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SPATIAL DATABASE: FOUNDATION OF SCIENTIFIC EXPLOITATION OF AGRICULTURAL LANDS

MIHAI RACOVICEAN, PAUL PÎRŞAN

Banat University of Agricultural Science and Veterinary Medicine
Timişoara, Calea Aradului 119, Romania
mihai.racovicean@gmail.com

Abstract - Spatial database: foundation of scientific exploitation of agricultural lands
This paper is the result of studies and research concerning the systematic recording of a cadastral sector as a component part of the pilot-project "Spatial database: foundation of modern, performing management" carried out in the Commune Livezile (Timiş County, Romania), a project that aims at defining coherent procedures for the development, updating, and management of a database at the level of a Territorial Administrative Unit (T.A.U.), including the inclusion of data concerning the promotion of a modern and efficient agriculture, a project with promotion perspectives at regional and national level. The Livezile T.A.U. is one of the 89 communes of the Timiş County, located in the south-west of the county, covering 5,579.49 ha, of which 5,230.43 ha agricultural lands. This T.A.U. is made up of two localities: Livezile and Dolaţ. The objective of this paper was to collect real data concerning basic entities, i.e. plot, building, and owner, to achieve the functions of cadastre, and other information allowing environmental protection. To reach this objective, we chose the north-west area of the locality Livezile covering communal grassland, the object of the communal interest of systematically recording ownership. Systematic recording operations were carried out in cooperation with the Company OTNIEL Ltd. Which, in partnership with the Banat University of Agricultural Science and Veterinary Medicine of Timişoara, the Timiş County Council, the Timiş Prefect's Institution cover the measurements for the entire pilot-project. Collecting pedological data was done with the support of the O.S.P.A. Timişoara based on the „Pedological study for quality cadastre: Assessment and technological characterisation of agricultural lands" at the 1:10000 scale, carried out in 1988 at the Banloc T.A.U. and based on the data collected in the field, between April and June 2011, together with the specialists working for the "National programme concerning a national and regional soil – land monitoring system for agriculture" designed by the D.A.J. Timiş and approved by the M.A.D.R. The information thus collected can be used by both the public local administration to establish the development strategies of the community in order to make proper administrative decisions, and land owners that wish to exploit scientifically and efficiently their agricultural lands.

Keywords: production, data, favourability, crop, environment

INTRODUCTION

Designing proper agricultural policies concerning the socio-economic development of the rural area needs to incorporate, besides economic or political connotations, the results of pedological studies and research.
Soil and climate conditions in Romania allow the use of the most proper agricultural practices in accordance with the natural landscape conservation and environmental protection principles of the European Union.
To fully and systematically know the buildings to be taken into account technically, economically, and legally, we also need to know them qualitatively. As defining aspect of cadastre, the economic function is, together with the technical function (achieved through measurements meant to identify the terrestrial area of each portion of the dry land) and the legal function (establishing, based on documents that define the ownership right and land circulation, etc.) the element defining the production capacity and the vocation of each portion of land (known as cadastral plan, the basic entity of the system) from the point of view of its most adequate use.

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Due to its economic function, cadastre is an important instrument in outing into practice the stipulations of the Romanian Constitution according to which the State must ensure:

- the exploitation of natural resources in accordance with the national interest;
- the recovery and the protection of the environment as well as the maintenance of the ecological balance;
- the development of natural conditions to improve life quality.

MATERIAL AND METHOD

This paper refers to an area of 5,579.49 ha, of which 5,230.43 ha of agricultural land, whose main use categories are shown in Table 1.

