SYSTEMS SCIENCE

ADDRESSING GLOBAL ISSUES

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SYSTEMS SCIENCE AND THE ALTERNATIVES TO THE CHANGES OF SOIL IN AREAS OF TRADITIONAL AGRICULTURE

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INTRODUCTION - AIM OF THE TASK

The ecological theory has been developing for many years in the same conceptual and methodological framework as the general theory of Systems (Hernández, 1991). Ecosystems, as complex systems, are in many cases difficult to study, but much more when they are subjected to human interventions during many centuries. Such is the case of Agrosystems. The agricultural landscape is the expression in space and time of human effort in search for his daily nourishment. But since the landscape is a complex system of relationships, it is necessary to analyse its components so as to understand the past and their processes of development.

The present trends about landscape knowledge, taking into consideration the ecological and systemic approach are expressed in Hernández and Pastor (1991). We have already talked about the high degree of resemblance that exists between "ecological thought" and "systemic thought" (Hernández and Pastor, 1989). Now the question is if we can apply the most theoretical question to the realization of a project about the changes which some characteristic systems can suffer.

It is a question of giving importance to ways of relationship man-nature and of social interaction which can satisfy basic human needs, but looking for a new balance with the environment at the same time. Therefore we'll talk about agroecosystems. In short, to maintain the ability of production and respect for the environment.

To apply the knowledge of systems science to our study subject means that agroecosystems will be explained by means of some variables which is important to determine.

But our final aim is to be able to know the dynamics of these systems so as to intervene in them in a more reasonable and ecological way. Because of that, to describe them will not be enough. We have to find the variables of these dynamics and then to build a model which allows us to act taking into account the exploitation, the resources conservation and the decreasing of the erosion which these systems are subjected to. Then, next the main results

that we have been obtained in the first stage of this project are exposed: characterization of the systems components and the main variables.

THEORETICAL BASE OF THE PROJECT

The conception of the system as an interrelationship between these elements has privileged the character of its organization. The central concern is not the "relationship" but the organization which shows the parts of the whole. We agree with Morin (1983) affirming that the organization is the category which explains the productive and dynamic strength that the concept of system has in itself. The properties for the assessment of Agroecosystem: productivity, stability, sustainability, autonomy, equitability are directly related to the organization of the system.

The productivity parameters will not only be of an economic nature, but they will also be based on the potential of the edaphic and biotic resources. The main questions which demonstrate what we understand by stability are expressed in Hernández (1991). The autonomy will take into account the self-sufficiency (autochthonous species against imported cultivation, farm work techniques suitable for the territory where the agroecosystems are located, etc.) as well as not promoting environmental impact (for example by agricultural practices which contribute to further erosion or pollution of the soil. As for the property of equitability, it will be necessary to take into consideration the evenness of distribution of benefits (Hence the importance that the agricultural collectives have in these systems).

One of the main aspects to consider in the development of sustainable projects is the correct management according to the environmental conditions of each region of the three natural and inter-connected resources the soil, the vegetation and the livestock. However, these resources are often considered independently over a short time, and without an integral view of them. In our country, big extensions of the mediterranean area with low rainfall and exclusive use for cereals and/or sheep (González and Hernández, 1992), are much damaged as a result of ignoring the complex system of soil-plant-herbivore.

Therefore, it is necessary to get to know the organization of the system so as to manage it reasonably. Firstly the components of the system will be identified and secondly the principal variables of each of them to be analyzed. The flow or the interrelation between the variables will be seen later.

STUDY AREA

Mediterranean agrosystems of siliceous soils are of great interest due to the heterogeneity of their structure and the high biodiversity in forage value grasses and legumes which are in many cases needed to resist erosion processes. At the same time these semiarid environments have a scarce capacity of regeneration which is sharpened by the negative influence of deforestation, misguided repoblation, fire, heavy grazing and mechanized agriculture. Recently, new problems like the abandonment of cereal growing lands and the loss of traditional agrarian activities have added to them. These disturbances facilitate the disappearance of plant cover and generate an almost bare soil with low organic matter content, nutrient loss problems and altered biogeochemical and biotic cycles. Irregularity and scarcity of rains, and the mild climate, which favours the quick disappearance of mediterranean agrosystem, as well as, the bad state of the plant cover which provides low soil protection.

According to the E.C. criteria, the mediterranean landscapes show the strongest proportion of impoverished areas. The productive base of land and work in this area not only

Table 1. Estimated parameters for the study of the system components

Components	Parameters
Physical	Soil particles, soil density, soil structure, soil humidity parameters.
Chemical	Ca, Mg, P, N, K, S; organic matter, soil pH.
Biological	Plant cover, soil seed bank, soil microfauna.
Productivity	Sheep production, cereal production, pastures production.
Human	Searchers-farmers workshops.

Figure 1. Main processes of degradation and conservation practices in the studied agrosystems.

reflects a relative economic underdevelopment, but also difficult agricultural conditions of productions.

The work has been carried out in two experimental farms located in the central area of Spain, with similar climate but different soils, frequently used for dry farming, grazing or fallow-cereal rotations with the sheep participation. The experimental design takes into consideration the different uses of these soils and the repercussions on soil structure modification, potential pioneer pasture plants and sheep stocking rate (Hernández et al, 1992).

Degradation processes of the soil due to the use of it just for cereal cultivation are described in Figure 1. Conservation practices which are being studied are also reflected in the same figure.

CHARACTERIZATION OF THE COMPONENTS AND SYSTEMS VARIABLES

The soil degradation is a process which lowers the present and potential ability it has to produce goods and services. This process does not necessarily in a continuous way, but may happen in a relatively short period between stages of ecological balance. This degradation is not only function of material factors, but that the type and use of the soil determines the degree and extension of degradation. In different territory sectors that have been studied, the several alternatives of use, we are analysing the same physical, chemical, biological, of productivity and human components.

The difficulty to look for the variables with a greater information in the dynamic of these systems is that they are always variables linked to the inner part of the subsystems, which -at the same time- interfere among them in the bosom of the global system. For example, the study of the productive component implies the simultaneous consideration between relationships, soil, climate, water, slope and the plant, as the interferences between that aforementioned set and other combinations of variables in the determination of different forms, order and election of the cultivated species.

The evaluation of the components of the soil-plant-herbivore system has been elaborated from the integrated analysis of the information. (See Table 1).

CONCLUSIONS

The recent reforms in the directives of the Community Agrarian Policy are affecting cereal agrosystems and also the systems of traditional production in our country. We are studying the compatibility between exploitation, conservation of resources and the reduction of erosion in these systems. The experimental design which seems to allow us to get satisfactory results so as to channel a sustainable development of the resources, soil, vegetation and livestock is based on the science of systems.

The first results obtained about this fact help us to assess the next variables: compactation, erosion and the nutrients in the soil; biodiversity generation through the soil seed bank; the plant biomass and the efficiency of crops and the ways of farmer intervention of the area in the research project.

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