

Research on Soil Resources of the NorthWest Part of the Cracau-Bistrita Depression for Sustainable Agriculture

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Cracau-Bistrita Depression it belongs to the investigated it is a unique physical geographical unit within Moldavian Subcarpatians, which occupies the center of the groove subcarpathic between Moldova and the Trotus Rivers. In geological terms we refer territory corresponds to a restricted part of the Moldavian Platform appears as an extension to the southwest of Russian platform. Geological rocks that are part of the northwest Cracau-Bistrita Depression parent materials generated relatively differentiated by features and nature that can be eluvial, colluvial and alluvial. After compiling size, they are made of clay and marly clay, sand, alluvial deposits. The main pedogenetic processes which led to differentiation and the formation horizons of soil the soil cover of the northwest Cracau-Bistrita Depression may be mentioned bioaccumulation, clay migration, argillisation, gleyzation and stagnogleyization. Ensemble pedogenetic factors and pedogenetic processes specific area led to the formation of a coating on the ground floor consists of relatively varied protisols, cernisols, cambisols, luvisols, hidrisols and antrisol. Of these, the largest share is occupied by cernisols. Arable land suitability is limited by several factors, of which the most important are considered the soil, topography and drainage. So outstanding were six classes of land: from those with very good suitability for field crops, without restriction, to land that can be used only for forests as those from nearby watercourses due to flooding. Misuse of the land has led to extreme natural phenomena, considered risks that go to produce immense damage by reducing agricultural production. I particularly physical, chemical and complex risks. Most worthy of notice covers the main physical and chemical properties of soil and land degradation by destroying the soil. In order to eliminate the negative effects of limiting factors of agricultural production, reducing risk and thereby improving the productive potential of the northwest Cracau-Bistrita Depression were proposed a series of works agropedoameliorative such as regulation of water and embankment works, paper land on the contour and avoiding weeding plant cultivation on slopes, erosion control works and avoid prolonged grazing early spring or fall, ripping papers for land compacted or affected by excess moisture.

Keywords: *pedogenesis, classification, morphological characteristics, physical, hydro and chemical properties, sustainable agriculture*

Investigated area is located in the eastern half of the country, in the county Neamt and belongs Moldavian Subcarpathians, Cracau-Bistrita Depression is one of the largest depressions in the relief unit [2, 23, 38].

The northwest part of the Cracau-Bistrita Depression is among the regions that the diversity of the natural components ensure users obtain optimal agricultural production and income, especially if harnessed effectively, economically and environmentally existing technologies.

A productive agriculture is essential prerequisite for sustainable development of agriculture with multiple objectives, to reduce poverty and improve livelihoods, with preserving and protecting the natural resource base.

All these are not possible without special research, extensive and often lengthy.

On this importance is the territory under study dealing extensively formation, development, spread soil in the territory, morphological description of soils and the main physical, hydro and chemical, suitability natural environment for agriculture of the region and agropedoameliorative requirements [8].

Closely related to training, development and distribution of land in the territory, was intended at the outset how the appearance of each factor in the complex territory, analyzing the row structure, dynamics and function of each of them, as their role directly or indirectly in the genesis and land development.

Since the economic efficiency of agriculture is not possible without the use of all factors of landscape, I made reference to land suitability for agriculture. Thus, they considered physical properties, hydro and organic soils in all pedologic reported to the various categories of agricultural use [21].

Overlapping boundaries of this territory west of contact between geological formations of the Miocene flysch subcarpathic and oscillates between altitudes of 500-550 m over the entire frame mountainous north and east of Cracau meandered course and south course Bistrita.

In geographical research focus on detailed knowledge of the dynamics of the landscape. The researches carried out [1, 4, 9-11].

Referring to researches soil and pedogeographic on depression, this has been achieved for the first time in [12].

From 1991 to undertake a series of studies and researches soil to afford new data on soil cover in this part of the country. Scientific papers that relate to soil properties from depression, have published some researchers [18-20, 29, 30].

Particularly important for soil survey has spread knowledge of the main lithological units that directly influence features parent material.

Carpathian molasses deposits have undergone many changes during evolution depression under the influence

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of exogenous and biotic factors, but certain features were preserved until now.

Morphogenesis processes mobilized these formations that parent materials not conserve all their properties. Closely related to training, development and distribution of land in the territory, to supervise the occurrence of each pedogenetic factors as direct or indirect role in the evolution and genesis of soils.

Overall, physical-geographical factors specific northwest part Cracau-Bistrita Depression led to the formation of a complex soil cover quite strongly differentiated from each other. Since the economic efficiency of agriculture is not possible without harnessing all environmental factors, I referred to the suitability of land for agricultural use of soil resources.

Experimental part

Materials and methods

The primary unit of basic research and mapping of soil cover was the soil profile, which allowed studying morphological characteristics of the soils and some feedback on their fertility. As a result, soils were classified based on their intrinsic properties respectively soil profile, considering horizons and diagnostic characteristics [31].

