THE MAIN PHYSICAL-GEOGRAPHICAL CHARACTERISTICS OF THE LUGOJ HILLS AND THEIR CARTOGRAPHIC REPRESENTATION

Ionuț-Dan ZISU
West University of Timișoara, Romania, Department of Geography
Email: ionut.zisu@cbg.uvt.ro

Abstract The Lugoj Hills represents a part of the Western Hills of Romania, the Banat Hills sector, and they are found entirely within the Timiș County’s territory. In terms of methodology they appealed on a cartographic data base represented by the sheets of the geologic, geomorphologic and pedologic maps (on scale 1:200,000). For the main Lugoj Hills morphometric indicators characterization it was used the terrain digital elevation model (DEM) on 30 meters spatial resolution. The hypsometric parameters (slope, aspect and landscape vertical fragmentation) have been derived from this DEM, by the help of ArcGIS 9.3 software. Further, their calculation and interpretation was made. The map with the Lugoj Hills use of land has been obtained by derivation from Corine Land Cover 2000 (CLC 2000), which is the European reference dataset for land use. The geology from this area is defined by the presence of the crystalline schists which are strongly faulted and divided into blocks on which the Neozoic sedimentary formations, represented by the gravels, sands, clays and marls, have been submitted. The main geomorphologic parameters (hypsometry, declivity, relief energy) make that the analyzed area to be included into the middle hills category through which it is made the transition to the plain field from the western part of Romania. From thermic and pluviometric point of view, the studied place has a moderate continental temperate climate, with oceanic and subtropical influences, with not so warm summers and pretty mild winters. Regarding the hydrography, the Lugoj Hills present a radial network with the origins into the mountain area and which straightens to the main collectors – Bega, in the north, and Timiș, in the south-west. The land use in the studied area is quite diversified. Presently, it is observed that the natural vegetation is found only on the surfaces where the relief conditions or the soil humidity excess have not allowed cultivating the land. In terms of pedology, different subtypes of preluvisoils, luvisoils (luvisoils class) and fluvisoils (protoisols class) are predominant in Lugoj Hills.

Key words: Lugoj Hills, morphometry, DEM, land use, luvisoil.

1. INTRODUCTION

The Lugoj Hills are a part of the Western Hills of Romania, the Banat Hills sector, and they are found entirely within the Territory of Timiș County in its eastern side (fig. 1), being situated about 50 km from Timișoara. This hilly space has a surface of 619 km², representing 7.11 % from Timiș County area and 0.25 % from Romania area.
The main physical –geographical characteristics of the Lugoj Hills

Fig. 1: The location of the Lugoj Hills within Timiş County and in Romania.

The analyzed relief unit is presented in specialized literature under different names: Lugoj Hills (Vespremeanu, E., 1998; Posea, Gr., 2002, 2005), Făget Hills (Coteţ, P., 1973), Ruscăi Hills (Roşu, Al., 1973), Surduc Hills (Ianoş, G., 1995, 1997), Bucovăţ Hills (Pop, G., P., 2005) etc. From these appellations it was chosen the most used and eloquent name, that of Lugoj Hills, in the detriment of the most rarely met ones and with a limited knowledge.

The Lugoj Hills present a pronounced asymmetry, being almost divided in two parts by the Surduc Height. For this reason, Ianoş, G., (1997) separates them in two subunits: Lugoj Hills – west of Surduc Peak and Făget Hills – east of this mountain extension.

It still persists much confusion regarding the regionalization of the depression section situated between the southern part of Apuseni Mountains and the northern part of Poiana Ruscă Mountains, where the Lugoj Hills are also found. This space is unclear delimited and the subdivisions are created after quite arbitrary criteria, Vespremeanu, E., (1998, p. 12) saying that "the limits of the subunits are quite blurred and difficult to draw". Even so, the limit between the hilly area and the Poiana Ruscă Mountains frame is clear, non creating special problems in delimiting the relief subunits. After analyzing the specialized literature and the cartographic materials related to it, the course of Bega River was established as northern limit of the Lugoj Hills.

In the eastern side, the separation between the Lugoj Hills and Lăpugiu Hills is marked by the Holdea-Coșevița col area, reported in the specialized literature by many authors (Vespremeanu, E., 1972, 1998; Posea, Gr., 2002, 2005; Pop, G., P., 2005).

Analyzing on the field the topography, it was observed that the western limit goes until the Timiş-Bega Chanel and Gruni village.
2. MATERIALS AND METHODS

In the second part of the last century, in our country cartographic materials were made, on scale 1:200,000, in the domains geology, geomorphology and pedology for the entire area of Romania. So, the most of the physical-geographical information for the Lugoj Hills has been extracted from the sheets of these maps. The data has been also completed with some other existing materials.

