

REZUMATUL TEZEI DE DOCTORAT

**„ INFLUENȚA CONDIȚIILOR GEOMORFOLOGICE ASUPRA  
SOLURILOR DIN BAZINUL SUPERIOR AL BÂRLADULUI,  
AMONTE DE BĂCEȘTI”**

(ÎN LIMBA ENGLEZĂ)

## **Chapter I: Introductory Aspects**

### **I.1. The geographic setting and the limits of the river Bârlad's upper basin**

The upper basin of the river Bârlad is set in the east of Romania, in the north-western part of the hydrographic basin Bârlad, occupying the western part of the physico-geographical unit Central Moldavian Table-Land.

## **Chapter III: Conditions of the natural setting**

### **III.1. Geological Considerations**

#### **III.1.1. Lithological composition**

For the pedological coat and the quality of the soil from the studied area, the sedimentary formations characteristic to the last cycle have the biggest importance, made out of rocks increasingly younger from north to south and from the lower parts to the higher ones of the landscape, on account of which the superficial deposits formed.

The deposits that appear to date and influence the geomorphological processes, pedogenetic and the formed soils in the studied area belong to the medium Sarmațian (Basarabianului), superior Sarmațian (Chersonianului) and to the Meoțian.

### **III.2. The Landscape and current geomorphological processes**

#### **III.2.1.1. The altitude**

Under the altitudinal aspect, the superior basin of the river Bârlad, upstream of Băcești, unfolds between 149 m, at the confluence of the river Bârlad with the creek Crăiasa and 466,2 m in Miliște Hill, witness of erosion, sustained by the chersonian formations, situated in the west of the basin.

#### **III.2.1.2. The declivity**

In the superior basin of Bârlad, the inclined surfaces have values of the slope between 3° and 40°. The horizontal surfaces (under 1°) and cvasihorizontal (1°-3°) are encountered in the meadow areas (Bârlad's meadow, the meadows of creeks Crăiasa, Bozieni and Poienari), in which the geomorphological processes are the ones of accumulation, and the pedogenetical ones are of gleyzation (15,28% of the territory).

The slopes between 5°-10° have the largest share (44.85%), with appearances at the contact of the slopes with the interrivers and most part of the cuesta reverses, and the slopes of 10°-15° are characteristic to the biggest part of the slopes (19,92%).

#### **III.2.1.3. The setting of the slopes**

The analysis of the graphic that shows the share of the exhibition classes from the superior basin of Bârlad indicates the fact that big values have the exhibition

classes north-east and south-west (18,1%, respectively 17.5%), then north and south (7%, respectively 10.5%), that reflect the morphostructural asymmetry of order I (pct. nr. 4). The share of the slopes with westic opposition is 13%, and those with eastern exhibition is of 18.7 %, which points out the morphostructural asymmetry of order II (Ioniță I., 2000), subordinated to the order I morphostructural asymmetry.

#### **III.2.3.1. The structural landscape**

The structural landscape from the studied area is characterized by the presence of *the structural plateaus, the peaks of the structural- lithological plateaus, the valley structural shoulders, lithological structural witnesses* and of different types of *valleys* that in a mostly *monoclinal structure* have created the most characteristic landscapes from the Central Moldavian Table-Land: *cueta*.

*The structural-lithological plateaus* are represented by flat or slightly inclined surfaces, with a variable width, engrafted in harder rocks, like the hone-chalk formation of Repedea, the hone of Șcheia or the chersonian hone of Păun.

*The structural-lithological witnesses* appear under the shape of relative flat hills at the superior part, protected by the sandstone board situated close to the surface. According to the orientation of the hydrographic network to the monoclinal structure, the valleys are consecvente, resecvente, subsecvente and obsecvente.

#### **III.2.4. The current geomorphological processes**

The land degradations from the superior basin of Bârlad, are owed mostly to the landslides, the areolar erosion, the linear erosion and, secondary, to other geomorphological processes with a punctual spreading.

##### **III.2.4.1. The surface erosion**

Surface erosion has two components: the erosion of the rain drops and the erosion caused by the surface leakage.

This form of erosion plays an important part in the current dynamic of the landscape and the pedogenetical processes, being present on all the slopes, but also on the interriver peaks with a certain incline.

The erosion influences sensitive the pedogenetical processes by decreasing the bioaccumulation rhythm, modifying in a negative way the physical, chemical and biological properties of the soils.

##### **III.2.4.2. The depth erosion**

The depth erosion doesn't get involved in the current morphodynamic of the slopes, gullies being little spreaded in the basin. The big development of the basarabian formations, mostly clayey and secondary, sandy, didn't favor the big scale development of these degradation forms.

