LAND EVALUATION INFORMATION SYSTEM FOR REGIONAL PLANNING

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ABSTRACT

Since 1987, a coordinated research Project on Methodological Approach for Regional Planning is being carried out by the Consejo Superior de Investigaciones Científicas (CSIC, Spain) and the Universidade Estadual Paulista (UNESP, Brasil). This paper reports experience gained through the development of a land evaluation information system (LandIS), as powerful tool for characterization and evaluation the land/soil units. Major research emphasis was to develop a microcomputer-based land qualitative/quantitative evaluation methodology.

Additional index words: Automated land evaluation, Land capability, Land suitability, Early prediction, Geographycal information system.

1. INTRODUCTION

Presently economic crisis and environmental problems impose changes and restrictions on land use. Land evaluation can help policy makers to define standards as indicated by McRae and Burnham (1981), because the final product of land evaluation is a decision on optimum land use.

The potential use of computer-based methods in soil/land data analysis and classification, as in many other scientific branch, has been recognized since the 1960s (Hole and Hironaka, 1960). Two decades later, along the 1980s, the microcomputer (the popular PC) has become the spiral center of computer science. In the framework of the European Community, the Steering Group on Land Evaluation has emphasized the need of computerized systems for date gathering and modelling during the last workshops on Agroecological Modelling, Socio-Economic Criteria on Land Evaluation, Land Evaluation for Mediterranean Areas, and Application of Computerized EC Soil Map and Climate Data (CEC, 1982-89). For land use planning in less developed regions, this need is timely due to several particular reasons as related by Davidson et al. (1990).

Within this context, a coordinated research project (1987-90) on Methodological Approach for Environmental Planning is being carried out by the Consejo Superior de Investigaciones Científicas (CSIC, Spain) and the Universidade Estadual Paulista (UNESP, Brasil). As results of this Project, it may be pointed out the collaboration to develop the "CEAPLA: Centro de Analise e Planejamento Ambiental" in the Instituto de Geociencias e Ciencias Exatas, Universidade Estadual Paulista (IGCE, 1990). The adopted methodology and initial results on land resources survey of three test areas: Leme from Brasil, and Madrid and Huelva from Spain, were previously reported by the participating scientistis of the Project (García et al., 1989).

The aim of this paper is: i) to explain the methodology of a computerized qualitative/quantitative approach on land evaluation; and ii) to present the preliminary results of its application in Andalucia region.

2. LAND EVALUATION APPROACH

Within land evaluation and land-use planning, capability and suitability have often been confused or even regarded as synonymous. At the present, the experts draw a distinction between suitability for a single clearly defined purpose, e.g. barley production, and capability for a broader use such as agriculture or urban development (Verheye, 1986; Ferrari and Magaldi, 1989).

There also are different levels of detail in the technical approach of land evaluation (Bouma, 1988). Qualitative land evaluation methods, which represent less detailed technical approach often produce quick but general answers. More quantitative information is usually needed. which can be provided by applying quantitative land evaluation methods. The essential difference between qualitative and quantitative

procedures is that the latter applies more detailed technical approaches. The quantitative evaluation methods require more input data and more sophisticated tools than the qualitative ones, so application is generally more expensive. Thus and as indicated by Lanen et al. (1989), the most efficient use of quantitative methods would be to combine them with the qualitative ones. This mixed approach involves the broad screening of all lands for moderate or severe restrictions for a particular land utilization type, using qualitative evaluation methods, and then applying quantitative methods for the remaining areas wich are potentially suitable.

According to this considerations, the main research emphasis was to develop computerized techniques for assessing land capability, land suitability and early prediction, within a whole land evaluation approach. As part of a land resources information system, mixed qualitative/quantitative land evaluation methodology has been developed. The first stage of this mixed evaluation approach (Fig. 1) comprises the screening of land, based on severe climatic and site limitations using qualitative method. Slope (t), soil characteristics (l), erosion risks (r) and bioclimatic deficiency (b) were used as limitation factors to classify the lands into five capability classes. The lands grouped in Classes S1 and S2 are considered potentially very favourable for agricultural uses, and the other two Classes S3 and N correspond to excluded lands (De la Rosa and Moreira, 1987).