Each of these three maps is composed from 50 individual sheets which respect the arrangement and the nomenclature of the Gauss-Krüger projection on scale 1:200,000 (fig. 2). Besides the Gauss-Krüger nomenclature, each map sheet has related a unique number (between 1 to 50 – the counting of the sheets being made from north to south and from west to east), and also the name of the most important locality within the map. It must be mentioned that for the sheets of the Geomorphologic map no number is assigned.

The map sheets on which the Lugoj Hills are found have been processed by scanning, georeferencing and mosaicking and after that the main geologic, geomorphologic and pedologic units have been extracted by digitizing using the ArcGIS program.

The terrain digital elevation model (DEM) on 30 meters spatial resolution has been used for characterization of the main morphometric indicators from the Lugoj Hills area. For this DEM, the parameters hypsometry, slope, aspect and landscape vertical fragmentation have been derived using the ArcGIS 9.3 software. The next step was their calculation and the results interpretation.
The meteorological data recorded in different time periods at the weather stations from Lugoj, Făget and Timişoara were used for the climatic and hydrologic characterization of the study area.

The map with the Lugoj Hills use of land has been obtained by derivation from Corine Land Cover 2000 (CLC 2000), which is the European reference dataset for land use. The CLC 2000 classification system includes 44 distinct classes grouped on 3 hierarchical levels. The satellite data base which led to realizing the CLC 2000, known by the name IMAGE 2000, was formed from images type LANDSAT ETM+ (http://earth.unibuc.ro/download/datele-corine-landcover-reprojectate-in-stereo70).

3. RESULTS AND DISCUSSIONS

3.1. The geological characteristics of the Lugoj Hills

The most information about the Lugoj Hills geology was obtained from the existing cartographic materials and from those auxiliary to them. On the Geologic map of Romania, on scale 1:200,000, the Lugoj Hills area is found on the sheets 24-Timişoara and 25-Deva (fig. 2). Each sheet has an external document (a book with a B 5 format) where there are presented the explanatory texts regarding the lithological and paleontological formations’ content, their distribution and some considerations about the geologic evolution of the territory.

There is also a series of more detailed geologic maps, made on scale 1:50,000. By the sheets of this map the coverage of the entire territory of the country is wanted, but this project is still ongoing because, until now, the printing of only a third part of the sheets was made. The territory of the Lugoj Hills is located on 7 sheets from which only 4 have been printed until now.

From this reason, for creating the Lugoj Hills geologic map (fig. 3), it was used as input data those extracted from the sheets on scale 1:200,000. These sheets were scanned and after that introduced in the ArcGIS software where they were georeferenced and mosaicked. Further, the surface type elements were digitized.
The most ancient formations, belonging to the Upper Proterozoic and Paleozoic, are not very spread and they are represented by the epimeta morphic crystalline schists from Danubian and Getic domains and the mezometa morphic ones from Danubian domain. They are disposed on the southern part, on the contact of the hills with Surduc Ridge.

Giușcă et al. (1967) state that the banatitic magmatic bodies from the western and south-western part of Poiana Ruscă Mountains were putted in place at the beginning of Paleogen. From those, in the Lugoj Hills it can be found porphyritic diorites in the eastern part of Drinova locality. Intrusive rocks can be found also in the crystalline schists at Hăuzești (pyroxenes diorite) and at Zolt (diorite). A few small rhyolites patches appear in the south-eastern part, in the area of the localities Românești and Tomești.

Lugoj sedimentary basin was formed during the Neogen due to the sinking of the older formations along some fracture systems. Neogene subsequent volcanic eruptions started to be manifested from Miocene (Badenian). These eruptions gave birth to the magmatic formations situated between the northern part of Poiana Ruscă Mountains and the southern part of Apuseni (Gherasi et al., 1968). From these formations, in the studied hilly area, it can be found a portion of Sarmatian quartz andesites with amphiboles and biotite situated in the western part of Pietroasa village.

According to Oncescu, N., (1965), in the western part of Mureș basin, south from Ilia, a Tortonian entering deposits is located. These deposits are transgressive arranged over various formations previous to Miocene. They go until the north-eastern part of the Lugoj Hills, eastern from Homoijdia locality (the most part of them) and in the western and north-western part of Coșevița village. Gherasi et al. (1968) specify that these Tortonian deposits

Fig. 3: The Geologic map of the Lugoj Hills.
are formed from a various lithologic range: breccia, conglomerates, gravels, sands, marls, loamy marls, coal remains, limestones, gypsum and pyroclastics.