The profiles were located on the ground so as to form a network of points studied. The methods used beams parallel routes located almost equidistant to cover more or less evenly across the work surface, as well as the method circuit territories with rugged terrain and soil cover relatively complex, without a network paths.

Pedological mapping was performed at 1: 10.000, using topographic maps with contour lines and soil map sheet Piatra Neamt, scale 1: 200.000.

Determining the number of primary and secondary profiles is envisaged category of complexity and scale soil map. The study falls into the category of complex a-II-a and pedological mapping was performed at 1: 10.000.

They opened 25 soil profiles depths ranging from 1-2 m, in which soil samples were collected from numerous genetic horizons of soil, the thickness is not larger than 20 cm.

There have been made proposals then slips samples of tests to be performed (granulometric composition, the bulk density, the permeability, the content of humus, reaction pH, the base saturation degree, total nitrogen, phosphorus, potassium, etc.) [32].

The morphological description of soil profiles was done according to the Romanian System of Soil Taxonomy (SRTS, 2003, 2012), ICPA, Bucharest [14]. In order to establish the soils diagnosis, their morphological features have been taken into account, namely the thickness of morphological horizons, color, texture, structure, composition, adhesion, etc. Soil samples were taken from genetic horizons both in modified and unchanged settings.

In modified settings, soil samples of 20 cm thickness were taken in bags, for the chemical characterization to be carried. In natural (unchanged) settings, soil samples were taken using a metal cylinder of known volume (200 cm³), to characterize the physical and hydro-physical features, as well as the momentary soil moisture.

The analytical methods used for determination of physical, hydro-physical and chemical

Particle size analysis (granulometry)

- pipette method for fractions <0.002 mm, including;
- wet sieving method for fractions from 0.002 to 0.2 mm and dried sieving method for fractions > 0.2 mm.

For the the textural classes and subclasses, we used the Romanian system, according to the Methodology developed for soil studies, ICPA, 1987 [39].

Bulk density (DA) method: metal cylinder of known volume (200 cm³) for the momentary soil moisture [6].

Total porosity (PT): by computing $PT = (1-DA/D) \cdot 100$

The coefficient hygroscopicity (CH): drying at 105 °C of a sample of soil moistened in advance in equilibrium with an atmosphere saturated with water vapor (in the presence of a solution of H₂SO₄-10%) - % by weight (% g/g).

Withering coefficient (CO): by calculation, by multiplication with 1.5 coefficient hygroscopicity, determined by the method of modified Mitscherlich - % by weight (% g/g).

$CO (\%) = 0,05 + 0,35 A$, where:

A = clay content < 0,002 mm

Total water capacity (CT): by calculation from the formula $CT = PT/DA$, % by weight.

Useful water capacity (CU) by calculation:

$CU = CC - CO$, % by weight.

Field capacity (CC). This can be determined by the direct method using the platform or the estimated indirect way. On indirect way are several possibilities:

- based on texture and bulk density;
- on the basis of equivalent moisture and bulk density;
- on the basis of the suction curve (measured on samples with the alignment unchanged).

Water permeability (K) is determined by several methods, one of which, in the laboratory on samples with unchanged alignment, taken in the metal cylinder, the method I.C.P.A.

Organic matter (humus) determined by volumetric method Walkley - Black wet oxidation after the change Gogoasa (Stoica et al., 1986) [36].

Total Nitrogen (Nt): Kjeldahl method disintegration H₂SO₄ at 350 °C, a catalyst of potassium sulfate and copper sulfate.

Phosphorus accessible (P mobile): method-Riehm-Domingo and dosed with colorimetric molybdenum blue method after Murphy-Riley (reduction with ascorbic acid).

Potassium (K mobile) accessible: after extraction method Egner-Riehm-Domingo and determination by flame photometry.

pH: potentiometric, determined the combined glass electrode and a calomel, in aqueous suspension the soil/ water ratio of 1/2, 5.

Sum of bases (SB): extraction using 0.05 n hydrochloric acid (Kappen-Schofield- Chirita method).

The base saturation degree (V%) and total cation exchange capacity (T me/100 g soil), by calculation.

Hydolytic acidity (Ah me /100 g soil) was determined by extraction with 1 N sodium acetate solution buffered to pH = 8.3.

Total cation exchange capacity (T me/100 g soil) was determined with the following formula: $T (\text{me}/100 \text{ g soil}) = SB + Ah$

Interpretation of the results has been submitted in accordance with *Methodology developing soil studies*, ICPA Bucharest, 1987, provided for in current legislation on the subject [39, 40].

The main sources used to develop the map soil parent material from northwest Cracau-Bistrita Depression are topographical maps, scale 1:100.000 with callsigns L-35-29; L-35-41; soil map, scale 1: 200.000, sheet Piatra Neamt [13, 41].

To identify the boundaries of the northwest Cracau-Bistrita Depression were consulted in addition to topographical maps, relief units developed by Badea L. and Posea Gr. (*Regionalization geomorphological*) and

information on the *Geography of Romania*, Vol. IV, 1987 [3, 27].

General physical and geographical elements (river, odds elevation, localities) were taken by vectorization of topographic map.