The more detailled, semi-quantitative methods are than focus on the remaining, potentially favourable land (Fig. 2). A first land suitability method establishs the relative aptitude of the agricultural soil for specific

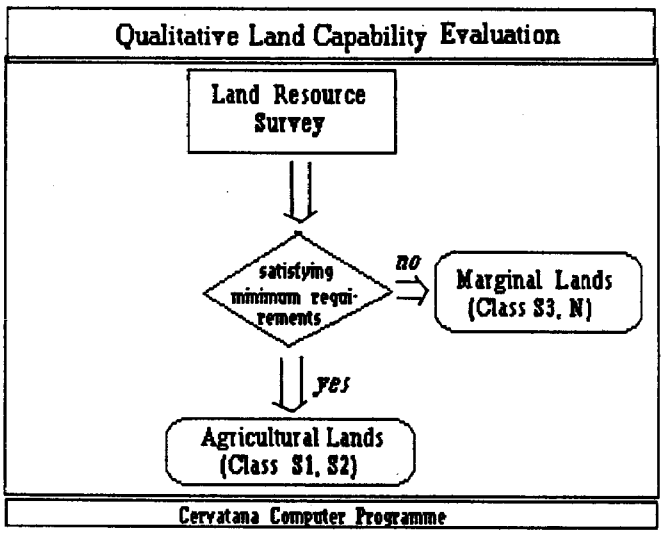

Fig. 1. Relational diagram of the evaluation process # 1: qualitative land capability, to exclude less favourable lands for agricultural uses.

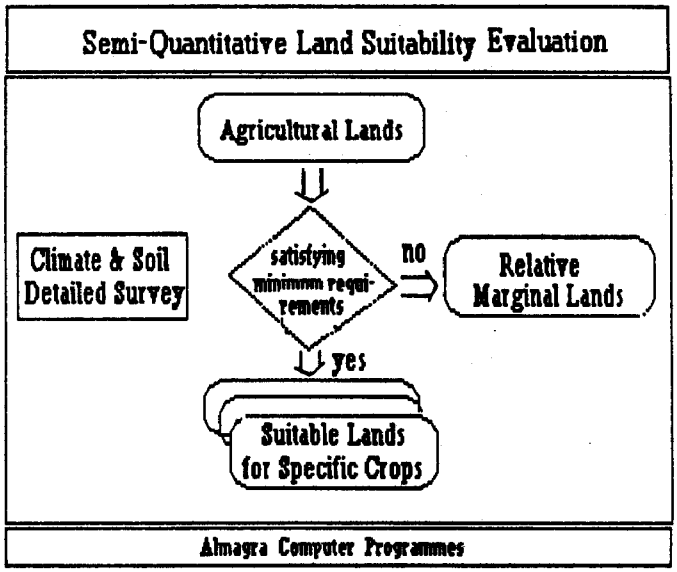

Fig. 2. Relational diagram of the evaluation process # 2: semi-quantitative land suitability, to choose more favourable lands for specific crops.

crops in Mediterranean regions. Seven soil characteristics: useful depth, texture, drainaje, carbonates, salinity, sodium saturation and profile development, are used as diagnostic criteria; and five suitability classes for each selected crop. For the most detailed land suitability studies, statistical models were formulated and calibrated for predicting crop yield from a combination of soil properties. These models, which represent transfer equations or mathematical classificaters, can be considered as modern techniques for quantitative soil evaluation system (De la Rosa, 1989).