The southern and eastern part of the Lugoj Hills is covered by Pliocene and Panonian materials composed from a succession of sands, loamy sands, marls and clays disposed on a gravels and sandstones layer. Drăgulescu et al. (1968) consider that the sands have the largest development and they present various colors, from yellowish-reddish to whitish gray.

The same authors consider that, during the Panonian period, the region would have been affected by the intense negative movements. This fact is reflected in the considerable depth of the formations which varies between 800 and 1,600 meters.

Gillet (1944, cited by Gherasi et al., 1968) affirms that the presence of the Pontian in the Lugoj Hills area is known for long time especially through the faunal species from Criciova. Huiș and Stănîloiu (1961, cited by the same authors) specify that another fossiliferous site was discovered at Bucovăț. Dreissena auriculata Fuchs, Dreissena simplex Fuchs, Congeria balatonica balatonica Partsch, Congeria balatonica protracta Brus, Phyllocardium complanatum Fuchs, Linnocardium vicinum Fuchs etc. are known from these two fossiliferous points.

The new subsidence movements were registered starting from Quaternary. They were highlighted especially in the western part of the Lugoj Hills, where the rivers Bega, Timiş, Glăviţa, Lighitiş, Biniş, Hezeriş, Eruga gather convergent.

The Upper Pleistocene is represented by the alluvial deposits composed from gravels, sands and clays. These deposits have reduced thickness, between 3-10 m, and represent the low, upper and high terraces.

The alluvial accumulations of the high terrace, which have been attributed to the basal part of the Lower Pleistocene, are composed from boulders, gravels and sands in the petrographic composition of which enter quartzites, gneiss, micas, granodiorites, limestones and sandstones. The depth of the deposits varies between 4-6 m. The high terrace’s upper Pleistocene deposits mostly occur along the Bega River (Drăgulescu et al., 1968).

The fluvial deposits of the low terrace composed from gravels and sands are assigned to the Lower Holocene.

The recent alluvial meadows, formed from sandy clays, sands and gravels, belong to Upper Holocene. The deluvial deposits on the forehead terraces had been reported also to the Upper Holocene.

The regional metamorphism appears on the small areas, being represented by the phyllites and sericite-chlorite schists situated in the central-eastern part and by the limestones located on a narrow strip at the contact with the mountain frame between the localities Zolt-Baloșești and Românești-Pietroasa.

3. 2. The geomorphologic characterization of the Lugoj Hills

The existing cartographic materials are very helpful for presenting the geomorphologic characteristics of the Lugoj Hills. Buza, M., (1997) mentions that during the period 1976-1990, at the Geography Institute, the General geomorphologic map of Romania, on scale 1:200,000, composed from 50 sheets, was made. The Lugoj Hills territory is located on the map’s sheets Timişoara (L-34-XXII) and Hunedoara (L-34-XXIII) (fig. 2). Each map sheet has also an ample explanatory material.
The Lugoj Hills area was extracted from the two map sheets (fig. 4), following to be extracted by digitizing the main morphografic units using the program ArcGIS.

Quite many inaccuracies can be remarked between the two surfaces especially in terms of the color tints which don’t fit very well. This is due to hand made of the sheets which compose the Geomorphologic map of Romania (on scale 1:200,000). It can be observed also many concordances resulted firstly by using approximately the same signs in legend.

Analyzing the Geomorphologic map, the main relief types met in the Lugoj Hills can be observed. The most part of the area is occupied by the erosion fluvial relief. In the western part, the Lugoj Hills are strongly eroded by the torrent organisms. In the south-western part, on the alignment of the hills Nevrincei, Ibrilont, Herezişului, Zăcătoare and Comoara (from west to east), it is observed an area with many gullies, pipping tunnels and ravines.

The fluvial accumulation relief is present in the lowest parts, appearing in the floodplain of the main river networks (Bega, Timiş, Glăviţa, Săraz, Gladna, Biniş, Vădana).

Many dejection cones can be met in the region where the rivers go out from the hilly space to the areas with much lower slope (meadows). They appear mostly in the north-western part occupied by the Țipari-Nedea-Sudriaș hills and in the north-eastern part of Lugoj town.

The eastern part of the Lugoj Hills is characterized by a more highly fragmented relief then in the western sector. The sculptural denudation relief is characterized by main and secondary rounded peaks, situated in the highest southern parts of the hills and in the eastern part of Curtea village.

Fig. 4: The geomorphologic map of the Lugoj Hills.
The accumulation denudation relief is found in some sectors from the southern and eastern part of the studied hilly area. Some eroded piedmont formations can be observed in the highest part, at the contact with the neighboring mountain frame.

