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ANALYSIS FOR SOILS CHARACTERIZATION IN THE PURPOSE OF RAINFALL-RUNOFF PROCESS MODELING

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Abstract

The paper presents the results of a pedological study conducted on the soils of Baltati commune, Iasi County. 25 profiles were executed from which soil samples were taken, both in a natural and modified settlement, on horizons, for the following physical and chemical analyses: granulometric composition, bulk density, current acidity (pH), alkaline earth carbonates, hummus, total azote, mobile phosphorus, mobile potassium, soluble salts, anions CO^{-2}, HCO^{-}, anion Cl^{-}, anion SO_4^{-2}, cation Ca^{+2}, cations Na^{+} and K^{+}, T (total cation exchange capacity) and Na^{+} changeable.
The research conducted revealed the existence of a varied soil coating. According to their characteristics and limitations, the soils in the study area were classified into 5 classes, from II to VI. They are soils with varied fertility, and some of them are affected by processes of erosion, landslides, gleization, pseudogenization, alkalization, and salinization.

***Key words**: classes, fertility, processes, soils.*

INTRODUCTION

Soil is an open, dynamic system, influenced by many natural and anthropogenic factors. Therefore, in many situations, it is necessary to update knowledge of the physical, chemical, and biological properties of soils in an area.
The process of transforming precipitation into runoff over a basin is complex and shows both temporal and spatial variability. However, in a river basin, the variability is controlled mainly by the physical and chemical properties of the soil surface.
The runoff surface is an important factor in soil loss as well as in the movement of nutrients from the soil surface with consequences in decreasing soil productivity and crop yield, especially in agricultural land.
The purpose of this study conducted on the soils of Baltati village, Iasi County is to provide a series of the necessary information to analyse the process of precipitation runoff. Using mathematical models, we will verify with measurements, the rain-flow runoff relationships, depending on the hydraulic characteristics of the soils from the studied area.
Considering these aspects, soil samples were taken from the field, which was then analysed in the laboratory.
A characterization with enough degree of detail of the soils from the studied area was made, so we can be able to define as accurately as possible the conditions under which the infiltration of water from precipitation occurs (Statescu et al., 2011).
One of the most important factors favouring the formation of runoff is the soil, which by diversity and its characteristics, also play a fundamental role in water exchanges between shallow and underground runoff, intermediate between meteorological factors (precipitation) and underground drain.
The runoff processes are influenced by soil character and their physical condition: water saturation, degree of compaction, degree of freezing.
A good understanding of the topographic, hydrological, and climatic state of the study area and the appropriate set of data that define them is very important to analyze and simulate as realistic as possible the hydrological and hydraulic situation in the basin. Moreover, the quality of the data used for modeling directly

affects the result, so the data collected should be screened and processed before use.

MATERIALS AND METHODS

The study was carried out on the common territory of Baltati, about 35 km from the municipality of Iasi, located in the southwestern part of the Moldavia Plain (Figure 1).

From a hydrological point of view, the territory of Baltati belongs, for the most part to the Bahluet middle basin. The hydrological regime of Bahluet is characteristic of this area of lower terrain (Moldavia Plain) with moderate rainwater supply and snow water supply. The period of high water is in February-March. The density of the hydrographic network is 0.5-1.25 km/km^2. The climatic regime is characterized by an average annual rainfall of 487.9 mm at Podu Iloaiei and 502.3 mm at Targu Frumos; an average annual temperature of 9.1°C.

As a topographical basis, land-keeping plans with level curves were used at a 1:10000 scale.

Were executed 25 main profiles from which soil samples were taken, both in a natural and modified settlement, on horizons, for physical-chemical analysis.

Figure 1. Area location

The granulometric composition of soils is dependent on land use. Figure 2 illustrates the map of land use in the river basin Bahluet.

The land uses of the studied area are arable-corn, arable-wheat, scorch, degraded pasture, pasture, arable-stubble, wheat, orchard: pear tree, quince.

The main properties analysed and the laboratory methods used are shown in Table 1 (Cucu et al., 1995).