The entire land evaluation operation of assigning land at a point or in some small area to a capability and suitability classes has been committed to a microcomputer. In the sequel, the Cervatana, Almagra I and Almagra II programmes* were developed, in GWBasic lenguage for MS-Dos/Personal Computer, to be used as interactive and user-friendly tool.

Finally, a quantitative early prediction process is being now carried out into the framework of Columela Project (Fig. 3; De la Rosa, 1989), in order to evaluate the cultivar crop growth potentials referred to yield production and product quality. A capture/structure processing of observational data and experimental knowledge of soil, climate, management and yield parameters has been developed, for several crops and study sites from Andalucia. Such recopilated

(*) This software, on two 5 1/4" of 360 K bytes floppy disks, may be obtained by contacting the senior author.

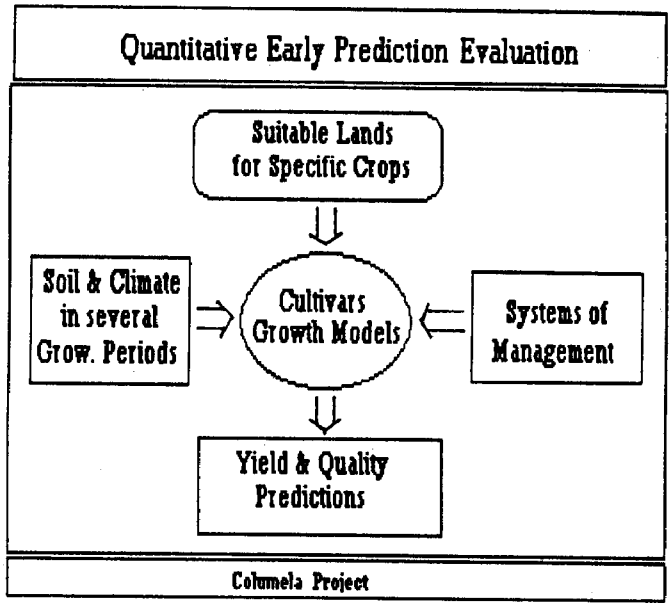

Fig. 3. Relational diagram of the evaluation process # 3: quantitative early prediction, for assessing cultivars yield and quality production.

information will be processed folowing computerized techniques of data and knowledge engineering.

3. PRELIMINARY RESULTS

The spanish benchmark zone for the Project was Andalucia, which is a Mediterranean region with an extention of 87,000 km2, and is included into the xeric belt of the European Community (Coordinates: 38°00'-38°44' N; 1°38'-7°31' W). Basic information of the Natural Resources Evaluation from Andalucia Programme (De la Rosa and Moreira, 1987), were used for interpretation according to the first stage of the proposed land evaluation approach. This basic land resource survey was conducted at an exploratory level of detail, scale 1/400,000, and referred to geomorpho-edaphic, hidro-climatic and present--use mapping units.

The interpretative results of applying the qualitative land capability method (Fig. 1), are presented in the Table 1. Andalucian acreage of excluded land (Classes S3 and N) is nearby 75 percent of the regional extension, whereas the most favourable lands for agricultural uses represent only the 26 percent. The spatial distribution of these land capability results was validated using remote sensing techniques (MSS-Landsat satellite imagery, scale 1/400,000).

TABLE 1

Acreage of excluded land and potentially very favourable land for agricultural uses in Andalucia region.

Capability Classes	Excluded		Favourable	
	km2	%	km2	%
Class S1			5,350	6
Class S2			17,350	20
Class S3	23,110	27		
Class N	40,730	47		

4. CONCLUDING REMARKS

To develop the entire concept "land resource inventory-land evaluation-land use planning", making use of computer information processing, it is need previously to establish appropiated land capability, suitability and prediction procedures as parts of land evaluation information systems.

These research works have to be made by scientific experts in close collaboration with land managers and policy makers, in order to get really operative land information systems. Thus, it may be possible to stablish the optimum use of land for maximum quality and yield production, and for minimum land resources degradation.

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