The Lugoj Hills present a pronounced asymmetry, being almost divided in two parts by the crystalline Surduc Height (fig. 4). These hills have the aspect of some extended and large ridges with east-west direction and their altitude varies between about 100 m, in Bega meadow, and about 400 m, at the contact with the mountainous area.

In the north-western part, the hills go down to the Bega River meadow by a system of 2-3 large and very flat terraces, covered with fine-textured materials.

The mountains tectonic uplift from the beginning of Quaternary (Wallachian phase orogenesis) intensified the surface erosion which blurred the break lines. In the same time, some rivers like Gladna and Glăviţa, attracted by the western subsidence, modified their initial course (to the north) going to the west, north-west.

The crystalline penetration into the hilly area and also the numerous gulf type depressions from here give to the hills a look of spurs similar to the Subcarpathians ones (Mazăre, V., E., 2006).

The presence of some crystalline and igneous cores formed from clorito-sericite schist is explained by Badea et al. (1986) by the Lugoj Hills position at the edge of the Poiana Ruscă Mountains. These zones impose itself in relief because of the ridges aspect which dominates with 100-200 m the piedmont hills level from surrounding. An example in this sense is Drinova dioritic hillock (373 m).

3.3. The morphometric characteristics of the Lugoj Hills

3.3.1. The hypsometry of the Lugoj Hills

With an average altitude of approximately 190 m, the Lugoj Hills integrate into the middle class hills (200-500 m) (fig. 5).

The minimum altitude is 98 m and it is recorded in the western part of the Bega River meadow. The maximum altitude of the Lugoj Hills measures 408 m, being recorded in Zăcătoarei Hill which is located in the western part of Firdea locality, at the contact with the Surduc Ridge.

Analyzing the Lugoj Hills hypsometry, it observes that the altitudinal steps increase progressively from about 100 m, from the meadow low areas situated in the north-western part, to about 400 m on the contact with the mountain frame from south-east.

From the histogram of the Lugoj Hills hypsometric classes (fig. 6) it can be observed that the most part of this relief unit (more than 60 %) records altitudes lower than 200 m.

Nearly 35 percent of the analyzed area (34.54 %) is between 200 and 300 m altitude and 3.62 % belongs to the altitudinal step contained between 300-350 m. Only a few small areas are situated on altitudes higher than 350 m. They represent less than 1 % from the entire surface of the Lugoj Hills (fig. 5, 6).
3.3.2. The relief declivity in the Lugoj Hills

The spread of the most important geomorphologic process which act in the Lugoj Hills area differ according to the main slope classes’ distribution.
According to the Lugoj Hills slope map (fig. 7), the mean slope gradient is 4.93º. This fact can be observed more clearly regarding the slope classes areas histogram (fig. 8) which shows that the highest frequency appears for the 0-2º class (27.2 %). This one together with the one between 2-4º characterizes more than 50 % (53.64 %) of the studied territory. These classes, with very small slopes, are characteristic for the low alluvial areas situated especially in the northern and western part of the Lugoj Hills.

The declivity grows progressively, like in the hypsometry case, from the low north-western areas, situated in the meadow, to the south-eastern one located at the contact with the Poiana Ruscă Mountains frame (fig. 7).

Analyzing the Lugoj Hills area slope classes’ distribution, it can be observed that about 87 % of this space is framed between 0-10º, corresponding to the weak to moderately sloped surfaces. The slopes moderately to strongly inclined, between 10-20º, have a frequency about 12 % and those with pronounced declivity (> 20º) occupy the surfaces under 1 %.

The slopes more inclined denote a higher denudation potential in the south-eastern areas especially in the condition of a friable lithology, formed, mainly, from Panonian gravels, sands, marls and clays.

The higher declivity is recorded in the south-eastern part of the Lugoj Hills, on the right shore of the Bega Poieni River, between the localities Pietroasa and Românești. The maximum slopes inclination (46.74º) is reached in the same area, on the south-eastern side of the La Vii Hill (381 m), located near Pietroasa at the confluence of Slăveasca valley with Bega Poieni River.
3.3.3. The Lugoj Hills slopes aspect

For characterization the slope aspect of the Lugoj Hills, the map of the slope orientation (fig. 9) and its corresponding histogram (fig. 10) was made.
According to the graphs which show the Lugoj Hills relief orientation, it can be observed that the slope aspect is very balanced. Even so, analyzing how is made the distribution of the exposition classes (fig. 10), it can be noticed that the most part of the slopes is orientated to the west and north-west.

In terms of the Lugoj Hills slopes aspect (fig. 11), it remarks that a little over half of them (51.89 %) are shady and half shady, while 48.11 % are in the sunny and half sunny side.