The depth of the slope gully is between 1 and 5 m, and can get to even more than 10 m. Between the most representative gullies from the study region, we mention

the ones in the forehead of cuesta Bozieni, from the village Iuça, whose depth exceeds 10m (pct. nr. 5), gullies on the Poienari Coast etc.

*The bottom of valley gully*, through their size, are the most spectacular forms of linear erosion from the superior basin of Bârlad, upstream of Băcești. These gully are found throughout the studied area, both through the length of Bârlad, where the depth can exceed 5-6 m, and through the length of the main affluents. (Bozieni, Crăiasa, Râș, Fundătura).

#### **III.2.4.3. The landslides**

The big amplitude of landslides in the superior basin of Bârlad is favoured by the geological composition mostly made out of clay and sand of the Basarabian or sandy-clayey of the Kersonian.

The surface occupied by these geomorphological processes is of *10818 ha*, which represents *50,6%* of the superior basin of Bârlad upstream of Băcești.

After a long period rich in precipitation 1969-1973, the surface occupied by active landslides in the superior basin of Bârlad occupies 2317 ha, spreaded mostly in the southern half of the basin, on the foreheads of cuesta, but also on the slopes of the affluent valleys of Bârlad.

In the conditions of the current climate, more arid, landslides have small dimensions, entailing small sediments, the surface occupied being reduced at 444 ha.

The main landslide affected areas are present on the south, west, both part of the studied basin, occupying the forehead of cuesta slopes with a northern exhibition (the cuestas of superior Bârlad, strongly fragmented by the valleys of the obsecent affluents, cuesta Bozieni, Poienari etc), but also the foreheads of cuesta with western exhibition situated on the left of the reconsecent valleys or on the right of the obsecent valleys, specific to the order II morphostructural asymmetry.

The landslides from 1968-1973, triggered by an excess of humidity of pluvial nature, have determined the movement of the villages Bunghe and Linsești, and the reactivation of others generated significant damage to the constructions in the area. After a period rich in precipitation (1969-1973), the active landslides had a big amplitude, the authorities in the area being forced afterwards to equip the slopes by planting a series of species with a deep radicular system to fix the sediments.

### **III. 3. The climatic conditions of the region**

#### **III.3.2.1. The temperature**

The highest average annual temperatures are registered at the Negrești weather station (9,3<sup>0</sup>C), followed by the Roman weather station (9,1<sup>0</sup>C) and Strunga (8,5<sup>0</sup>C).

The annual temperature regimen of the air presents the same characteristics at all the weather stations analysed, with maximum values in the month of July (between 20,2<sup>0</sup>C, at the station Negrești, and 19,5<sup>0</sup>C, at Strunga) and minimum in January (between -4,1<sup>0</sup>C at Negrești and -3,5<sup>0</sup>C at Strunga).

### **III.3.2.3. The atmospheric precipitations**

The multiannual medium values of the atmospheric precipitations vary between 510,9 mm at Negrești at the pluviometric station Băcești 589,0 at Roman and 638,2 at Strunga.

The annual regimen of the atmospheric precipitations has important variations, the monthly medium precipitations knowing an increase, generally from January or February until June, afterwards decreasing until January.

In the conditions in which the vertical drainage and/or lateral are poor or there is recorded an excess of humidity from rain or melting of the snow, when the oxido-reduction processes take place, forming stagnosols or stagnic subtypes of the different soil types.

## **III.4 The role of the hydrologic factor in the pedogenetic processes**

### **III.4.1. Hydrogeological conditions**

The hydrogeologic regimen is characterized by maximum values of the hydrostatic level (NH) in October (over 170cm) and minimum in April (under 120 cm), being strictly conditioned by the pluviometric variations and local hydric.

Based on the data from the topographical maps and over 120 expeditive measures realised on terrain campaigns in April-June 2011 and October 2011, it is noticeable that the depth of the groundwaters, exploited by the fountains and wells by the population, is at about 1-3m at the level of the meadow of the river Bârlad, 3-5 m at the level of the terraces of the river Bârlad and over 5 m at the slopes level.

For the pedogenetic processes and quality of the soils from the superior basin of Bârlad and upstream of Băcești, the groundwater situated at critical depths (1-3m) and subcritical (3-5m) have a great importance.

## **Chapter IV: The Typology and repartition of the soils from Bârlad's upper basin**

### **IV.1. Pedogenetic Processes and the networking with geomorphological processes**

The most characteristic pedogenetic processes in the studied area are represented by bioaccumulation, clay, argiloiuluviere and iluviere, gleyzation and stagnogleyization.

