SPATIAL ANALYSIS IN SOIL RATING BY MEANS OF GIS TECHNIQUES

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***Résumé:** *Le projet envisage implémenter la techniques GIS (Systèmes Informationnels Géographiques) à l'étude de la qualité des terrains agricoles. Vu que les facteurs qui déterminent la qualité des terrains agricoles ont une distribution spatiale, l'on considère que l'action complexe d'évaluation (surtout sur de grandes surfaces) ne peut se réaliser que dans le cadre d'un système informationnel. Par rapport à d'autres procédés d'évaluation du potentiel productif des terrains agricoles, l'utilisation des techniques GIS (Systèmes Informationnels Géographiques) fait possible le stockage et le traitement facile, informatisé de certaines données complexes géoréférencées et descriptives, provenues de différentes sources et qui offrent aux facteurs décisionnels du management agricole / territorial, des informations dans un bref délai et à un prix bas.*

Keywords: layers, quality of soil, geographical information system.

***Rezumat:** Proiectul îşi propune implementarea tehnicii GIS în studiul calităţii terenurilor agricole. Ţinând seama de faptul că factorii ce determină calitatea terenurilor agricole au o distribuţie spaţială, considerăm că acţiunea complexă de bonitare (îndeosebi pe suprafeţe mari) nu se poate realiza decât în cadrul unui sistem informaţional. În comparaţie cu alte procedee de evaluare a potenţialului productiv al terenurilor agricole, folosirea tehnicilor GIS face posibilă stocarea şi prelucrarea facilă, computerizată a unor date complexe georeferenţiate şi descriptive, provenite din surse diverse, oferind factorilor decizionali în managementul agricol / teritorial, informaţii într-un timp scurt şi la un cost mult mai scăzut.*

Cuvinte cheie: sraturi informationale, bonitarea terenului, sistem informational geographic.

1. Introduction

The use of Geographic Information Systems - GIS, in determining the quality of soils and the appraisal of agricultural land is a very modern technique both in our country and worldwide. As there is a wide variety of environmental conditions, in order to assess lands' productivity, we selected only the most significant aspects, namely, the conditions connected to landscape, climatic resources, hydrology and the features of soil. Within these groups of factors we also set only certain indicators, the most important, significant and most easily measurable, which are usually found in existing mapping papers: rating indicators. Value scales or divisions, partitions were developed for each indicator. The degrees of the value scales or divisions were thus designed to allow the differentiation of their influence by figures – coefficients. The use of GIS techniques is required and is justified especially due to the spatial display of information as well as the speed of obtaining information.

In 1977 a National System of Monitoring Agricultural Land Quality was founded in Romania as part of the Environment Quality National System, according to the recommendations of U.N.E.P. and the Order of the Agriculture Ministry.

The objective of this system is to observe the development of local soil features and their capacity of crop production and develops prognoses for the evolution of soil quality, in order to prevent the development of unwanted soil processes in due time.

Agricultural land rating represents a complex action of study and quantitative appraisal of the main conditions for plant growth and production, of establishing the degree of favorability for these conditions in the case of each use and crop (because a particular land may not be favorable for certain uses and cultures, but may be favorable for others).

Since lands' production capacity is altered under the influence of natural factors, but mainly due to man's intervention, the appraisal must be permanently kept up to date (to correspond to each stage of agricultural and economic development, on the whole). In the event of land improvement works which determine, in each case, a significant upgrade of environmental factors, this should be taken into account when assessing the land's production capacity by introducing the so-called potentiating elements.

