MAINTENANCE OF THE PHYSICAL POTENTIALITIES OF LAND: Case of Andalucia

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ABSTRACT

In the European Community (EC), maintenance of the biophysical land potentialities and diversification of the agricultural land uses may be presently considered the major challenges for land use planning. Within the framework of a mediterranean region: Andalucia, the concept of land marginality is revised through the land evaluation approach and considering both environmental constraints and crop quality aspects.

INTRODUCTION

Present land uses of the EC have to be changed considering new applications for its agricultural production, in order to get more quality and less environmental constraints (soil erosion, destruction of natural reserves, air, soil and water pollution). These changes must be made according to the physical potentialities and limitations of land, selecting optimal locations for the traditional and new crops (e.g. wheat, sugar beet and vineyard; and protein, oilseed and timber crops). For the mediterranean regions, the diversification of the appropriate uses of agricultural lands has to be analyzed studing, at the same time, the increasing marginal lands and the scarce natural lands. Land evaluation methods combined with computer-based information systems appear to be a powerful tool for this integrated analysis (Lanen and Bregt, 1988).

Land evaluation creates an "interface" between land related information and the integrated information requirements of land use planning (McRae and Burnham, 1981). Ecological land evaluation is concerned principally with the biophysical aspects of the land, without considering integration of socioeconomic factors. Natural resource inventory is fundamental to any form of planning, and its evaluation has to be able to effectively guide land use and conservation strategies in agriculture, forestry, wildlife, engineering, tourism and some mineral extraction.

Remote sensing and computer science represent the information new technologies more strongly used within the land evaluation process. Geograpfycal Information Systems (GIS) and Artificial Intelligence/Expert Systems (AI/ES) technologies, as sub-fields of computer science, are now a constantly envolving field with great potential for land evaluation and land use planning (De la Rosa, 1989).

The purpose of this paper is to point out the present need to revise the concept of land marginality, including more environmental and crop quality aspects; the role of land evaluation as "interface" between the land resource survey and land use planning; and the excellent prospectives to combine land evaluation methods with computer-based information systems for this integrated analysis. Results of the research programme "Ecological Land Resources Evaluation in Andalucia" (AMA, 1987) are used as reference for such considerations in the mediterranean regions.

GENERAL MARGINALITY

In the biophysical sense, land marginality may be considered antonymous term of land potentiality. According to conventional land evaluation approachs (FAO, 1976), land potentiality includes land capability and land suitability. General land capability makes special reference to the physical limitations of land in order to avoid environmental constraints. Relative land suitability is concerned with the optimal place for each specific land use. Therefore, it appears interesting to consider, separately, both general and relative marginality.

The land evaluation as interpretative grouping of land capability classes used to be established from the basic land survey: relief, climate, soil and present use, and for agricultural, forestry, grazing uses and natural protection. The subclasses point out the major conservation needs or land limitations: slope, soil, erosion risks, bioclimatic deficiency, etc.

In the "Ecological Land Resources Evaluation in Andalucia" programme (AMA, 1987), the basic land inventory of the region (87,000 Km^2) was conducted at an exploratory scale (1/400,000) using numerous already existing studies at various levels of detail and of local, provincial and regional application. In the geomorpho-edaphic survey, map units were differentiated according to patterns of land-forms, geological materials and dominant soils. Altitudes range from 0 to 3,478 m in the region, where 36 % are areas between 200 and 600 m, and only 0.6 % with 2,000 m; 40 % of the total area present 7 % slopes, and the 19 % have 30 %; and Entisol/Xerorthents and Xerofluvents (30 %), Inceptisols/Xerochrepts (25 %), Alfisol/Rhodoxeralfs (13 %), Vertisol/Chromoxererts (11 %), Aridisols/Camborthids (2 %), Mollisols/Haploxerolls (2 %), Ultisols/Palexerults (T), and Litosols and others (15 %), are the Orders/ /main Groups soils identified in the whole region. The hidro-climatic map shows mapping units which are identified according to climatic potentialities and limitations, surface and ground water resources. Precipitation presents an annual mean of 630 mm, with the maximum (912 mm) in Cadiz and minimum (347 mm) in Almeria province. Temperature annual mean is 16.8ºC, being maximum (17.6ºC) in Sevilla and minimum (16.3ºC) in Jaen. The global estimation of subterranean water resources is 4,000 Hm^3/year, and the total big dams capacity is about 6,5000 Hm^3. The present-use and vegetation map shows current land use by delineating arable cropping patterns, grazing, forestry and non-agricultural land use. Estimated proportions of main land use forms are showed in the Table 1.