The areas covered by different soil types were grouped in classes taken by tracing the soil map. Subsequently vectorisation using soil map legend, demarcated areas textural classes. The projection system used was 70 Stereo. System were georeferenced topographic and soil maps.

The program maps used to achieve the parent material of the soil, the soil cover, after the suitability of arable land group was ArcView GIS. Digitization geographical elements type areas of land became a subject polygon using as a working soil map, scale 1: 200.000, sheet Piatra Neamt, spatially referenced projection Stereo 70 for overlapping elements physical and geographical statements topographic map [13].

Results and discussions

Since geologically investigated area belongs Moldavian Platform which is an extension to the southwest of Russian Platform. This is made up from the Sarmatian deposits and in deep deposits Neozoic, Mesozoic and Paleozoic. Southwest platform sank well below molasse and Carpathian flysch [41].

Quaternary presence through Pleistocen, higher Pleistocen, holocen lower and upper holocen. Eegarding Pleistocene, it consists of sands, gravels and loess-like deposit, widespread on the roof of the Cracau high altitudes between 35-40 m and 75-90 m and between.

After the granulometric composition, the parent materials consisting of clays and marly clays, sands, argillaceous marly, local gravels, loess-like deposit and alluvial deposit (fig. 1).

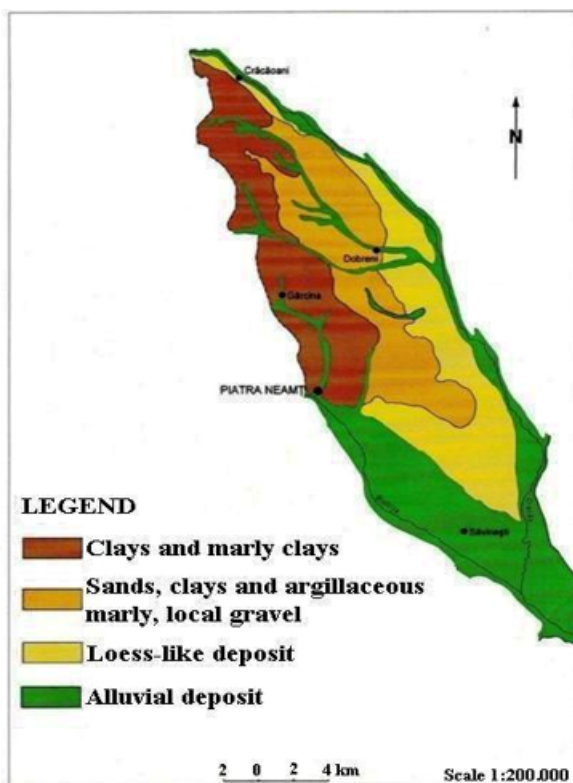


Fig. 1. Map parent material soil of the northwest Cracau-Bistrita Depression [41]

Clays and marly clays they are dominant in the western part of the basin bordered by mountain peaks of Massive Stanisoara and Gosman. Further eastward, passing for less homogeneous material, in addition to clay and marly clays on narrow ridges, some sands and gravels. On larger areas meet loess material which covers the surface of the main decking bridges, plus alluvial deposits Bistrita Floodplain and the Cracau (fig. 2) [16].



Fig. 2. Loess-like deposit terrace middle Bistrita

The thickness of these materials is quite uneven, being present at some local day gravels less run. Cracau-Bistrita is in Moldavian Subcarpathians, which occupies the central part of the groove subcarpathic between Moldova and Trotus rivers.

In the northwest basin Cracau-Bistrita differentiate two genetic types of relief namely: river denudational and fluvial [26, 27].

Relief river-denudational. Erosion processes and denudational processes they had the main role in the formation and evolution interfluvies and slopes [24, 25].

In a territory development have denudational interfluvie. They show in most cases a matter of rounded peaks and gently sloping plateaus. The area that we covered, peaks are generally oriented northwest-southeast, are relatively narrow and has a slope slowly falling especially for Cracau Valley (fig. 3).



Fig. 3. Interfluvies Horaita-Cracau between Poiana and Oslobeni

Relief fluvial has a considerable development in the northwest Cracau-Bistrita Depression. Thus, we can say that more than half of the study is fluvial origin, being located mainly on its east and the confluence of two rivers Cracau-Bistrita. The relief is represented by the floodplain and terraces (fig. 4) [37].