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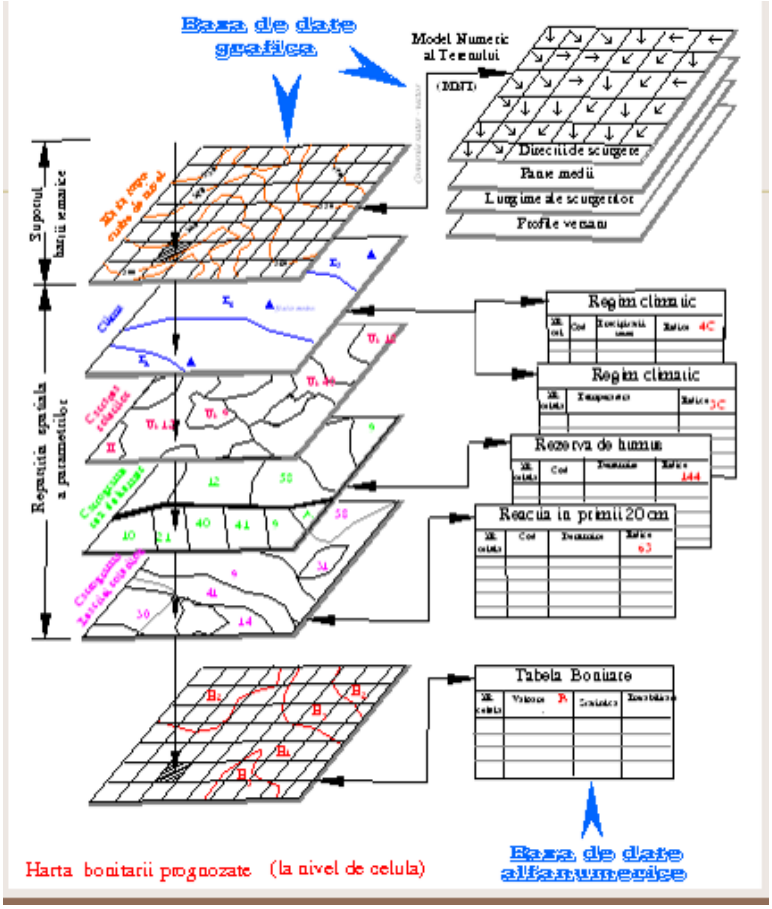

2. Study location

The studies for this paper are located in „Valea Livăzui" river basin, a tributary of Şomuzul Mic in Suceava county. The area studied is exclusively part of Fălticeni Plateau which represents the southern part of Sucevei Plateau. The studies were conducted in the Şomuzul Mic river basin, representing a hydrographic complex with an area of almost 300 ha located between Suceava de Nord and Şomuzul Mare de Sud rivers.

3. Research method approached

For implementing GIS techniques in the application from this contract we employed GEO – GRAPH Geographic Information System, a GIS-type software.

Figure 1 – *Overlay* technique for information layers within the GIS project

We used the overlay technique for information layers, by means of the pixel method. The size of a pixel was of 50 x 50 m; the graphic database was created on a relational-type SGDB (FoxPro under Windows). The scheme of this method is shown in figure no.1

The main stages of the study conducted (with examples in the following figures) are the following:

- identification of the studied river basin, complete study data;

- creation of GIS project architecture
- plan conversion from analogical into digital format – vectorization;
- creation of information layers for each rating indicator (graphic database);
- topology development;
- creation / development of calculation/simulation programs for Geo-Graph;
- development of attribute-type database (alphanumerical) (figure 3);
- software development for GIS-type query

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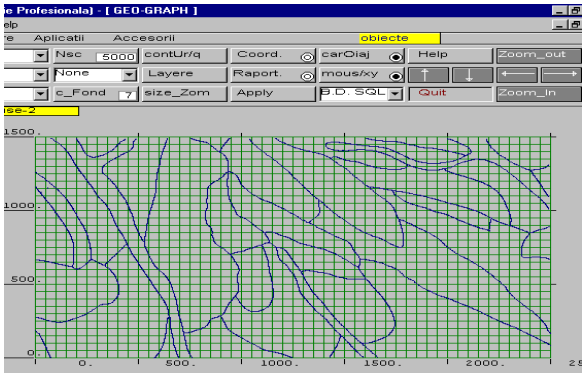


Fig. 2 – Detail for the overlay of the grid over the land unit plan for developing the topology

As the site plan of soil units is the most significant media for creating the database (and implicitly of the study) of rating indicators, the following layers which will be generated and shown in this study report are based on the mentioned site plan.