### **IV.2. The taxonomix fitting of the solis according to SRTS**

The taxonomix fitting of the solis was made according to the *Romanian System of Taxonomy of Soils* (SRTS, 2003), according to which in the superior basin of Bârlad were identified 6 soils classes, 11 taxonomic units at type level and 26 taxonomic units at subtype level.

In the studied area the surface of approximately 13000 ha agricultural soils belong to six classes of soil, respectively: the Luvisols class - (38,52%), the Protisols

class 4092 ha (31,48%), the Chernisoils class - 2094 ha (15,95%), the Antrisoils class- 1616 ha (12,43%), the Hidrisoils class 183 ha- (1,40%) and the Pelisoils class-19 ha (0,15%).

### **IV.3. The territorial repartition and the main features of the taxonomic units of soil**

#### **IV. 3.1. The Chernisoil class (CER)**

From these classes in the studied area are present three types: chernozems, faeozems and rendzinic.

##### **IV 3.1.1. Chernozems (CZ)**

Chernozems have a small share, owning just 2,99% from the agricultural surface being spreaded in the meadow of Bârlad close to the village Băcești, in the interriver peak Bozieni-Crăiașa (inferior third towards the confluence) and on the slightly inclined slope situated east from the village of Cuci.

##### **IV.3.1.2. Faeozems (FZ)**

At the faeozems from the superior basin of Bârlad stand out a weak variation of the clay content and of the pH until the depth of 100 cm, after which the values of the clay content drop and those of the pH rise, because of accumulation of the carbonates at this depth. In the case of hummus, there are recorded drops of the values from over 2% in the superior horizon, at under 1% at depths of over 40 cm.

#### **IV 3.2. The Luvisoil Class (LUV)**

Luvisoil represent the dominant soil class from the studied territory, occupying 38,52% from the surface of the agricultural terrains. At the level of this class, there are present two types: preluvosoil and luvisoils.

##### **IV.3.2.1. Preluvosoils (EL)**

Preluvosoils own 16,07% from the surface of the agricultural terrains of the basin, being represented by the subtypes: typical, mollic, stagnic, spreaded mostly on the interriver peak Păltiniș-Băbușa, on the right slope of the valley Fundul Ocea etc.

##### **IV.3.2.2. Luvisoils (LV)**

Are the most spreaded soils of the region, having a share of 22,45% of the surface of the arable terrain, being situated mostly on flat or slightly inclined surfaces, at altitudes of over 350m, in the conditions of a cool climate and relatively humid. The largest surfaces with luvisoils are on the structural plateau Bozieni-Băneasa-Averești and on the interriver peaks that detach towards the south, on the interriver peak that separates the basin of the superior Bârlad from the hydrographic basin of Siret, the biggest part of the middle third of the interriver Poienari-Fundătura, the superior third of the basin of the valley Fundătura etc.

At a subtype level, dominant are the typical luvisols, followed by the white one, stagnic and psamic.

#### **IV.3.4. The Protisols Class (PRO)**

In this class fit the aluviosols and regosols. The protisols class is well represented in the studied area, with a share of 31,48% of the agricultural terrains.

##### **IV.3.4.1. Aluviosols (AS)**

In the superior basin of Bârlad, aluviosols own a share of 14,08% from the total of the agricultural terrains being present in the major river beds of the main rivers the major river beds of the smaller affluents on the right side of Bârlad.

##### **IV.3.4.2. Regosols (RS)**

In the superior basin of Bârlad their share is of 17,4% of the agricultural surface, being met the chalk subtype, especially on the steep slopes of the foreheads of cuestas with a northern exhibition, north-east and west, but also in the superior basins of Bârlad's affluent, associated firstly with erodosols

#### **V.3.5. The Antrisoils Class (ANT)**

From the antrisoils class, in the superior basin of Bârlad are present the erodosols.

##### **IV.3.5.1. Erodosols (ER)**

Erodosols are soils strongly eroded or overburdened as a consequence of the inappropriate anthropogenic intervention, that own 12,43% from the agricultural surface of the studied territory.

## **Chapter V: The Quality and Productivity of the soils with agricultural use**

### **V.1. Physical features- control factors of the quality of the soils**

The analysis of the physical parameters of soil quality include: thickness, structure of the soil, texture and textural differentiation, density and apparent density.