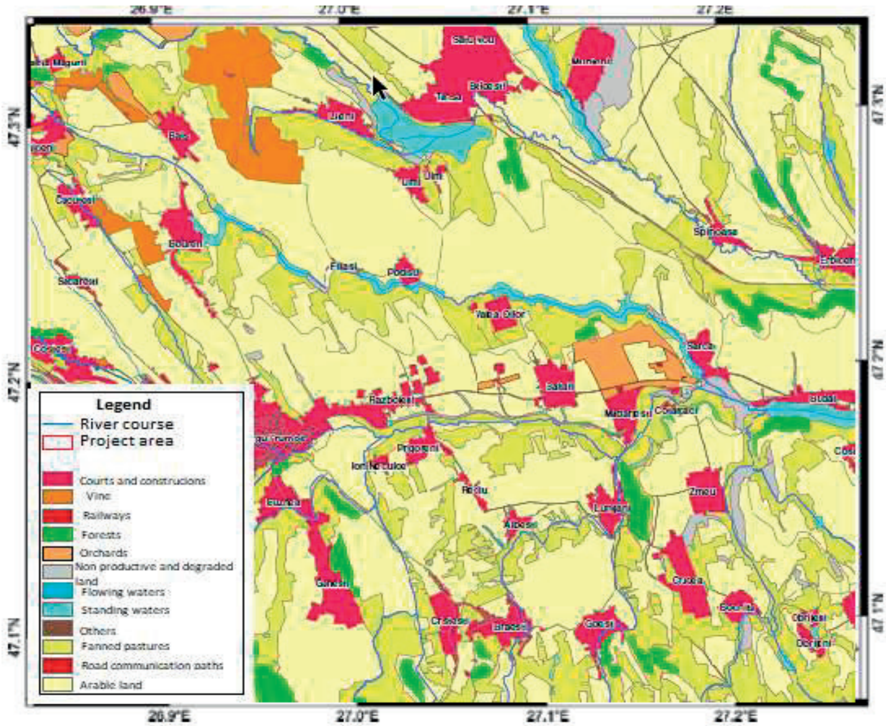

Figure 2. Map of land use in river basin Bahluet

Table 1. Laboratory-determined soil properties

Soil analysis	**Method used**
Granulometric composition	Kacinski (treatment of soil with hydrochloric acid and separation of fractions by pipetation)
Bulk density	Cylinders with known volume and weighing
Current acidity (pH)	Potentiometric
Alkaline earth carbonates	Scheibler
Humus	Titrimetric after Schellenberger.
Total azote	Kjeldahl
Mobile phosphorus	Egner-Riehm-Domingo
Mobile Potassium	Ammonium acetate-lactate solution and dosing to the photometer with flame
Soluble salts	The watery solution, evaporation, and weighing
Anions CO_3^{2-} and HCO_3	Titrimetric
Anion Cl^-	Mohr
Anion SO_4^{2-}	Gravimetric as $BaSO_4$
Cation Ca^{2+}	Complexometric
Cations Na^+ and K^+	Flame photometer
T (cation exchange capacity)	Percolation with a solution of ammonium acetate at pH 7 and distillation, Schollenberger-Cernescu method
Na^+ changeable	Ammonium acetate extract and photometer flame

RESULTS AND DISCUSSIONS

By analysing the properties of the soil can notice their impact on the process of runoff formation.

The solution to most of the problems of transport and flow requires knowledge of the physical properties of the soil in unsaturated conditions.

The establishment of the hydrological soil group is done considering primarily the physical properties of soil: texture, structure, and porosity.

Soil texture, porosity, infiltration speed, and hydraulic conductivity influence hydro physical behaviour through water drainage capacity (Statescu et al., 2010).

The modification of the pedological conditions in a river basin directly influences the processes of infiltration, the formation of runoff surface area, their concentration, and the formation of floods (Statescu et al., 2011).

The values of characterization of the analytical properties in the laboratory were centralized, for each soil profile.

For each soil sample were determined in the same way, the physicochemical properties (L.P. van Reeuwijk, 2002).

Table 2. Soil Profile No.1

Relief	Parental material	Horizons	Am	Am	Ab	CA	Cca
		Depths (cm)	0-25	25-40	40-50	50-75	75-120
Trays- terrace	Loessoid deposits	Fine sand (0.2-0.02 mm) %	43.8	50.6	44.8	42.8	45.5
		Dust (0,02-0,002 mm) %	23.1	21.1	25.7	27.4	25.7
		Clay 2 (less than 0.002 mm) %	33.1	28.3	29.5	29.8	28.8
		Physical clay (less than 0.01 mm) %	43.5	35.9	43.6	43.0	42.5
		Texture	LL	LL	LL	LL	LL
		Ph	6.9	7.0	7.8	7.9	8.0
		Carbonates (%)			2.6	6.1	8.2
		Humus (%)	3.9	3.6	3.0		
		Total N (%)	0.191	0.182	0.148		
		Mobile P (ppm)	10	19	30		
		K immovable (ppm)	216	162	156		

Based on the criteria for framing the properties of the soils studied, the following classes and soil units have been identified (SRTS 2012).

From the class II of soils belong typical chernozem, typical cambic chernozem, typical cambic chernozem, cumulic; coluvosoil molic, weakly alkalized; coluvosoil molic, strongly gleized; typical chernozem with weak surface erosion, typical cambic chernozem with poor erosion in the surface.