The SGDB proposed in the GIS project represents a system for the management of relational databases. Simply put, a relational system comprises several databases (usually called *„tables"*) simultaneously opened, connected through common field. The number of databases and common connection fields defines the complexity of the S.G.D.B.

CoefS	DBF	65,422
Cote	dbf	1,877,480
Directii	dbf	1,877,480
Eroziune	dbf	1,877,480
Folosint	dbf	2,743,996
Pante	dbf	1,877,480
Sisteme	dbf	2,743,996
Soluri	dbf	2,743,996

Figure 3 – Tables from the alphanumerical database

One of the main functions of a GIS is the query of the alphanumerical database, this function representing the difference between CAD and GIS systems. For making a query, the Database Management System which is used during the query as well as the query type need to be set up.

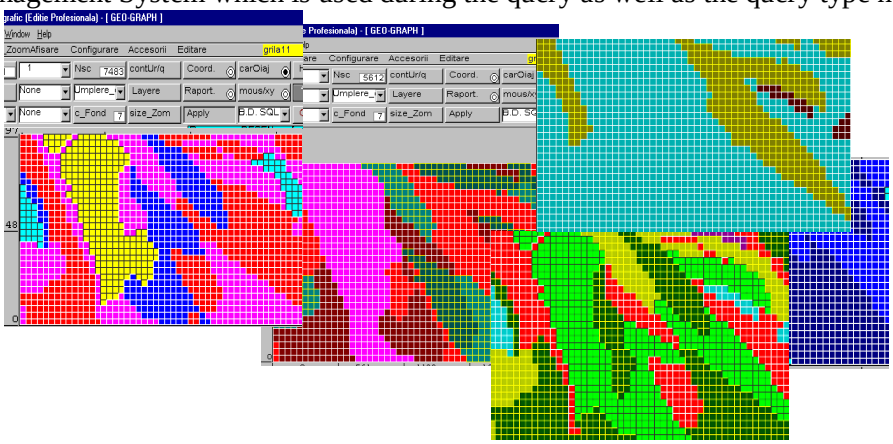


Figure 4 – Information layers for 5 rating indicators in the studied territory

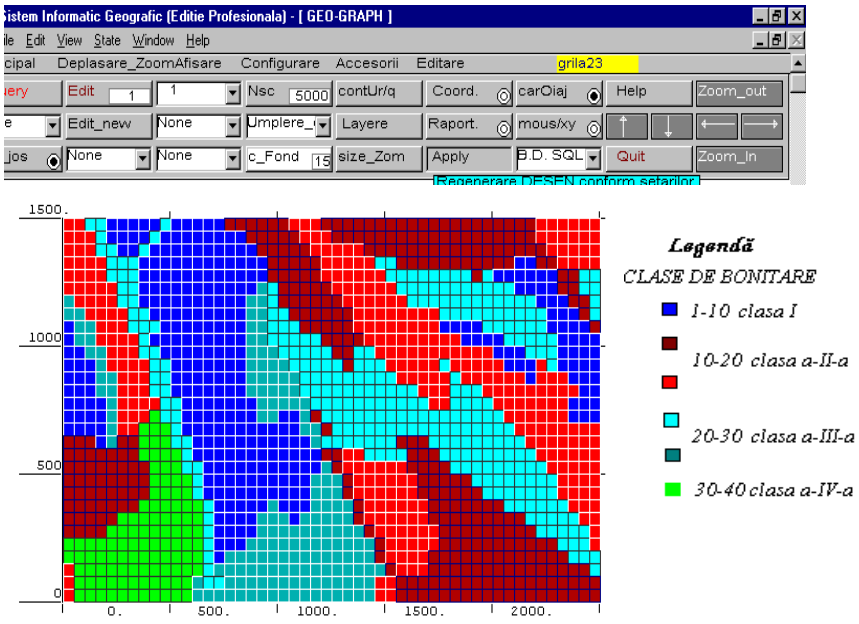


Figure 5 – *„Grid 23”* information layer - Rating classes resulted

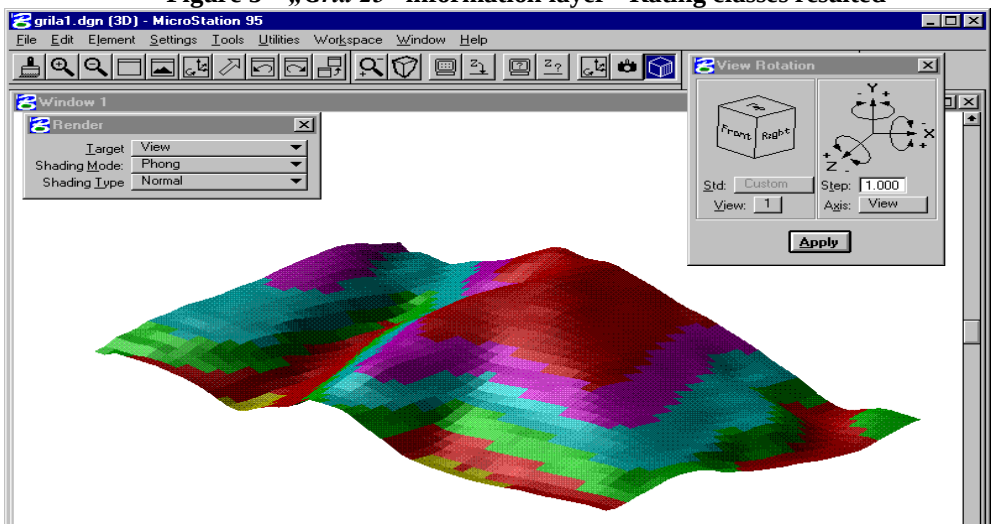


Figure 6 – Digital model of the field in 3D representation 3D on a test area

4. Results obtained regarding rating indicators for the studied river basin