Table 1: Land fund structure in the Commune Livezile

Use category	Arable (ha)	Grassland (ha)	Hay making fields (ha)	Vineyards (ha)	Orchards (ha)	Total agricultural land (ha)	Forest - Pd (ha)	Duct - HC (ha)	Service Road - De (ha)	Buildings and adjoining areas - CC (ha)	Barren - N (ha)	Total non-agricultural (ha)	General total (ha)
Extra	4214,36	829,47	30,66	-	2,66	5077,15	5,05	128,40	60,61	40,62	8,36	243,04	5.320,19
Intra	150,03	3,25	-	-	-	155,28	-	4,17	42,74	58,26	0,85	106,02	259,30
Total	4364,39	832,72	30,66	-	2,66	5230,43	5,05	132,35	103,35	98,88	9,21	349,06	5579,49

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Characterising the ecopedological conditions, defining soil and land units, as well as analysing limiting and restrictive factors of land quality was done in accordance with the „Methodology of Carrying out Soil and Agro-chemical Studies" (vols. I, II, and III) developed by the ICPA Bucureşti in 1987, and completed with elements from the Romanian Soil Taxonomy System (SRTS-2003).

Knowing the land production capacity depends on the detailed knowledge of the correspondence between the physiological requirements of each species apart and the features of the biota, taking into account that agro-ecosystems are spatial and temporal formations functioning as cybernetic systems and achieving substance, energy, and information exchange both between phytocoenotic and zoocoenotic elements, and between these elements and their environment; they can turn cosmic energy into potential energy that they store in vegetal and animal biomass.

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The **relief** characteristic of a divagation plain is made up of a succession of fluviatile dunes and fluvio-lacustre depression areas characteristic of a continental delta. Absolute maximum altitude is 89.70 m in the north-eastern part of the territory and absolute minimal altitude is 75.93 m in the south-western extremity of the territory. The general direction of the forms of relief is almost parallel with the east-west direction, with a slight slope in the same direction, in concordance with both the drainage slope of the Bârzava River and with the general slope of the plain. The dunes have, here and there, bumps with, in most cases, obvious anthropic influences. Both on the dunes and particularly between the dunes there are faults and micro-depressions some tens of metres to hundreds of metres wide (even 2-3 ha) in which there is water that lasts sometimes for longer periods of time. Thus, this plain is mainly a recent plain: though apparently it is rather plane, if scrutinised more closely we can see there are frequent uneven portions represented mainly by old meanders now lacking water, micro-depressions, and dunes made up, generally, from coarser materials due to uneven deposits of alluvial material during the overflows of the rivers Timiş and Bârzava, before the channelling, the building of dikes, and later setting.

Geologically, the researched perimeter is part of the great Pannonia Depression, i.e. its eastern extremity, made up by the gradual clogging of the lake in the Pleistocene-Quaternary. The basis of this depression has a Carpathian foundation, made up of crystal formations and Palaeozoic, Mesozoic, and paleogenous age, overlapped by Tortonian, Sarmatian, and Pliocene deposits (COTEŢ QUOTED BY PUŞCĂ, 2002, ŢĂRĂU, 2003). Quaternary deposits with lacustre character at the basis and alluvio-proluvial in the upper part are several to several tens of metres thick. In the Holocene, the entire area was subjected to new and repeated falls resulting in wide lacustre and marshy areas that subsisted until the last century.

Hydrographically, the researched area is part of the group of south-western hydrographical systems – the Bârzava-Timiş hydrographical basin. The River Bârzava, 127 km long, has its sources on the northern and western slope of the Semenic Mountain, at 965 m altitude. Bârzava is a river with small tributaries and the mean width of the reception basin in Romania is only 7.5 km (UJVARI 1972 QUOTED BY ŢĂRĂU D., 2003). Downstream Deta and Denta, the River Bârzava was regularised ever since the beginning of the 18th century; at present, its course is crowded between dikes whose length reach, on the left bank, 11.5 km, and on the right bank, 13.9 km. Bârzava used to flow, initially, towards the marshy depression Alibunar (Serbia), together with its present tributary, Moraviţa. The lower courses were directed towards the Timiş River through the desiccation system Terezia built in the 18th century (UJVARI 1972 QUOTED BY ŢĂRĂU D., 2003). As for the distribution of the flow along the year, we need to mention that it is strongly influenced by the ocean, overlapped by the sub-Mediterranean influence, materialised in the relatively early debut of spring in February and March. Then follow the low waters of spring (April), which end with the occurrence of overflows in May-June. From July to November, there are low waters whose flow is sometimes interrupted. At the debut of the cold season the water levels raise.

