ECOPEDOLOGICAL INTERPRETATION OF SOILS FROM AGRICULTURAL ECOSYSTEMS OF LOWER PRUT RIVER MEADOW

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ABSTRACT

A detailed chracterization of agricultural ecosystems is necessary for their efficient use. This research aimed at the characterization of the ecosystems of the Lower Brates ecopedotope, belonging to the lower Prut Meadow, at the confluence of the river Prut with the Danube. These ecosystems were born from the former Brates Lake and riverside areas drainage.

Soil analysis has been performed according to „Soil Taxonomy Romanian System" (SRTS, 2003) and the Pedological Studies Elaboration Methodology (ICPA, 1987), while the ecological interpretation of soils was done after the methodology by Chiriță in 1974.

The soils of this ecopedotope are represented by soils from Regosol class represented by the calcaric, mollic, gleyc and salic alluviosols subtypes, used as arable land, and the Hydrosol class, including mollic and calcaric gleysols, used mainly as pastures and natural hay fields but also as arable land. Soil profiles were studied in the field, while their main physical, chemical and biological traces were determined in the lab which allowed the elaboration of ecological records/files, the values of soil trophic indicators and ecological soil diagnosis.

Most factors and ecological determinatives under analysis could be included within the classes of medium and low favorability for agricultural crops.

The dry seasons, inadequate use of the soil,and the medium and fine soil texture were found to be the main factors of negative ecological impact, that lead to an inappropriate use of the high trophic potential of the Lower Prut meadow ecosystems.

Key words: characteristic, conservation, diagnosis, ecological factors, evaluation.

INTRODUCTION

The Lower Prut unit is placed at the confluence of the river Prut with the Danube and it was born from the former Brateş Lake and riverside areas drainages, the preexistent geomorphologic units being represented by the lake which was 2.5 m in depth and the north-eastern and southern coastal levees with heights of 2.5 m. By leveling, the relief forms were unified (lake bottom, pools, streams, levees).

MATERIAL AND METHODS

The research was done on the Lower Prut Meadow agricultural ecosystem, the County of Galatzi. The territory under study is placed at the confluence of the river Prut with the Danube and occupy an area of about 11,449 ha.

Soil analysis was done in accordance with „The Romanian System of Soil Taxonomy" (Florea and Munteanu, 2003) and with the Elaboration Methodology of Pedological Studies (ICPA, 1987). The ecological interpretation of soils was done after the methodology elaborated by Chiriță in 1974.

The interaction and the correlation of ecological factors of biotope with the biocenosis and the environmental factors was described by soil diagnose which shows the trophic potential of soils in a zone and the global ecological context (Pârvu, 1980, 1999).

RESULTS AND DISCUSSION

As a result of dyking and drainage, which triggers off stopping of alluvia accumulation, sediments have turned into soils, bioaccumulation and leaching being the major pedogenetical processes. Dyking-drainage works have given two directions to the evolution of soils in the territory:

- an *automorphous direction*, from alluvial protisols with a weak profile development up to alluvial soils with mollic horizon and even chernozems, characteristic to well-drained areas and sandbanks (soils from Protisol class);
- a *hydromorphous direction,* comprising soils of gleysol type with various subtypes (soils from Hydrosoil class).

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1. Ecological interpretation of soils from the Ecopedotope Lower Prut Meadow

1.1. Alluviosol physical, chemical and biological characteristics

In this area the following Protisol type soils (with the subdivisions: calcaric, mollic, gley and salinic alluviosols) were identified on an area of 7,832 ha.

Alluviosols belong to the Protisol class (SRTS-2003) and are defined by the presence of a horizon A (Am, Ao) followed by the parental material represented by river, lake and river-lake deposits with varied textures. The results of analyses on soil samples taken from the soil profile, on pedogenetic horizons, are shown in table 1.

The synthetic index of soil potential trophicity Tp is 160 points, the soil being considered as megatrophic, while the index for effective trophicity Te is 74 points because of the insufficient rainfall.

1.2. The profile record for soil ecological characteristics

In table 2 we show the quantitative and qualitative evaluation of the main ecological indicators and their inclusion in favorability classes.