For the GIS project, the following types of query are possible: through *„Fox keys”* or through *„SQL language”*, and by editing an SQL command, the *criteria query* is possible.

For the 3D display of the land's digital model it is necessary to use a software that has the capacity of *„rendering”* three-dimensional vector

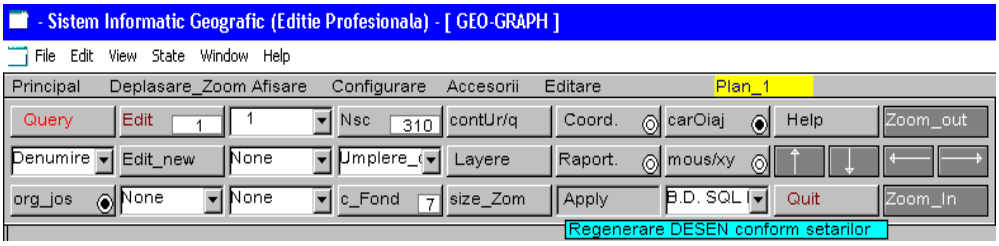
images. In the next figure we show the 3D graphic representation of the studied perimeter in the river basin, selecting the use of Microstation 95 (Bentley) software.

5. Conclusions

1. The need and usefulness of creating a system for the supervision of soil and soil features' hydrotechnical improvement systems for irrigation and drainage, in which the hydric and salt regime of the soil is highly altered due to the agricultural developments; the aim of this monitoring has been and still is to timely identify the negative trends of soil features' evolution under the influence of land improvement works and to take the appropriate measures to prevent or stop these tendencies, in due time.

2. The increased accuracy of studies conducted on the agricultural land quality may be achieved by constant database development and update and by making use of complex mathematical models for the prognosis of its evolution.