#### **V.1.1. Thickness of the soil**

The thickness of the soil profile, considered until skyline C, has values that fit frequently at the slopes level between 60 and 80 cm, at the interriver peaks level or the structural plateaus 120-140 cm, in meadows and in colluvial glacia 100-120 cm. At the level of the slopes affected by the deluvial processes the thickness of the soils is variable from 30-40 cm and until 100-120 cm. The quality of the soils is affected just at the level of the slopes, the most severe limitations being characteristic to the regosols and erodosols.

### **V.1.2. Structure of the soil**

In the studied area, the majority of the soils have a grainy and gromelural structure in the superior skyline, because of the content of organic material, but also because of the linking elements taken from the parental material (*Vasiliniuc I., 2009*).

In the case of the soils in which, because of the leaching of the clay and accumulation of it processes, in the middle part of the soil profile, the resulted structure is polyhedral angular or prismatic subangular, eventually prismatic-columnar.

### **V.1.3. The texture and textural differentiation index**

The analysis of the soil texture from the superior basin of Bârlad highlights the fact that most part of the territory fits in the groups of middle and textural classes. The framing of most soils in these textural classes represents a consequence of the influence of the geological substratum, mostly made out clay, with sandy intercalations.

The clayey texture, fitted in the middle class accordind to *MESP-1986*, dominating as a surface the agricultural terrains (51,68%).

## **V.2. The Analysis of the chemical parameteres of the soil quality**

The main evaluated chemical parameters for the analysis of the soil quality in the superior basin of Bârlad, are the reaction of the soil, the quantity of hummus, the cationic exchange units and the supply with nutritive elements.

### **V.2. 1. Soil Reaction**

The reaction values in the superior horizon of the soils from the superior basin of Bârlad vary between 5,91 (stagnosoil) and 8,39 (regosoil), with an average of the pH of 7,28. These values of the soil reaction fit between the moderat acid and weak alkaline classes, considered relatively optimum from a quality point of view.

### **V.2.2. Hummus content**

The soils from the superior basin of Bârlad have a hummus content that varies in the superior horizons between 0,09% and 5,89%, the average being of 2,11% which positions the pedological later in the moderate content, but in a weak quality level.

## **Chapter VI: The current way of using the terrain**

### **VI.1. The current use of the terrain**

For the analysis of the current way of using the terrain from the superior basin of Bârlad orthophotoplans from the year 2005-2006 were used, the cadastral plans, the topographical plans, topographical mapps, and the investigations realised in the expeditions.



At the level of the entire basin (year 2006) it was found that the pastures and hayfields, forests and arable terrains have the biggest share, these areas occupying also the surfaces from within the built-up areas (table nr.1).

Table nr. 1.The current way of using the terrains from the superior basin of Bârlad (2006)

Categoria de folosință	Surface (ha)	% from Total
Agricultural Terrains	12999.4	60.29
Arable	6211.0	28.81
Pastures and Hayfields	6387.2	29.68
Vineyards and Orchards	151.0	0.70
Degraded Vineyards and Orchards	250.4	1.10
Non-agricultural Terrains	8558.9	39.71
Forests	6467.0	30.00
Shruberry	221.0	1.02
Non-productive Terrains	277.0	1.28
Lakes and Ponds	19.9	0.01
within the built-up areas	1575.0	7.30
TOTAL	21558.3	100.00

In the year 2010, the agricultural terrains from the superior basin of Bârlad occupied a surface of 12999,4 ha, representing 60,29% from the total surface (table nr.1). In the agricultural terrains the pastures and hayfields have the biggest share (29,68%), followed by the arable (28,81%), very small shares being owned by degraded vineyards and orchards (1,1%), followed by the actual vineyards and orchards(0,7%).

*The arable terrains* have the biggest spreading north of the valley of Bârlad, occupying structural plateaus, interriver peaks, revers of cuesta slopes (in the biggest part) and the better drained sectors of plains.

*The pastures and hayfields* occupy the biggest surface (6387,2 ha–29,68%); they are generally specific to the moderately and strongly inclined slopes, but big surfacea are also found in plains.

*The vineyards and orchards* used to occupy quite big surfaces in the superior basin of Bârlad before the laws concerning the retrocession of the terrains, getting up to 401,4 ha(1,8%). In the present, the surface has reduced to less than half (151 ha), most of it being in different stages of degradation.

## VI.2. The framing of the soils in quality classes

The map of the quality classes for the agricultural soils from the basin reflects predomination of the quality classes IV and III, with a share of 71,36%, from the total of the agricultural terrains).

The soils from quality *class I* included terrains that engage very well to arable, with a middle texture, very well supplied with nutritive elements, that offer very good conditions for the development of culture plants. These terrains own a very small share from the studied area (0,08%).

