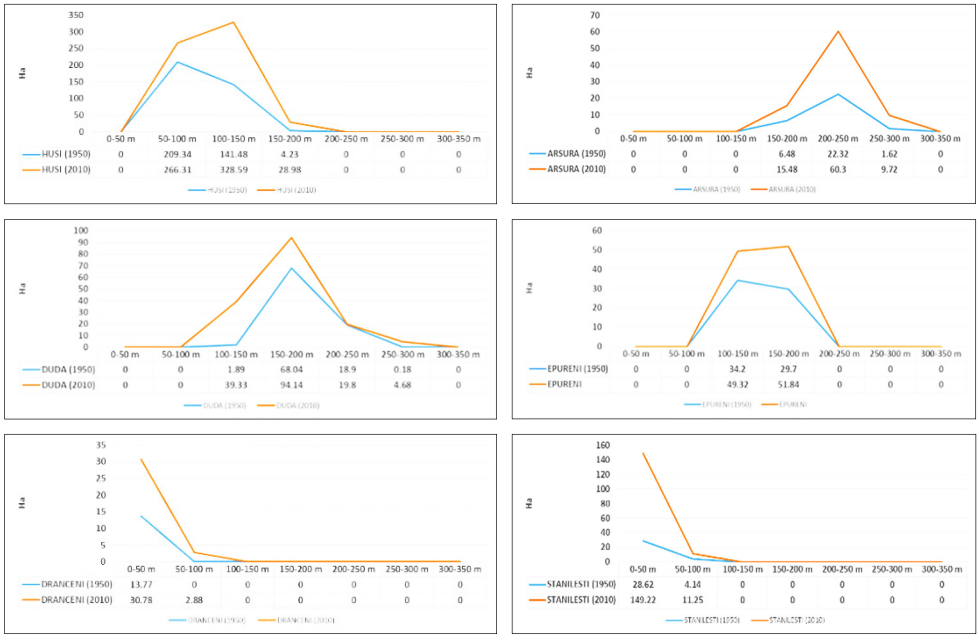

Fig. 3. The distribution of the built area (ha) on altitudinal classes (1950-2010).

It is noted that in the case of Huşi the built-up area expanded mainly in the 50-100 m spacing corresponding to the old center of the locality, but significantly advanced to the highest ground, in the vineyard, at altitudes of 150 m and even 200 m.

Epureni and Duda extended more horizontally in the altitude of 150-200 m spacing, the highly fragmented landscape forbidding the expansion of these settlements in altitude.

5. CONCLUSIONS

The specific natural conditions for Huşi Depression and certain social-economic and historical features that existed along time in this region provided a favorable environment for the development of human communities, so that most of the currently existing settlements are documented here even from the14th-15th centuries. Over the time, the succession of several political regimes led to profound legislative changes that had important effects on how land was used and onthe way that settlements expanded. The spatial evolution of settlements in the Huşi Depression experienced the most important transformations in the last century, many villages having doubled their surface during this period.

The diachronic approach on the development of human communities in the Depression of Huşi reveals the spatial development of settlements and how the land was used during the 20thcentury. It appears that in the case of Huşi and other localities situated on the western side of the depression, within hollow type slip basins located at the heads of valleys, the extension of the built-up areas, although conditioned by this rather improper relief, took place on higher slopes (5-8^0) and at a higher altitudes compared to the original situation. In the case of Huşi, the location has expanded mainly in the 50-100 m spacing corresponding to the old hearth of the city, but significantly advanced in the higher area, in the vineyard, at an altitude of 150m and even 200m.

The villages located in the central part of the depression or those on the terraces and on the Prut valley are characterized by land expansion conditions with an optimal gradient (1-2^0), specific to terraces, sculptural interfluves or accumulation glacises.

The overall conclusion is that through its specific characteristics, the relief is a key factor, sometimes limiting for the location of human settlements. The geomorphological specificity of the Huşi Depression consists of an alternation of land propitious for settlements development, such as interfluvial plateaus and ridges or terraces and high levees, with less favorable ones of the cuestas affected by slope processes or excessively humid floodplains, conditions that could not prevent the continuous human presence in this geographical subunit.

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