Floodplain is the youngest relief river Holocene age. The range extension have Bistrita Floodplain and the Cracau, whose altitude varies between 1-2 m. Bistrita Floodplain widths of up to 4 km and it is accompanied on the left of

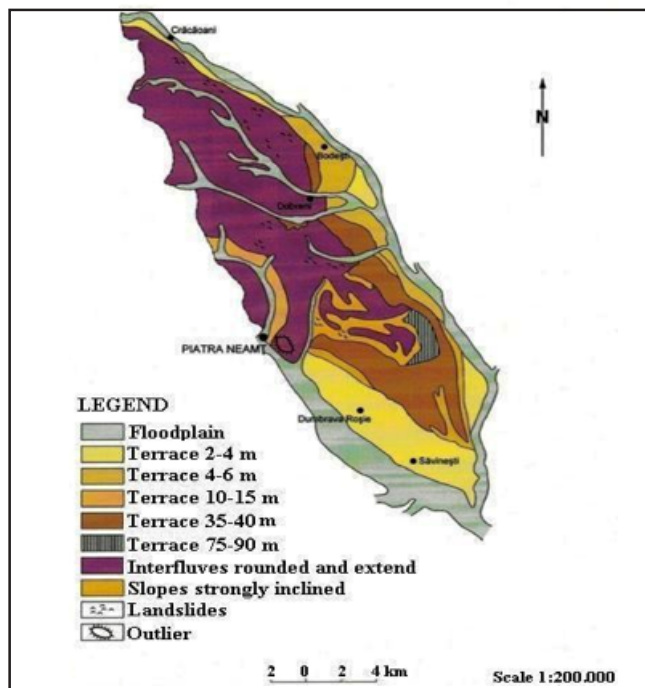


Fig. 4. Map relief of the northwest Craiacu-Bistrita Depression (Posea et al., 2005) [28]

10-15 m terrace which gradually decreases to 3-4 m (at Podoleni).

The terraces have a large development in the territory. There were great many levels as follows:

- Terrace 2-4 m occurs discontinuously right left Craiacu and widely developed Bistrita, where widths which can exceed 2 km. In general, her forehead is evident downstream Savinesti.

- Terrace 4-6 m is present only just right Craiacu from Bodești downstream to Caciulești.

- Terrace 10-15 m can be seen on the left Cuișdii. It is located on the bridge district Darmanesti City of Piatra Neamt.

- Terrace 35-40 m terrace is representative right Craiacu, but may be considered terrace confluence.

- Terrace 75-90 m, the highest level meets only the right Craiacu north of the town of Springs.

Among current geomorphological processes, we can mention: bed processes, accumulation processes, surface erosion, deep erosion and landslides.

Bed processes have a high intensity river Craiacu as the main tributaries thereof and is reflected by the sides collapses, the formation of islands, meander, etc. These dynamic processes do not allow solidification of sediments that are constantly reshaping, regardless of the flow of rivers.

Accumulation processes is reflected by the deposit of silt in the major bed during floods and greater intensity on Craiacu, Horaita and Almas.

Surface erosion affects the destruction of soil horizons and geo-morphological integrity of the slopes. Present more evident peaks interfluvial separated Horaita and Almas Valleys.

Depth erosion is present everywhere in the territory where it causes the formation of gullies, oas and ravines (fig.5). The affected fields occur around the mountain landscape of the western end of the territory, with steep slopes, in the presence of miocene formations with a textured change.

Landslides affecting slope stability must be regarded as dynamic equilibrium processes. Towards the western end of the basin, landslides affecting all the massive hills, more preferably from the Craiacu and Horaita, where spread

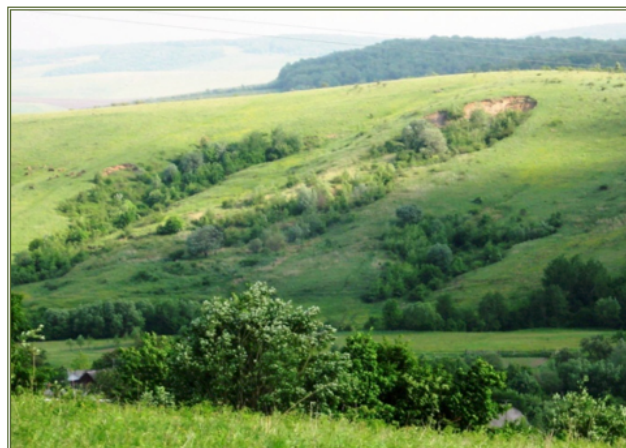


Fig. 5. Geomorphological processes slope to Oslobeni with added clays and Miocene marls and higher density of the drainage (fig. 6).



Fig.6. Landslides west of town Critei

Studied area is drained by rivers Bistrita and Craiacu which springs in the Carpathian Mountain region, and a number of their tributaries they receive after entering the Carpathian region (fig. 7).

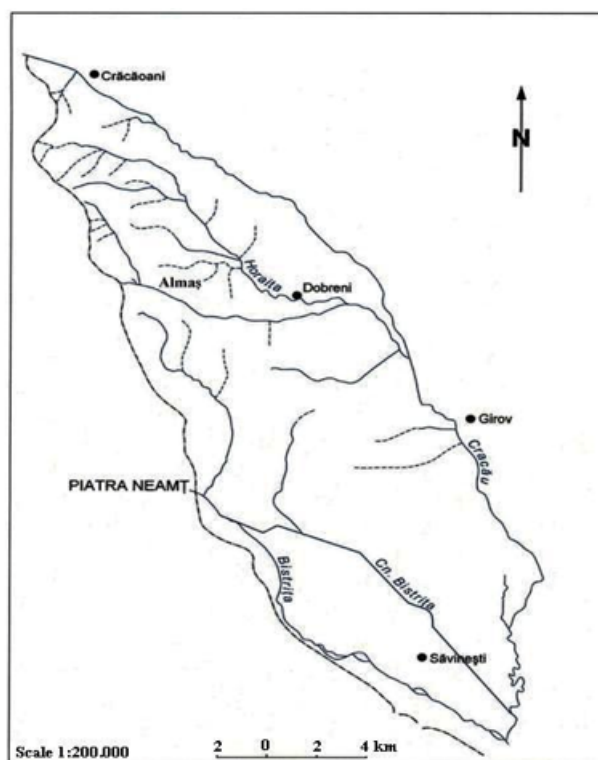


Fig. 7. Map hydrographic network of the northwest Craiacu-Bistrita Depression [15]