3.3.4. The Lugoj Hills relief vertical fragmentation
The energy of the Lugoj Hills relief was calculated using the method of the cartograms with 1 km² area (fig. 12). According to the results generated by this method, the mean landscape vertical fragmentation is 49.67 m, the values varying between 0 and 164 m.

The frequency histogram (fig. 13) shows a predominance of the values between 0-45 m (49.73 %), followed by the intervals between 45-60 m and 60-75 m, with similar proportion, 13.32 %, respectively 13.18 %. The values higher than 75 m have a quite significant percent which reaches to almost a quart (23.97 %).

The meadows of the Bega and Timiş rivers and their affluences are characterized by the lowest values of the landscape energy (< 15 m), while the high values (> 120 m) are specific to the regions located at the edge of the mountain frame.

Fig. 12: The map of the Lugoj Hills relief vertical fragmentation.
3.4. The characterization of the main aspects of climate

From the thermal and rainfall point of view the studied zone has a moderate continental temperate climate with oceanic and subtropical influences. The summers are not very warm and the winters are pretty mild. The tropical maritime air invasions are frequent during the winter due to the cyclones which move from Mediterranean Sea to the north-east over the Pannonian Basin. They produce the increase of the air temperature in the hilly studied area (Clima R.P.R., 1962).

Multiannual average air temperature in the Lugoj Hills area is about 10.75°C. Annual value of the aridity „de Martonne” index is 33.3 (exoreic regime). The hydroclimatic annual index records the value 100 which is characteristic for an equilibrated hydrologic balance (Mazăre, V., E., 2006).

For the thermal regime of soils, it is observed that during the months February-March it has a slowly increase following closely the air temperatures evolution. Mazăre V., E., (2006) states that the arable layer exceeds consistently 5°C at the beginning of the second decade of March and 10°C in the first decade of April.

Annual average amount of precipitations in the Lugoj Hills area is 679.1 mm (fig. 14) and the potential evapotranspiration, calculated using the Thornthwaite relation, is 676.1 mm.
The dominate winds are from the east, south-east and north-west directions. The relief configuration from this area imposes to the wind the directions which coincide to the valleys axis. The wind regime from the Lugoj Hills is determined by the particularities of the general circulation of the atmosphere and in a small way by the aquatic surface particularities.

The wind annual average speed is between 2.6-3 m/s. The highest monthly averages are recorded within the ranges February-April and October-November (3-4 m/s), with a slow decrease from May until September and in December (2-2.5 m/s).

3.5. The hydrographic characterization of the Lugoj Hills

Starting with Quaternary new subsidences movements are recorded. These movements are highlighted especially in the western part of the Lugoj Hills where the rivers Bega, Timiș, Glăvița, Lighitiș, Biniș, Hezeriș, Eruja converge.

In the same time, some rivers like Glăvița, attracted by the western subsidence, modified their initial course which was to the north and they redirected to the west, north-west.

Resuming the ideas of Ficheux, R., (1937) and Pop, G., (1948), Mihăilescu, V., (1966) supports the hypothesis of a Mureș River course, during the Quaternary period, to the south through the col area Coșevița-Holdea. He names this area „Lăpușiu and Beghei corridor”. The argument that supports the author’s idea is given by the reduced role played by the Mureș River in modeling of Lipova piedmont platform.

Vespremeanu, E., (1972) calls the depression entering drained by Bega River with the name Mureș Gulf. In this way, he supports the Mihăilescu’s hypothesis (1966, 1969) regarding the paleocourses of the Mureș River.
The main physical–geographical characteristics of the Lugoj Hills

Analyzing the courses of the Mureş and Bega rivers, Coteţ, P., (1973) makes some remarks about their role in the relief area genesis and modeling. Also, he affirms about the intermountain Mureş corridor that is located actually along the Bega River. So, his conception is integrating to the hypothesis claimed by the previous studies.

At present, the Lugoj Hills have a radial hydrographic network which has its origins in the mountain area and which goes to the mains collectors – Bega (S=2,241 km²; L=168.6 km), in the northern part, and Timiş (S=5,248 km²; L=241.2 km), in the south-western part (fig. 15). This rivers network fragments the hills quite intensely especially in the eastern part where are the rivers Icuiu, Nândreasca, Homojdia, Bega Poieni and Vădana, but also in the southern part where Hăuzeasca valley is located.