Climatically, the research area is, according to Romanian climate maps, part of the temperate-continental climate, at the crossroads between the ocean-influenced climate province sector and the sub-Mediterranean-influenced climate province sector. From July to the beginning of September, there are tropical air masses, and the mean temperature is above 20^{0}C< in July, mean temperature reaches 21^{0}C, and annual mean temperature is 10.9^{0}C. Precipitations oscillate between 412.5 mm (1999-2000) and 790.3 mm (1930-1931), with a multi-annual mean of 631 mm in Timişoara. According

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to Koppen, the climate of the studied area is part of the Cfbx climate province. The annual mean value of the De Martonne index is below 26.

As a conclusion, we can say that, from a climate point of view, the studied area supplies favourable conditions for all types of crops familiar in the area. We need to take into account the differences of temperature between certain years and the multi-annual mean temperature, as well as the differences in precipitations, and particularly their distribution during vegetation.

Since the studied area is located in a divagation plain with a wide lithological diversity, there are a wide variety of mezo- and micro-reliefs and a water table not very deep in the soil (most of it) in the natural vegetation; on one hand, there is variation of the soil moisture regime, on the other hand, there is variation of its degree of salting.

The vegetation of the forests within the studied area is represented, nowadays, by woody plant associations made up of the following species: *Quercus robur*, *Fraxinus excelsior*, *Ulmus foliaceus*, *Acer campestris*, *Crataegus monogyna*, etc.

In addition, there are also smaller and rarer patches of vegetation on the old water courses, made up of the following species: *Salix fragilis*, *Acer campestris*, *Robinia pseudacacia*, and, rarer, *Quercus cerris*, *Quercus pedunculiflora*. In the villages, there are also such species as: *Armeniaca*, *Persica*, *Prunus*, *Cerasus*, *Sydonia*, etc. These species can also be seen in the orchards within localities.

RESULTS

Assessing agricultural lands is a complex operation based on the deep knowledge of the plant growth, development, and fructification conditions, and on the determination of the degree of favourability (suitability) for certain crops (or use categories), through a system of technical indicators and of assessment grades. As such, the assessment determines how better a land is than another one, taking into account its fertility as seen in its productions.

The amount of crop per area unit, i.e. the productivity of the crops depends on the environmental conditions on the whole (relief, climate, hydrology, soil) as well as on the man's influence, who can change natural factors or the plant's features in order to get the best results in natural conditions. Thus, in close correlation with the variety of geo-morphological factors determining the existence of diversified relief units, of geo-lithological factors that resulted in a wide variety of materials, and of climate or hydrological ones, as well as of the different anthropic interventions, there is, nowadays, a numerous population of soils with specific features (related or completely different) in continuous evolution. Each of the 11 land units (TEO) identified within the studied area was characterised according to the present Methodology of Development of Pedological Studies using the 23 assessment indicators representing the most important and the easiest to measure features generally mentioned by mapping works developed after 1987 by all territorial pedological and agro-chemical offices, on the ground of the methodology developed by the ICPA Bucureşti and TEACI D., 1980, ŢĂRĂU D., MARTON GH., RACOVICEAN M., TRETA D., 2005.

Characterising the land technologically is an activity of defining and classifying agricultural lands from the point of view of the soil intrinsic features that determine different behaviours during the production process and that also requires specific soil works and soil improvement works necessary to increase the land yielding capacity; it is done using a system of indicators concerning the main improvement and cultivation aspects incumbent to soil agricultural use.

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Table 2: Assessment grades for the main use categories and crops

Nr. TEO	P	F	GR	OR	PB	FS	CT	SF	SO	MF	A
1	81	72	65	65	63	73	51	81	65	65	66
2	81	72	65	65	73	65	58	73	65	65	66
3	66	65	58	51	50	58	40	65	51	51	53
4	73	72	58	58	57	65	45	73	58	58	59
5	66	65	58	51	50	58	36	58	51	51	52
6	81	72	81	72	80	72	65	80	72	72	74
7	65	58	35	35	35	39	24	45	31	35	35
8	49	44	12	16	6	16	5	17	5	5	10
9	73	73	58	51	58	51	36	52	46	51	50
10	65	58	43	38	45	38	27	40	35	38	38
11	73	73	46	46	45	52	32	58	41	46	46

Note: Use Categories: P – Pasture; F – Grass land; A - Arable
Crops: GR – Wheat; OR – Barley; PB – Corn; FS – Sunflower; CT – Potato; SF – Beet; SO – Soya; MF - Pease and Bean

Pedological information is the basis of technological characterisation consisting in the following: establishing the improvement and cultivation requirements of different lands, identifying the plots with different requirements, establishing land categories requiring different improvement and cultivation technologies, justifying the estimate of economic effects of improvement and cultivation technologies specific to different lands.