Table 3. Analytical data for each soil unit of class II

Soil units / Characteristics	Clay (%)	Humus (t/ha)	Humus reserve	pH	N (%)	P (ppm)	K (ppm)
Typical chernozem, typical cambic chernozem, typical cambic chernozem,cumulic	33.1-36,9	3.6-4.2	204-241	6.5-6.9	0.179-0.209	4-10	204-216
Coluvosoil molic, weakly alkalized	27.4-32.4	3.24-3.84	195-225	7.0-7.8	0.165-0.189	35-200	335-400
Coluvosoil molic, strongly gleized	24.3-31.1	3.07	185	6.7-7.2	0.143	13	175
Typical chernozem with weak surface erosion	24.9-28.9	2.16-3.18	185	6.8-8.1	0.175	24	282
Typical cambic chernozem with poor erosion in the surface	33.6-38.2	3.6	231	6.0-7.9	0.182	6	313-363

Class II of soil includes lands with good suitability, with reduced limitations on fine texture, slope, surface erosion, temporary excess groundwater, or stagnant humidity.

From the class III of soils belong cambic pseudorendzin; typical chernozem with moderate surface erosion, typical cambic chernozem with moderate surface erosion; aluviosoil molic strongly gleized; aluviosoil strong gleized, weakly salinized, moderately alkalized; gleiosoil weakly salinized and alkalized, aluviosoil strongly gleized, weakly salinized and alkalized; coluvosoil molic, poorly salinized, moderately alkalized, typical chernozem complex (30%), typical cambic chernozem (30%), gleized chernozem, salinized and weakly alkalized (40%).

Table 4. Analytical data for each soil unit of class III

Soil units / Characteristics	Clay(%)	Humus (t/ha)	Humus reserve	pH	N (%)	P (ppm)	K (ppm)
Cambic pseudorendzin	50.4-53.5	6.32	400	6.6	0.317	6	363
Typical chernozem with moderate surface erosion, typical cambic chernozem with moderate surface erosion	34-35	3.14	180	6.8-8.4	0.160	25	210
Aluviosoil molic strongly gleized	57-59	4,9	305	7.9-8.0	0.245	42	313
Aluviosoil strong gleized, weakly salinized, moderately alkalized	21-33	1.53-3.7	128-167	7.8-8.2	0.251-0.265	22-126	190-317
Gleiosoil weakly salinized and alkalized, aluviosoil strongly gleized, weakly salinized, and alkalized	69	6.2-7.5	210-366	7.7-8.4	0.224-0.336	37-40	331-386
Coluvosoil molic, poorly salinized, moderately alkalized	25.1-30.2	3.8-5.2	175-209	7.7-8.1	0.175-0.265	26-48	240-400
Typical chernozem complex (30%), typical cambic chernozem (30%), gleized chernozem, salinized and weakly alkalized (40%)	35-41	4-5	290	7-7.8	0.199-0.242	10	244

Class III of soils includes lands with medium suitability for arable land, with moderate limitations on erosion, fine texture, salinization, and alkalization.

From the class IV of soils belong: typical chernozem with strong surface erosion, typical erodic anthrosoil; aluviosoil weakly gleized, salinized, and weakly alkalized, aluviosoil strongly gleized, weakly salinized, moderately alkalized, aluviosoil strong gleized, moderately salinized, low moderated alkalized, gleiosoil moderately salinized, low alkalized, typical chernozem complex with moderate surface erosion (50%), typical erodic anthrosoil (25%), erodic anthrosoil salinized (25%) around stabilized landslides.

Table 5. Analytical data for each soil unit of class IV

Soil units / Characteristic	Clay (%)	Humus (t/ha)	Humus reserve	pH	N (%)	P (ppm)	K (ppm)
Typical chernozem with strong surface erosion, typical erodic anthrosoil	28.7-30.2	0.9-2.34	24-61	7.9-8.0	0.071- 0.123	13-35	129-282
Aluviosoil weakly gleized, salinized, and weakly alkalized, aluviosoil strongly gleized, weakly salinized, moderately alkalized	13.1-28.9	1.51-3.72	75-92	7.9	0.078-0.190	42-44	208-400
Aluviosoil strong gleized, moderately salinized, low moderated alkalized	43.3-45.6	46.2–55.3	260	7.8–8.4	0.259-0.290	51-122	282–400
Gleiosoil moderately salinized, low alkalized	45.9	3.43	230	7.8–8.1	0.174	39	296
Typical chernozem complex with moderate surface erosion (50%), typical erodic anthrosoil (25%), erodic anthrosoil salinized (25%) around stabilized landslides	34-36.5	3.50	242	7.7-7.9	0.160	10	190

Class IV of soils comprises land with low pretentiousness with severe limitations on slope, erosion, excess moisture, texture, inundability, landslides. Limitations cause appreciable systematic decreases in plant growth and development.