Bistrita River is a river in Romania flowing from Rodnei Mountains from 1850 m altitude, crossing the Eastern Carpathians and flows into the Siret downstream of Bacau.

Until the entry into depression, Bistrita change several times the flow direction only from Piatra Neamt downstream, it becomes northwest-southeast thereby maintaining flows into the Siret, but with a very pronounced meandering coefficient (fig. 8).



Fig. 8. River bed Bistrita in Cut locality

Cracau River springs from Stanisoara Mountains and generally follows a flow direction northwest-southeast to its mouth in Bistrita, after many meander (fig. 9).



Fig. 9. Cracau River out of the mountains to Cracaoani

Northwest Bistrita-Cracau Depression belongs forest zone namely deciduous forest. Woody vegetation consists of forests *Fagus sylvatica*, *Quercus petraea* and *Carpinus betulus* and meadows which are generally mesophilic type.

In forming the soil cover in the northwest Cracau-Bistrita Depression a very important role was played by the climate, vegetation, topography, parent material and all local groundwater and water stagnation.

The main pedogenetic processes under the effect of environmental factors lead to the differentiation of horizons of soil and the formation and development of the soil cover of the northwest Cracau-Bistrita Depression may be mentioned: bioaccumulation, clay migration, alteration, gleyization and stagnogleyization [7].

The assembly pedogenetic factors and processes led to the formation area on the ground floor of a relatively varied coating consisting of protisols, cernisols, cambisols, luvisols, hidrisols and antrilsols (fig.10) [17, 33].

Protisols. Embedded soils in this class are not fully developed, young, emerging as ethnic aluviosols, eutric, gleyic, lithosols and rocks.

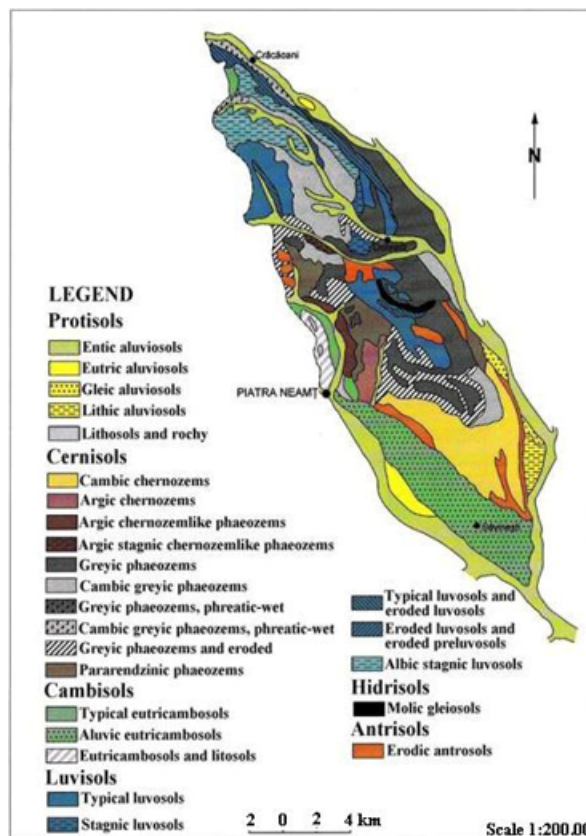


Fig. 10. Map soil of the northwest Cracau-Bistrita Depression [13]

Ethnic aluviosols are spread floodplain Cracau-Bistrita, as well as their main tributaries. Presents a varied texture from sandy to clay. The humus content rarely exceeds 1%. In most enthic aluviosols have low fertility. They are used in the culture timber (*Populus sp.* and *Salix sp.*) and the crop (vegetable crops, pasture and hay) [34].

Lithic aluviosols appear local quite floodplain Cracau downstream from Caciulesti, not cultivated because of low depth which is gravel. Presents a profile of type *Ao-AR-R* moderately developed.

These soils are similar to those distric, but the horizon R, frequently consisting of gravel, whose upper limit is between 20 cm and 50 cm depth (fig. 11).