Works meant to determine technological features and yielding capacity of the lands of agricultural units in order to establish the agricultural and economic profile is another way of using pedological material.

Works of technological characterisation, as well as works of assessment of agricultural lands, need to meet the following objectives: increasing the arable area, restructuring agricultural uses in difficult areas for an intensive and rational use of each and every plot ensuring soil protection against erosion, choosing the most proper crop structure, including cultivars and hybrids, to get maximum yields in plant production, with low costs and with economy of energy, establishing the most adequate cultivation technologies for the increase of soil productivity through improvement works, fighting soil erosion, desiccations, irrigations, preventing and fighting salt-affected soils and alkalinisation of the soils, establishing specific technologies for the working of the soils, for the fertilisation of the lands, and for plant cultivation.

CONCLUSIONS

The modernity of the activity of mapping, assessing, and evaluating agricultural lands also comes from the fact that the land, besides its features as a historical and natural body, is the most important means of production in agriculture and sylviculture and an asset that subjects it to ownership and, implicitly, an item of trade on the market, with a use value.

Systematic pedological and agro-chemical mapping of soils carried out by the Romanian offices of pedological and agro-chemical studies supply precious data concerning the evolution of the soil quality, the establishment and differentiate application of cultivation technologies, land assessment and the establishment of crop

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favourability, the foundation of improvement works and of improvement technologies, the organisation and systematisation of the territory, etc.

Without establishing relations of dependence between assessment and global income, i.e. net cadastral income from each assessment grade is the crop – a starting point in economic assessment – taking into account the quantitative expression of the land (soil) potential.

Despite the fact that the information system is based on the methodology of carrying out pedological studies developed by the I.C.P.A. Bucureşti in 1987, this system is not strictly linked to it: there is also the possibility of adapting it to probable changes of the assessment methodology and to use some polynomial mathematical functions to replace the functions based on coded values of indicators or of other systems such as "Spatial database: foundation of a modern and performing management".

The modernity of the activities presented in this paper is given by the high level of implementation of technical means and procedures, as well as by the system of measurement based on waves with magnetic recording of the results, by the measurement techniques using satellites, and by the analytical cadastral processing of photogrammes, of automated graphic rendition systems, or by the systems that combine traditional mapping methods with remote-detection methods and the information abilities of the Geographical Information Systems (GIS), hardware and software systems adapted to different work stages (collecting and processing primary, intermediary and final data) and to databank organisation.

REFERENCES

1. PUŞCĂ, I. (2002): Câmpia Banatului./Banat field, Fundaţia Naţională Satul Românesc, Bucureşti, p. 86-130;
2. TEACI, D. (1980): Bonitarea terenurilor agricole. Bonitarea şi caracterizarea tehnologică a terenurilor agricole./Agricultural land reting. Evaluation and tehnological charaterization of agricultural lands, Ed. Ceres, Bucureşti, p. 58-146;
3. ŢĂRĂU, D. (2003): Bazele teoretice şi practice ale bonitării şi evaluării terenurilor din perspectivă pedologică./Theoretical and practical base of soil rating and evaluation from the pedological point of view, Ed. Solness Timişoara, p. 358;
4. ŢĂRĂU, D., MARTON, GH., RACOVICEAN, M., TRETA, D. (2005): Impactul tehnologiilor informatice asupra activităţilor de cartare, actualizare şi modernizare a studiilor pedologice. /It impact on mapping, up dating and modernization in soil science activitis, Ştiinţa Solului, vol.XXXIX, nr.1-2, Ed. Signata Timişoara, p.188-199;