![Fig. 15: The map of the Lugoj Hills hydrographic network.](image)

Between the localities Româneşti and Răchita, Bega creates a large arc of circle (fig. 15) with a low meadow, very slow inclined and very asymmetric on the left side in the sector between Margina and Răchita. This fact is due to the pushing of the Bega River by its numerous tributaries which come from the mountain area (Ujvári, I., 1972). From those the most important are Carpen, Şopot, Vădana, Zopana, Bălășina and especially Gladna (Rîu) with Săraz which is the biggest tributary of Bega. Badea et al. (1986) observe that the Bega meadow has a width of 4-6 km near Marginea village which is double near Răchita.

Some old courses of the Bega River can be identified on its meadow. They are parallel with the actual course and they are flowing into the Bega tributaries, like Vădana, or they have large divagations, like Şopot.
In the western part of the Lugoj Hills, Bega is accompanied on the left side by a number of streams which flow parallel. From these ones the most important is Glăviţa which flows in Timiş-Bega alimentation channel.

The south-western part of the Lugoj Hills is bordered by the Timiş River which collects the streams Nădrag, Slatina, Măguri and Tapia. Nădrag River succeeds to deposite on the plain side a large cone of dejection between the localities Jdioara and Criciova, imposing so a local deviation of the Timiş meanders (Badea et al., 1986).

The natural rivers network was strongly anthropogenically modified in the low area. It can be remarked the channeled and dammed course of Bega which starts from Balinţ village and continues on the Serbia’s territory until the flow into Tisa River.

The course of Timiş was also very much anthropogenically influenced starting from the second part of the 18th century by the construction of the Coşteiu-Chizătău Channel which make the connection between this river and Bega. Some streams from the western part, like Eruga, Biniş with Lighitiş and Hezeriş and Glăviţa, flow into this channel (fig. 15).

The geomorphologic configuration from the confluence between Munişel and Gladna made possible to place here a permanently water storage which has the name Surduc (fig. 15). The construction of the accumulation lake dam started in 1972 and the filling in 1976. Surduc Lake has 362 ha surface and an available water volume of 24,225 millions m³. It represents the most important water accumulation from the hydrographic basin of Bega River and the biggest lake from Timiş County. Harabagiu and Teodorescu (1999-2000) consider that the Surduc Lake clogging rate is 2%/year and it will be completely clogged on 500 years.

Surduc accumulation is the only permanent lacustrine surface from the Lugoj Hills area.

3. 6. Biovegetal characterization of the Lugoj Hills

According to its structure, the forests from the studied area are composed from different oak species like Quercus polycarpa and Quercus petraea, Norway maple (Acer platanoides), field maple (Acer campestre), ash (Fraxinus excelsior), silver lime (Tilia tomentosa) and even sour cherry (Prunus avium).

On the large valleys, with groundwater near to the surface and with lateral drains, it can be found isolated tree clumps formed from different species of willow (Salix alba and Salix fragilis) and black poplar (Populus nigra) and from the shrub species we have the dog-rose (Rosa canina).

The shrub vegetation is well developed and it makes the transition to the characteristically species from the low areas. Besides the dog-rose, already mentioned, it can be found the blackthorn (Prunus spinosa), hazelnut tree (Corylus avellana), wild privet (Lyustrum vulgare), bladdernut (Staphylea pinnata), wayfaring tree (Viburnum lantana) and dog wood (Cornus sanguinea).

Mazăre, V. E., (2006) notices that on the higher places, at the transition from the plain to the hill, the common meadow-grass (Poa pratensis) is the dominant species. Other grasses can be found together with it: steppe fescue (Festuca valesiaca), perennial ryegrass (Lolium perene), orchard grass (Dactylis glomerata), couch grass (Agropyron repens). Also, it can be found some legume species represented by different clover types: white
The main physical–geographical characteristics of the Lugoj Hills

clover (Trifolium repens), red clover (Trifolium pratense), black medic (Medicago lupulina).

The swards vegetation is composed mainly from monocotyledonous grass species like common bent (Agrostis tenuis) and horse grass (Festuca rupicola). In association with this it can be met the mountain clover (Trifolium montanum), the yarrow (Achillea millefolium), the hoary plantain (Plantago media), the sage species called purple rain (Salvia verticillata), yellow lucerne (Medicago falcata), the pheasant's eye (Adonis vernalis), the centaury (Centaurea orientalis), the dewberry (Rubus caesius) etc.

In the depression forms it is met the barnyard grass (Echinocloa crus-galli), the dandelion (Taraxacum officinale), the comfrey (Symphytum officinale), the buttercup (Ranunculus sp), the commun rush (Juncus effusus).

The plant species most commonly grown in the Lugoj Hills area are the wheat (Triticum), the corn (Zea mays), the barley (Hordeum vulgare), the soy (Glycine max), the clover (Trifolium), the alfalfa (Medicago sativa) and the oat (Avena sativa).