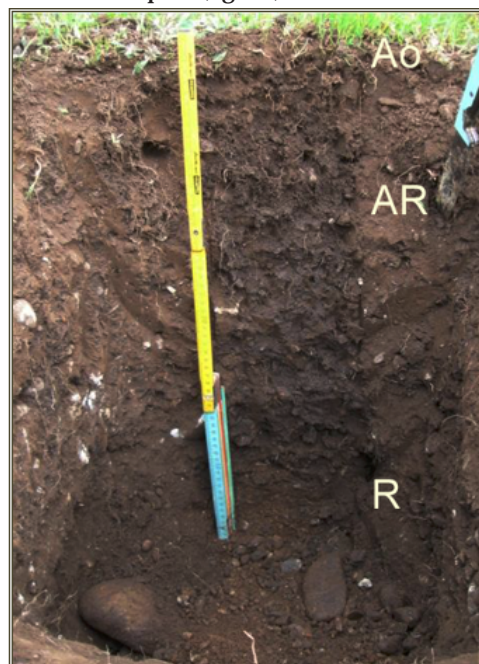


Fig. 11. Lithic aluviosols on the lower terrace of Bistrita in Dumbrava Rosie (Stanila, 2017)

Cernisols are represented by cambic chernozems, argic chernozems, argic phaeozems, stagnic phaeozems, greyic phaeozems, greyic cambic phaeozems, including eroded and pseudorendzinas.

Cambic chernozems only on the spread confluence terrace Cracau-Bistrita of 35-40 m relative altitude on loess-like deposit.

Presents a profile of type *Am-AB-Bv-Cca* developed. Have a texture loam-clay-loam, clay content < 0.002 mm is between 26-36% in horizon Am and can climb to 40% in AB and Bv horizons (table 1). The bulk density shows values that exceed 1.40 g/cm³ and the total porosity of 46-56% reach values. Regarding withering coefficient rarely exceeds 11%, the field capacity capacity ranges between 25-32% and useful water capacity it has values of 13 to 21%. Their good permeability ranging from 10 to 21 mm/h.

Generally cambic chernozems the reaction have slightly acidic pH (6.3 to 6.8) and a low humus content (2.4-3.0%). The bases are saturated (85-100%) and has a good supply of nutrients (N, 179%; P, 28 ppm; K, 98 ppm) (table 2) [5].

They can be used especially in agriculture. Good results give the culture of wheat, barley, maize and sugar beet.

Argic chernozems are widespread in the southern half of the territory north of Piatra Neamt within certain heights interfluvial relatively flat and fairly well drained.

It is characterized by a profile of type *Am-AB-Bt-Cca* approx developed. Argic chernozem soils are differentiated texture profile as a result of migration clay. The surface of the humus content is 2.6-3.1% and decreases in the profile. For the supply of nutrients, it shows poor nitrogen, phosphorus and very good potassium.

Argic chernozem soil fertility fall into the category of medium, the cultivation of cereals (wheat and maize), oil plants (sunflower) and legumes (alfalfa and clover). Only associated with the use of the mineral organic fertilizer nitrogen and phosphorus could improve the fertility of these soils.

Argic chernozemlike phaeozems were formed under a cooler and wetter climate specific forest area. Appear terrace Cuejdiu. Presents a profile of type *Am-AB-Bt-Cca* moderate developed. They have a texture loam-clay (20-

32% clay horizon surface). Contain from 3.5-5% humus, maintaining more than 1% below the depth of 100 cm. They are supplied with nutrient medium.

Argic chernozemlike phaeozems have a high potential fertility due to high humus content, and relatively favorable physical properties. Used with good results for both grain and for industrial plants.

Pseudorendzinas meet on large surfaces just north of Piatra Neamt, in terms of inter-grown hills or meadows and in the forest. Were formed on marly clay, marly.

Luvisols are represented by preluvisols and luvisols, the last with a wide range of subtypes: typical, albic, stagnic and eroded.

The *typical luvisols* appear in the upper basin of the Almas Valley, northwest of the town of the same name, in the hills north of Dobreni, between Sarata and Gura Vaili.

Typical luvisols presents a profile type: *Ao-Elv-EB-Bt-C* developed. Textured sandy loam in horizon Ao (22.7% clay) and gets clay loam in horizon B argic (40.4% clay).

The bulk density shows values that exceed 1.50 g/cm³ and the total porosity of 10-24% reach values. Regarding withering coefficient rarely exceeds 28%, the field capacity ranges between 7-15% and useful water capacity it has values of 7 to 17%. The permeability shows a value between 0.2 to 4 mm/h (table 3).

Generally typical luvisols the reaction have slightly acidic pH (5.8 to 5.9) and a low humus content (1.3 to 2.5%).

The base saturation degree have values 78% within the horizon Ao. The supply of nutrients is not satisfactory in terms of nitrogen (100-110%) and potassium (100-110 ppm), but the means (20-36 ppm) in terms of phosphorus (table 4).

Albic stagnic luvisols are spread the northern half of the territory, occupying large areas on peaks higher interfluvial Cracau-Horaita Valleys between Almas.

Presents a profile type: *Ao-Eaw-EBw-Btw-Bt-C*.

Has a differentiated profile texture: sandy-loam in horizon Ao and Ea, but the profile is medium-fine.

Under forest exhibit high humus content (10-18%), while in the culture was roughly 2%. The nutrients present modest values.