Table 1. Biological, chemical and physical properties of soil

Specification	Genetic horizons	
	Am	C
Depth (cm)	0-35	35-50
Clay (%)	33.1	23.4
Textural Class	LL	LL
pH	7.5	8.41
Humus (%)	3.825	1.754
Total Nitrogen (%)	0.293	0.085
Mobile Phosphorous (ppm)	121	65
Mobile Potassium (ppm)	283	198
Change Base Sum (SB - me/100 g soil)	28	23
Total Capacity of Cationic Exchange (T - me/100 g soil)	28	23
Base Saturation Degree (V%)	100	100
Potential Trophicity (Tp - points)	134	26
Effective Trophicity (Te - points)	74	
Biological Activity (dehydrogenases - mg TPF)	22.15	11.21

As shown in this table, from the 20 ecological determinatives and factors qualitatively, 5 factors and ecological, climatic and pedological determinatives enter the middle favorability class, 2 are included in the high favorability class, 3 ecological factors are included in the very high favorability class and 3 ecological factors are in the very low favorability class.

Table 2. Soil profile record for ecological characteristics (by Chiriță, 1974)

Ecological factors	Ecological factor favorability class													
	1	2	3	4	5	E_1	E_2	GR	OR	PB	FS	CT	SF	SO
Annual average temperature										▲	▲	▲		▲
Annual average rainfall (P)	•							▲						
Winds (V)			•					▲			▲			
Seasonal rainfall (Pe)	•													
Seasonal relative humidity	•													
Humus content			•					▲	▲	▲	▲	▲	▲	▲
Alkalinity		•												
Total nitrogen content			•					▲	▲	▲	▲			
Mobile phosphorous content		•						▲	▲	▲				▲
Assimilable potassium content	•							▲	▲	▲	▲			▲
Cationic exchange total capacity				•				▲	▲					
Saturation level in bases				•				▲	▲					▲
Dehydrogenate activity			•											
Alkalinity														
Seasonal consistency			•					▲	▲					
Soil aeration		•												▲
Edaphic volume					•			▲	▲	▲	▲	▲	▲	
Potential trophicity					•			▲	▲	▲	▲	▲	▲	▲
Bioactive period length					•					▲	▲	▲	▲	▲

1.3. Soil ecological diagnosis

The formula of soil ecological diagnosis indicates that the soil ensures a superior trophic fund to the biocenoses (the soil is mega trophic), but this potential is not entirely capitalized because of the excessively dry seasons. The formula is:

$DE = Tp_{160} \times Te74/(N_{III} \times A_I \times O_{II} \times C_{III} \times T_{IV} \times D_v)(H_{III} \times t_{III} \times V_{IV} \times Vev)$ (Chiriță, 1974).

2. Gleysol physical, chemical and biological characteristics

Gleysols belong to the Hydrosol class and comprise soils that have as diagnosis *a reduction gley horizon* (Gr) or an intense stagnic horizon (W) starting from the first 50 cm, associated with other horizons, without having intense salsodic properties in the first 50 cm. Calcaric and mollic gleysols have been identified on 2,792 ha of the area under study. As a result of soil analyses, taken from soil profile, on genetic horizons, the physical, chemical and biological characteristics shown in table 3 were obtained.

The synthetic index of potential trophicity has 73 points. The synthetic index of effective trophicity has 45 points (oligomezotrophic soil).

Table 3. The main physical, chemical and biological characteristics of soils (gleysols)

Specification	Genetic horizons		
	Ao	AGo	Gr
Depth (cm)	0-15	15-30	30-50
Clay (%)	36,56	46,0	48,4
Texture class	Tt	Tt	Tt
pH	6,5	6,0	5,8
Humus (%)	2,924	1,285	0,66
Total nitrogen (%)	0,182	0,111	0,075
Mobile phosphorous l (ppm)	39	26	17
Mobile potassium (%)	219	182	196
Exchange base sum (me/100g soil)	31	27	20
Cationic exchange total capacity (me)	23	21	18
Base saturation level (V%)	73	79	89
Potential trophicity (Tp = points)	32.19	15.22	11.74
Effective trophicity (Te)	27.21		
Biological activity (dehydrogenase - mg TPF)	14.45	10.77	7.38

2.1. The profile record of soil ecological characteristics (gleysol)

In table 4, we show a quantitative and qualitative evaluation of the main 20 factors and ecological determinatives.