A strong expansion of different fern types (Pteridophyta spp.) is remarked in some parts. These plants can be spread even on the entire slopes like for example in the hills near Coșevița or in Cozma Hill near Drăgășnești. The fern are plant species with rhizomes, being for this reason very resistant. Also these plants adapt and multiply easily having an excessive development. That is why they are harmful species which invade and replace the indigenous vegetation and affect the agricultural crops.

3.7. The Lugoj Hills main soil characteristics

A large pedocartographic project was developed in our country during 1963-1993 out of which the Soil map of Romania, on scale 1:200,000, composed from 50 individual sheets, resulted. Actually, this material represents the most complete series of soil maps made on medium scale for the entire area of Romania.

The Lugoj Hills are found on the sheet 24-Timişoara (a small portion from the northwestern part) and on the sheet 25-Deva (the largest part of the area) (fig.2).

Besides the cartographic materials which present the soils spatial distribution for the entire country level, regional or county level soil maps have been also made. The Lugoj Hills area was contained within the Banat and Timiş County soil maps.

All these cartographic materials serve as support for creating the new data bases and maps made in digital format by the help of different computer programs (ArcGIS, IDRISI etc.).

The figures 16 and 17 present two such soil maps. The first one was effectuated after the Banat soil map (on scale 1:200,000) made in 1994 by Ianoș together with his collaborators from Timişoara Soil Science and Agrochemistry Service. The second one was made after the sheets 24-Timişoara and 25-Deva of the Romania soil map (on scale 1:200,000). The necessary operations for its obtaining were supported by scanning the maps obtained by conventional means and their introduction in ArcGIS 9.3 software where they have been georeferenced. Further, the different soil units’ polygons were digitized.
Fig. 16: The Lugoj Hills soil map obtained after the Banat soil map (on scale 1:100,000).

Fig. 17: The Lugoj Hills soil map obtained after the Romania soil map (the sheets 24 and 25) (1:200,000 scale map).
Both maps present a series of advantages and disadvantages. First of all, their information must be adapted to the new soil classification system recently come into use in our country (SRTS-2012).

Some detailed soil areas can be observed on the map created after the one on scale 1:100,000. However, large forest areas also appear on this map. These forest areas haven’t been mapped when this map was made because only the agricultural land was taken into account.

The soil units from the Lugoj Hills area were classified into several soil classes and types. 6 soil classes with 11 types resulted for the map on scale 1:100,000 (fig. 16) and also 6 soil classes, but with only 8 types, resulted for the map on scale 1:200,000. Although it appears some differences between the information from these two maps due to the working map scale, from both maps it can be observed that different subtypes of preluvisoils and luvisols (luvisols class) and fluvisoils (protisoils class) are predominant in the Lugoj Hills area.

3. 8. The analysis of the land use and the settlements function from the Lugoj Hills

The map with the Lugoj Hills use of land (fig. 18) was obtained by derivation from the European reference dataset for land use Corine Land Cover 2000 (CLC 2000), which is.

![Fig. 18: The use of land in the Lugoj Hills area.](image)
Large forest areas are extended on the higher fields from the southern and southeastern part of the Lugoj Hills (fig. 18). Some bush transition parts, specific especially to the areas that have been grubbed before, are also found in the low area which is occupied by the fields used mostly in agriculture.

The orchards, with a significant spread in the south-central part, are especially composed from plum tree (*Prunus domestica*), apple (*Malus domestica*), sour cherry (*Prunus cerasus*), walnut (*Juglans regia*) and mulberry (*Morus*). The vine (*Vitis vinifera*) is cultivated on the quite reduced surfaces which are situated in the southern area between Tapia and Lugoj and in the perimeter of the localities Jureşti-Boteşti-Drinova.

Unirrigated arable lands, located with predilection in the low meadow areas, are cultivated with cereal plants (corn, wheat, barley, oat) and with soy.

The natural pastures can be found only in some small areas from the north-eastern part of Măguri village. They were replaced by the secondary grasslands which have a quite large development and an uneven spread in the Lugoj Hills area.

A few swampy areas are located in the Timiş meadow due to the divagant course of this river, but also to the high groundwater level from this part.

The surface occupied by the localities is 27.1 km² which means 0.31 % from the Lugoj Hills area. 56 settlements are completely or tangential located in this relief unit. They are classified as follows: 2 towns (Lugoj and Făget), 12 communes (Mănăştiur, Dumbrava, Margina, Pietroasa, Curtea, Tomeşti, Fîrdea, Traian Vuia, Birna, Criciova, Côşteiu and Balint) and 42 villages (fig. 19).