*The second quality class* frames soils good for agricultural cultured, with very limited given by the slide, by the depth of the groundwater level. These terrains own a share of 7,13% from the surface of the agricultural terrains and correspond in the biggest part to the aluvial plains, which are specific to the aluviosols, to some sectors from the structural plateau Bozieni-Băneasa-Averești occupied by preluvosoils and luvosoils.

Soils from the *IIIrd quality class* own a share of 29,38% from the agricultural terrains of the superior basin of Bârlad, gathering the terrains with a middle suitability with restrictions imposed by the slope, surface erosion, landslides or stagnoglezation. The soils of this class are spreaded on the structural Bozieni-Băneasa-Averești plateau, on the reverse of cuesta slopes, on both slopes of valley Fundătura, downstream of the village Holm, in the meadow and left slope of the valley Bozieni etc.

The soils that fit into *quality class IV* occupy 41,96% of the agricultural surface, gathers terrains with severe limitations caused by surface erosion, slope and landslides, flooding, gleyzation degree, compaction degree.

The *Vth quality class* owns 12,47% from the agricultural terrains of the superior basin of Bârlad and includes the terrains with severe limitations which reduce the range of the crops or need measures or special works of protection, conservation and improvement of the soil resources.

## **Chapter VII Conclusions**

The specific characteristics of the superior basin of Bârlad can be grouped in more categories :

*1. The analysis of the geomorphometrical parameters* highlights a series of definitory aspects for the studied territory:

- the altitude of the landscape varied between 140 m (minimum value) and 466 m;
- the slope of the landscape fits between very wide limits (0 and 40°), while the slopes orientation is diverse, but in a close relationship with the major lines of the landscape;
- the monoclinial structure of the geological deposits, the orientation and evolution of the hydrographic network highlighted the morphostructural assymetry of order I (foreheads of cuesta with northern and north-eastern orientation) and the one of order II, which generated the western orientation cuestas.

*2. The study of the types and landforms* shows a series of features specific for the studied area:

- the types of representative landforms are those of the structural and sculptural landscape developed in the generally monoclinial structure;
- the hard geological formations (chalk, sandstone-chalk or sandstone), have favored the conservation of some structural surfaces such as structural plateaus, structural witnesses and the valley structural shoulders'.

*3. The current geomorphological processes* are dominated by landslides, followed by surface erosion and depth erosion.

Landslides have a very big share (over 50% of the surface studied).

The surface occupied with active landslides has constantly reduced in time, because of the warmer climate. Today, it occupies only 444 ha, in comparison with the surface of 2317 ha, that they used to own after a period with greater precipitations between 1969 and 1973.

*Surface erosion* is omnipresent, if we take into consideration that 85% of the territory of the superior basin of Bârlad had slopes whose declivity exceeds 3°.

*Depth erosion* is poorly represented, although the sectors with sandy facies have favored the installation of some of the most spectacular forms of linear erosion.

4. *The soils wrap* is typological diversified, but affected by multiple degradation processes, natural or anthropogenic, as an effect of the overall physical and geographical conditions and the anthropogenic intervention.

According to the SRTS 2003, in the superior basin of Bârlad were identified 6 soil classes, 11 taxonomic units at a type level and 26 taxonomic units at a subtype level.

The biggest share in the basin have it the *luvisoils* that own 38,52% of the agricultural surface, after which come the *protisoils* with 31,48% and the *cernisoils* with 16,02%. *Antrisoils* occupy 12,43% of the surface, and the lowest shares have the *hidrisoils* with 1,40% and *vertosoils* with 0,15%.

5. *The quality of the soil* was approached also through the physical and chemical properties.

The analysis of the physical and chemical parameters of the soils, highlights the superior quality of the chernozems, faeozems and aluviosoils, intermediary qualities owning the preluvisoils, luvisoils, while the regosoils and erodosoils stand out by an extremely poor quality.

6. *The current use of the terrains* represents the natural consequence of the physical and geographical conditions and the anthropogenic pressure over the territory. The agricultural surfaces from the superior basin of Bârlad occupy a surface of 12999,4 ha representing 60,29% of the total surface of the basin, and the non-agricultural terrains own 8558,9 ha, which represents 39,71% of the total. From the agricultural categories dominate the pastures and hayfields (29,68%) and the arable (28,81%), and from the non-agricultural are relevant the forests (30%).

7. *The quality of the agricultural soils* is medium (IIIrd class) and poor (IVth class). The biggest part of the territory (71,36%) fits into the quality classes III and IV, that impose restrictions concerning the using as arable.