3. In the context of employing a GIS, a wide variety of data from various sources can be introduced in the system, sometimes extended through automatic statistical processing and thus a multitude of information is obtained, including syntheses for certain periods of time, graphics, and thematic maps for erosion risks or the need of intervention with agricultural- pedological improvement measures.



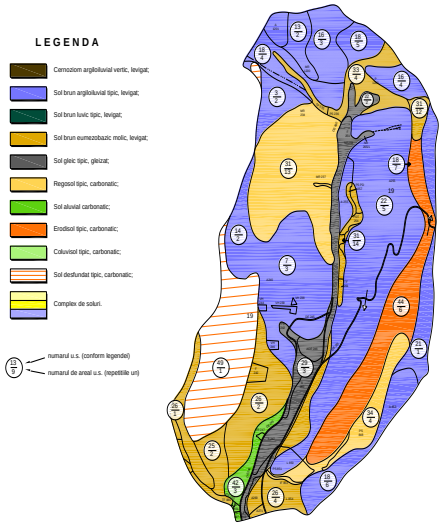


Figure 7 – Map of soils in digital format under Geo-Graph software in the studied river basin

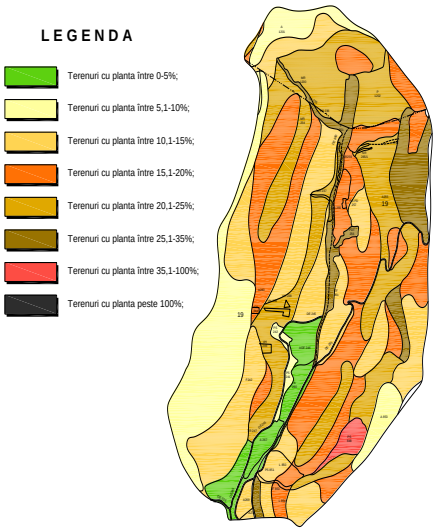


Figure 8 – Map of slopes in digital format under Geo-Graph software, in the studied river basin

4. *GEO – GRAPH* is a useful tool for the management and processing of graphical and non-graphical information. In the study reports, for each stage it was shown that the GEO – GRAPH system is an open system due to the structure of ASCII format input data. The user can generate his/her own programs which will create input data acknowledged by the GIS system, such as: data from sites represented by coordinate and outline files or data from *.dxf* files resulted from vectorization.

5. For the works of cadastre rating, it is required to transpose the limits of soil units taken from the pedological map on the lot cadastre plan. The rating marks (weighted averages) for each cadastre lot are recorded in the land registers.

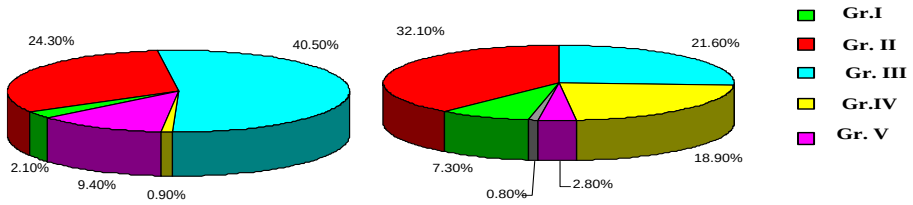


Figura 9 – Rating group repartition diagrammes in the studied river basin
evolution appeared simultaneously with the intensification of

6. The modeling/ simulation models support the specific land development solutions; the integration into a GIS, needs more data than usual, in order to obtain information / results as maps.

7. By analogy with other processes of production potential evaluation for agricultural lands affected by permanent degradation processes, GIS techniques provide real-time low-cost information to the land management decision makers.

8. In the context of natural and social-economic conditions from Romania, the use of Geographic Information Systems for the study and prognosis of land erosion and other associated processes represents a very modern requirement, taking into account the economic grounds and the speed of obtaining the information required for taking the appropriate decisions of improving the situation, in real time.

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Acknowledgements:
The research presented in the paper was done within the research project 31047/2007 DEGRATER, RESEARCH PROGRAM PNCDI II, Partenerships in Priority Domains.