Table 1
PHYSICAL AND HYDRO-PHYSICAL DATA ON CAMBIC CHERNOZEMS

Horizon	Depth (cm)	Granulometric composition				Physical and hydro-physical properties						
		<0,002 mm	0,002-0,02 mm	0,02-0,2 mm	0,2-2 mm	DA g/cm ³	PT %	CO %	CC %	CU %	CT %	K mm/h
Ap	0-17	38.8	33.1	28.1	0.0	1.19	56	12	32	20	47.1	98.0
Aph	17-30	37.8	34.2	28.0	0.0	1.40	48	11	26	15	34.3	-
Am	30-45	40.0	33.8	36.2	0.0	1.41	48	11	25	14	34.0	-
AB	45-62	39.0	32.1	28.1	0.0	1.44	46	11	25	14	32.0	-
Bv ₁	62-82	37.7	32.5	29.8	0.0	1.44	46	10	24	14	32.0	-
Bv ₂	82-112	37.3	35.0	29.7	0.0	1.44	46	9	24	14	32.0	-
Bv ₃	112-140	32.8	35.0	32.2	0.0	1.44	46	9	24	15	32.0	-
Cca	140-170	32.3	33.2	34.5	0.0	1.36	51	9	27	18	37.5	-

Table 2
CHEMICAL DATA ON CAMBIC CHERNOZEMS

Horizon	Depth (cm)	pH (H ₂ O)	Humus %	SB me/100 g sol	T me/100 g sol	V %	Nt %	P ppm	K ppm
Ap	0-17	6.3	3.0	18.8	21.1	89.1	0.179	28	98
Aph	17-30	6.5	3.0	18.9	21.3	88.7	0.169	14	87
Am	30-45	6.8	2.4	19.4	20.5	85.1	0.154	3	108
AB	45-62	7.2	2.1	19.7	21.1	93.4	0.138	3	108
Bv ₁	62-82	7.2	1.9	19.2	20.0	96.0	-	-	-
Bv ₂	82-112	7.2	1.2	18.1	18.8	96.3	-	-	-
Bv ₃	112-140	7.4	0.9	17.4	18.8	97.6	-	-	-
Cca	140-170	8.1	0.8	14.7	17.8	100.0	-	-	-

Table 3
PHYSICAL AND HYDRO-PHYSICAL DATA ON TYPICAL LUVOSOLS

Horizon	Depth (cm)	Granulometric composition				Physical and hydro-physical properties						
		<0,002 mm	0,002-0,02 mm	0,02-0,2 mm	0,2-2 mm	DA g/cm ³	PT %	CO %	CC %	CU %	CT %	K mm/h
Ao	0-20	22.7	35.5	41.3	2.5	1.46	10	23.0	15.3	7.7	30.2	4.0
Elv	25-37	25.2	35.0	40.4	6.4	1.45	11	23.0	14.3	8.7	22.6	2.0
EB	40-52	30.4	30.1	33.4	6.1	1.50	12	24.0	11.4	12.6	25.2	1.0
Bt ₁	53-79	40.4	28.4	29.7	1.5	1.65	18	26.0	7.7	18.3	28.0	0.2
Bt ₂	79-106	43.7	25.6	29.0	1.7	1.56	17	28.0	11.0	17.0	28.0	0.2
Bt ₃	106-131	37.9	29.4	30.9	1.8	1.58	18	27.0	10.5	16.5	24.0	0.3
Bt ₄	131-200	37.3	28.8	28.8	2.0	1.69	24	26.0	10.3	15.7	23.4	0.2

Table 4
CHEMICAL DATA ON TYPICAL LUVOSOLS

Horizon	Depth (cm)	pH (H ₂ O)	Humus %	C/N	T me/100 g sol	V %	Nt %	P ppm	K ppm
Ao	0-20	5.9	2.0	12.1	15.8	78.3	0.109	36	102
Elv	25-37	5.6	1.3	11.0	15.4	70.2	0.078	10	100
EB	40-52	6.5	1.0	10.1	20.6	71.5	0.064	-	-
Bt ₁	53-79	6.4	0.5	-	27.1	84.4	-	-	-
Bt ₂	79-106	6.6	-	-	-	85.2	-	-	-
Bt ₃	106-131	6.8	-	-	-	-	-	-	-
Bt ₄	131-200	7.0	-	-	-	-	-	-	-

Cambisols are represented by typical eutricambosols, gravel shallow, and in association with lithosols.

Typical eutricambosols appear right Cuediu Valley north of Piatra Neamt under a hilly peaks rounded and extend the parent materials clay, carbonate weak nature delluvial.

Presents a profile of type *Ao-AB-Bv-Cca* moderately deeply developed.

They are covered forest, but are also used for agricultural purposes, it is planted with maize, potatoes, vegetables and fruit trees.

Eutricambosols on river gravel deposits at shallow meet only 2-4 terraces of Bistrita downstream of Piatra Neamt, under a relatively flat relief to parent materials such as alluvial, fine gravel made of rolled material mixed with medium fine, clay loam.