The basic land information was interpreted, according to the FAO (1976) and CEC (Verheye, 1986) land evaluation approachs, in order to get the land capability classes (Table 2). In Andalucia, marginal lands (Class N) are almost the half of the whole area, and their extension is quite similar to the forestry, grazing and natural lands (Table 1). The lands of moderate capability (Class S3) are mainly agricultural lands which

need special conservacionist attention to avoid the general marginality.

TABLE 1

Present land use in Andalucia region

Land Use	Estimated Extension (10^3 ha)	Percentage
Irrigation crops	592	7
Rainfed crops	3,165	36
Forestry, grazing and natural	4,007	46
Others	936	11

TABLE 2

Land capability classes in Andalucia region

Capability Class	Estimated Extension (10^3 ha)	Percentage
S1 Excellent	535	6
S2 Good	1,735	20
S3 Moderate	2,311	27
N Marginal and Nule	4,073	47

In relation to the soil erosion risks, as one of the major land limitations of mediterranean regions, Andalucia have 45 % of lands with high or very high risks (Class S3r or Class Nr; Table 3). A detailed study on the erosion risks in agricultural lands from Andalucia has been developed by Moreira (1989), which establishs the relationships betwen the values of water erosion calculated by several empirical methods and its influence on land productivity.

TABLE 3

Soil erosion risks in Andalucia region

Risks Class	Estimated Extension (10^3 ha)	Percentage
S1 Low	1,398	16
S2r Moderate	3,379	39
S3r High	3,136	36
Nr Very High	785	9

RELATIVE MARGINALITY

The land evaluation as interpretative grouping of land suitability classes is developed in order to meet specific biophysical requirements of selected agricultural and forest uses. In Andalucia region, where the main annual crops get up the estimated yields presented in the Table 4, two suitability classifications were established for 18 crops and 24 forest species respectively, according to wide ranges (optimum levels) of soil and climate parameters. The soil factors are mainly useful depth, texture, drenaje, reaction and salinity, and the climate factors include maximum and minimum temperature, thermic integral, water need and growing period. For each factor and selected use, the optimum or preferable level was estimated through a comparison process of yield data and land related information, along with a bibliographic review referred mainly to Andalucia region. So, it was developed two general guide to select agricultural and forestry uses en Andalucia, as first approximation to a land suitability evaluation (AMA, 1987).

TABLE 4

Average yields (1979-1985) of main annual crops in Andalucia region

Crop	Estimated Yield (10^3 Kg/ha)	
	Range	Mean
Wheat	4.1 - 0.5	3.1
Barley	3.6 - 0.6	1.9
Oat	3.1 - 0.5	1.6
Corn	9.5 - 2.7	7.4
Sunflower	1.6 - 0.3	1.1
Sugarbeet	53.9 - 24.1	33.3
Cotton	3.9 - 1.0	2.9

For profounding in the relative marginality concept, information new technologies: Land Evaluation Information Systems (LandIS) and Artificial Intelligence/Expert Systems (AI/ES) will be used within the Columela Project (De la Rosa, 1989). To that end, in the Fig. 1 is designed the combination of both systems, LandIS and ES, for implementing a global Decision Support System (DSS) in Andalucia region.

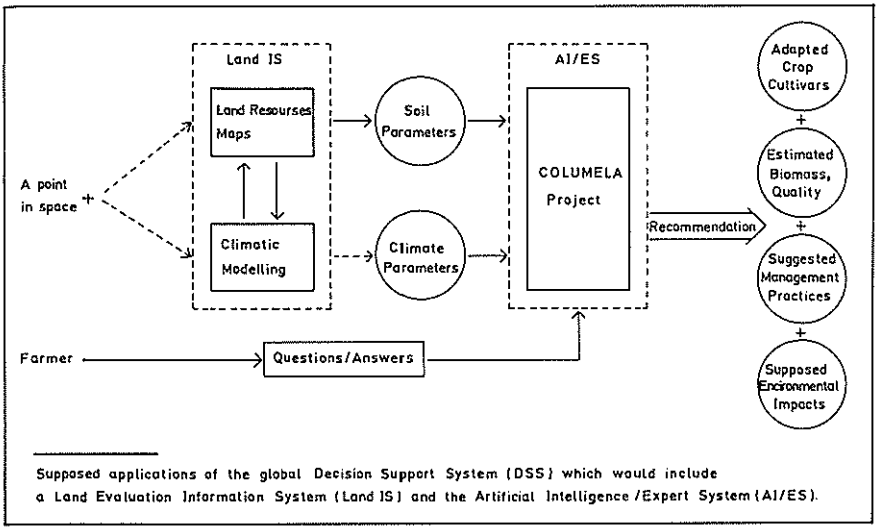

Figure 1. General flow diagram for predicting the ideal use and management of agricultural lands by way of a DSS.

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