From the class V of soils belong: gleiosoil marshy salinized, complex of salinized and alcalized chernozem from weak to strong, with weak and moderate surface erosion (60%), solonet moderately salinized (20%), anthrosol erodical salinized (20%), on saliferous deposits with texture from clayey to clay, complex of aluviosoil molic, gleized, salinized (50 %), gleiosoil marshy salinized (25%), coluvosoil molic gleized, sometimes salinized and alkalized (25%), Typical chernozem complex with strong surface erosion (25%), salinized and alkalized erodical anthrosol (25%), pseudorendzinic erodical anthrosol (50%), around semi-stabilized slips.

Table 6. Analytical data for each soil unit of class V

Soil units / Characteristics	Clay (%)	Humus (t/ha)	Humus reserve	pH	N (%)	P (ppm)	K (ppm)
The complex of salinized and alkalized chernozem from weak to strong, with weak and moderate surface erosion (60 %), solonet moderately salinized (20 %), anthrosol erodical salinized (20 %), on saliferous deposits with texture from clayey to clay	22-51	2.26-6.64	60-450	8.3-9	0.115-0.289	10-51	160-400
The complex of aluviosoil molic, gleized, salinized (50 %), gleiosoil marshy salinized (25 %)	>31	2.1-3,5	50-340	8-9	0.250-0.270	20-25	200-300
Typical chernozem complex with strong surface erosion (25%), salinized and alkalized erodical anthrosol (25%), pseudorendzinic erodical anthrosol (50%), around semi-stabilized slips	>30	2-4.5	40-250	6.6-9	0.100-0.300	9-52	150-400

This class of soils is recovering gleiosoil marshy salinized soils. It is in narrow valleys, depression areas in meadows, contact of the plain with the slopes, where springs appear at the base of the slopes. The soil is submerged most of the year. The reaction for this type of soil is weakly alkaline, the content of calcium carbonates and soluble salts is generally low.

The land for this class V of the soils has very severe limitations and to be taken in cultivation requires special, complex, and intensive planning and improvement measures.

Limiting factors are the permanent excess of groundwater and stagnant water, salinization and alkalization of soils, surface erosion, slopes, fine texture due to the high clay content, floodability, rare in some areas, frequent in lower areas, a landslide by sliding.

In general, the chemical properties have large variations in the horizontal plane due to the relief kneaded by sliding.

The landslides were triggered under the influence of the geological structure and the presence of coastal springs.

In class VI of soil is identified complex erodical anthrosol salinized (50%) and pseudorendzinic erodical anthrosol (50%) in the active slip area. They represent the most mobile areas of the slopes where the movement of earth masses continues to this day.

Class VI of soils is represented by land with extremely severe limitations on active landslides and deep erosion (ravines).
These forms of degradation occur and develop due to the:
- easily erodible geological substrate;
- accentuated slopes;
- rainfall regime with heavy precipitations;
- degradation of meadows on the slopes.

CONCLUSIONS

The researches made revealed the existence of a variety of soil coating. According to their characteristics and limitations, the soils in the studied area were classified into 5 classes, from II to VI. They are soils with different fertility due to their physical-chemical properties. Some of these are affected by processes of erosion, landslides, gleization, pseudo gleization, alkalization, and salinization (Statescu et al., 2004).
Soils through their hydrophysical properties and especially through the texture and use of land play a particularly important role in the formation of maximum liquid runoff, in the flow of alluvium in suspension, and the process of groundwater supply through infiltrations.
A relevant analysis of the formation of soil surface leakage in the study area cannot be done without considering the many factors influencing this process. In addition to these analyses, they must be carried out in addition to others, such as determination of pore shape and size, determination of hydraulic conductivity, determination of the suction curve (Statescu et al., 2011).
Given a large number of soil types and subtypes identified in the studied area, the conditions for producing the rain-drain process will be very different and difficult to quantify. Particularly good integration of soil conditions in the modelling process leads to certain value results, close to those obtained by direct measurements.
The process of transforming precipitation into runoff over a basin is complex, nonlinear, and shows both temporal and spatial variability. The runoff modelling is the first step in designing and planning many engineering projects for water resources.
Theoretical and field studies have also shown that the generation of runoff is strongly uneven due to the spatial variability of soil infiltration capacity. However, while in wetlands this variability is mainly attributed to spatial differences in soil moisture, in dry areas runoff is mainly controlled by the physical and chemical properties of the surface and precipitation characteristics.
The rate of water infiltration into the soil depends on several properties of the soils, especially the physical characteristics of the soil.
Plant production in agricultural land in this area of the Bahluet basin depends largely on rainfall conditions, which are marginalized by water stress.
Preventing runoff is a key issue for conserving soil productivity and water supply for crop production. Therefore, determining the soil properties that influence runoff in agricultural land is the first step in choosing a runoff control strategy.

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