---

*Fig. 19: The Lugoj Hills settlements category and their territorial distribution.*
4. CONCLUSIONS

The Lugoj Hills belong to the Western Hills of Romania, the Banat Hills sector, and they are found entirely within the Timiş County’s territory. This relief unit presents a pronounced asymmetry, being almost divided in two parts by the Surduc crystalline height. For this reason, some authors present them as two subunits.

This hilly area was individualized by the accumulation of some large Pleistocene and Holocene sedimentary deposits with different granulometric composition which were carried and submitted over the Tortonian and Panonian preexisting formations by the rivers descending from the mountain area. The Lugoj Hills foundation is composed from crystalline schists which are strongly faulted and compartmented in blocks.

The Lugoj Hills represent well individualized geomorphologic units because of their peripheral position to the mountain space, their deposits structure and their altitude (about 190 m - average altitude). This relief unit is included into the middle hills category through which it is made the transition to the plain field from the western part of Romania.

The main morphometric characteristics of the Lugoj Hills change progressively from the low north-western part to the highest south-eastern one.

From the thermic and pluviometric point of view, the studied area has a moderate continental temperate climate, with oceanic and subtropical influences. The summers are not so warm and the winters are pretty mild.

The Lugoj Hills have a radial hydrographic network which has its origins in the mountain area and which goes to the mains collectors – Bega, in the northern part, and Timiş, in the south-western part. The course of the rivers from this space was very much influenced by the Quaternary subsidence movements.

In terms of pedology, the luvisoils class with different preluvisoils, luvisoils and even planosoils subtypes is predominant in the Lugoj Hills. Along with these soils there are also met, in the low areas, on the quite large surfaces, soils formed due to the humidity excess (fluvisoils, stagniscoils and gleysoils) and eutricambisoils as well. Some isolated areas with vertisoils, anthrosoils, lithosoils ant tehnosoils are longer found.

Regarding the biovegetal factor, presently it is observed that the natural vegetation is met only on the areas where the relief conditions or the soil humidity excess doesn’t allow cultivating the land. The plant species most cultivated in the Lugoj Hills area are wheat, corn, barley, soy, clover, alfalfa and oat.

The land use in the studied area is quite diversified. The large forest area of the Lugoj Hills is formed especially from oak species. The orchards, with a significant spread in the south-central part, are composed from plum tree, apple, sour cherry, walnut and mulberry. The vine is cultivated on some reduced surfaces from the southern area.

Unirrigated arable lands, located mostly in the low meadow areas, are cultivated with cereal plants and soy.
REFERENCES


Florea, N., Munteanu, I. (coordonatori), (2012), Sistemul Român de Taxonomie a Solurilor (SRTS), „Sitech” Publisher, Craiova.


Mihăilescu, V. (1966), Dealurile şi Câmpile României, „Editura Ştiinţifică” Publisher, Bucureşti.

Mihăilescu, V. (1969), Geografia fizică a României, „Editura Ştiinţifică” Publisher Bucureşti.

Onescu, N. (1965), Geografia României, „Editura tehnică” Publisher, Bucureşti.

Pop, G. P. (2005), Dealurile de Vest şi Câmpia de Vest, „Oradea University” Publisher.

Posea, Gr. (2002), Geomorfologia României. Relief-tipuri, geneză, evoluţie, regionare, „România de mâine” Foundation Publisher, Bucureşti.

Posea, Gr. (2005), Geomorfologia României. Relief-tipuri, geneză, evoluţie, regionare, ediţia a II-a revizuită şi adăugită, „România de mâine” Foundation Publisher, Bucureşti.

Roşu, Al. (1973), Geografia fizică a României, „Editura Didactică şi Pedagogică”, Publisher, Bucureşti.

Ujvári, I. (1972), Geografia apelor României, „Editura Ştiinţifică” Publisher, Bucureşti.


Vespremeanu, E. (1998), Pedimente, piomonturi şi glacisuri în Depresiunea Mureşului de Jos, „University” Publisher, Bucharest.


*** (1967), Harta geologică a R. S. România, sc. 1:200.000, 24, Timişoara, L-34-XXII.

*** (1967), Harta geologică a R. S. România, sc. 1:200.000, 25, Deva, L-34-XXIII.

*** (1988), Harta geomorfologică a R. S. România, sc. 1:200.000, Timişoara, L-34-XXII.

*** (1989), Harta solurilor R. S. România, sc. 1:200.000, 24, Timişoara, L-34-XXII.

*** (1990), Harta solurilor României, sc. 1:200.000, 25, Deva, L-34-XXIII.