These soils are predominantly skeletal, high permeability.

It has a slightly acidic-neutral reaction, they are poor in humus and nutrients and low fertility. Currently used mainly for grazing.

Eutricambosols and lithosols

The presence of complex soils in this area is due to the non-uniformity of both the relief and the parent material.

Identified continuing typical eutricambosols, right Cuediu Valley under a slightly steep hilly slopes, mostly wooded.

Hidrisols. Included in this class are those soils that were formed and evolve under conditions of excess moisture coming from the ground water permanently. In the territory they are represented only by mollic gleisols on alluvial deposits.

Appear scattered along a valley, whose origin is Hill Balaurului, beneath which is outlined, moving through Popesti to get to confluency with Cracau.

Alluvial parent material is likely, the water table is situated at a depth between 0.5-1.0 m.

In forming gleisols contributed gleyzation caused by excessive groundwater wetting and bioaccumulation.

Presents a profile of type: *Am-AGox-Gr*. The texture of these soils is dominated clay loam.

They have a high humus content (5-10%), pH reaction a neutral-weakly alkaline.

Because of their regime aerohidric poor and low microbiological activity, fertilising elements are hardly mobilized, so that their culture is rather difficult agricultural plants. Currently we are successfully used for pasture.

Conclusions

Local especially in the central and southern territory, land suitability is limited by certain factors, for which the areas under cereal plants, in some crops (maize, barley, sunflowers) inadequate low yields are obtained compared with the surrounding areas [35].

Some restrictive factors of agricultural production can be considered the soil, relief and the drainage.

Soil factors

The composition of predominantly fine particle size (clay loam) both in the upper horizon and the profile, and determining the textural differentiation in other cases a too high soil moisture, a satisfactory aeration.

The settlement is part of a restriction that comes with texture to enhance limitations. Of great importance in achieving good results must be considered reserve humus production. Erosion occurs as a limiting factor in terms inclined slope relief and significantly reduce agricultural production (fig. 12).

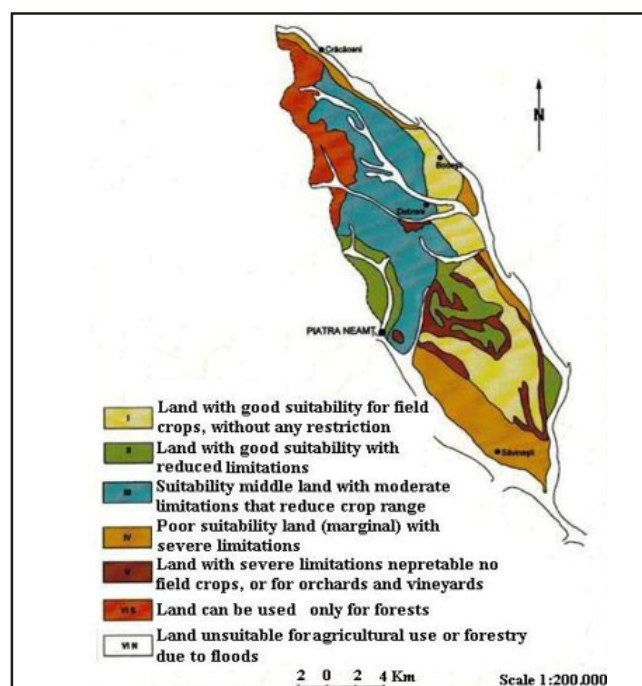


Fig. 12. Map group on the use of arable land after the suitability of the northwest Cracau-Bistrita Depression (Stanila et al., 2017) [13]



Fig. 13. Barley crop on the upper terrace of Cracau at Girov



Fig. 14. Rape culture at Dochia

Relief factor

This limited arable land suitability by its unevenness, an exhibition of land and steepness, the intensity of the current geomorphological processes.

Drainage factor

Depending on the nature and intensity of production factors have particularly restrictive for the following categories of suitability to agricultural use:

- Class I - land with good suitability for field crops, without any restriction. It refers to the part of the terraces Bistrita and Cracau (fig.13, 14).

- Class II - land with good suitability with reduced limitations; the deficiencies can be addressed by damming Cracau.

- Class III- suitability middle land with moderate limitations that reduce crop range; to prevent degradation special investments are needed.

- Class IV - poor suitability land (marginal) with severe limitations (low edaphic volume, gravel shallow, surface erosion) that causes an appreciable reduction in the yields systematic, require special measures.

- Class V - land with severe limitations nepretabile no field crops, or for orchards and vineyards.

- Class VI - the lands can be used only for forests.

- Class VII - Land unsuitable for agricultural use or forestry due to floods.

In order to eliminate the negative effects of the limiting factors of agricultural production, reducing risks and improving the productive potential of the territory studied, we propose the following range of works:

- regulation of water flow;
- slight embankment works;
- erosion control works and avoid prolonged grazing early spring or autumn;

- the work on the contour land cultivation and hoeing plants avoid the slopes;
- works by scarification or compacted land affected by the excess moisture;
- skeletal material removal from the surface, the organomineral fertilizer radical.

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