From the 20 factors and ecological determinatives 5 belong to the medium favorability class, one belongs to the high favorability degree, 2 are included in the very high favorability class, 6 are included in the low favorability class, and 5 are included in the very low favorability class.

Soil ecological diagnosis

Applying the formula for soil ecological diagnosis we conclude that the soil ensures a middle trophic fund (soil is mezotrophic) for the biocenoses, but this potential is not entirely used because of the extremely dry seasons. The formula is:

$DE = Tp59 \times Te27/(N_{II} \times A_I \times O_{II} \times C_{III} \times T_{Iv} \times D_v)$ $(H_I \times t_{II} \times V_{III} \times Vev)$, (Chiriță, 1974).

Zone, local and global ecological impact matrix

The evaluation of the anthropic impact upon the environment was done with the help of the local and global ecological impact matrix (Table 5) inspired from the Leopold matrix (Leopold et al., 1971) which was adapted for studies of local, zone and global ecological impact (climatic, pedological and anthropic) on earth ecosystems (Bireescu and Bireescu, 1999).

Table 4. The profile record of Lower Prut Ecopedotope

Ecological factors	Ecological factor favorability class													
	1	2	3	4	5	E_1	E_2	GR	OR	PB	FS	CT	SF	SO
Annual average temperature				▪				▲	▲					
Annual average rainfall	•							▲						
Winds			•					▲						
Seasonal rainfall	•													
Seasonal relative humidity	•													
Humus content			•					▲	▲					
Alkalinity		•												
Total nitrogen content			•					▲	▲					
Mobile phosphorous content		•						▲	▲					
Assimilable potassium content	•							▲	▲					
Cationic exchange total capacity				•				▲	▲					
Saturation level in bases				•				▲	▲					
Dehydrogenate activity			•											
Alkalinity														
Seasonal consistency			•					▲	▲					
Soil aeration		•												
Edaphic volume					•			▲	▲					
Potential trophicity					•			▲	▲					
Bioactive period length					•			▲	▲					

Table 5. Matrix of global and local ecological impact in the Lower Prut Meadow agricultural ecosystems

Negative ecological effects	Negative ecological factors of global and local impact			
	Rainfall deficit during season	Small relative humidity during season	Soil hard consistency during season	Chemical over-fertilization
Soil settlement	O	O	O	+
Biological activity reduction	O	O	O	O
Soil structure destruction	O	O	O	+
Insufficient aeration	O	O	X	O
Humidity deficit	X	X	O	+
Salinity	+	O	O	+
Soil reaction	+	O	O	O
Soil effective trophicity reduction	O	O	O	X

Note: + - minor impact; O - major impact; X - urgent measures required.

To evaluate the impact an estimation scale was established with three qualitative impact levels: minor, major impacts and urgent measures required.

The ecological factors of impact obtained from the soil ecological analysis are: the fine texture, the seasonal rainfall deficit, the hard seasonal consistency of the dry soil, the soil low aeration, the chemical over-fertilization.

The main negative ecological effects of the disturbing ecological factors through lack or excess: soil settlement, soil structure destruction (through excessive work), soil biological activity reduction and soil effective trophicity reduction.

CONCLUSIONS

The soils of this ecopedotope are represented by soils from Regosol classes, with the following subtypes: calcaric, mollic, gleyc and salic alluviosols, used as arable land, followed by soils from hydrimorph class, as mollic and calcaric gleysols, used mainly as pastures and natural hay fields but also as arable land.

The majority of factors and ecological determinatives under analysis can be included within the classes of medium and low favorability for agricultural crops.

The dry seasons, the hard seasonal consistency, inadequate use of the soil, the middle and fine texture are the main factors of negative ecological impact that lead to an inappropriate use of the high trophic potential of the Lower Prut meadow ecosystems.

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