Socio-economic analysis on land-use change studies*

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Understanding the dynamics of land-use change is a scientific challenge of considerable importance to humanity. The demands for improved knowledge of environmental processes and the impacts of policy on their dynamics must increase, as population pressures on food supplies and natural resources mount and the publicly held perception of preserving environmental diversity and amenity strengthens.

Some of the most profound changes in the landscape have arisen from direct decisions by man concerning land use, and these have affected both the quality of environmental resources and the sustainability of food production. Land-use decisions are based on opportunities and constraints affected by both biophysical and socio-economic drivers. Predicting future land-use change requires methodologies that integrate understanding of the processes affected by these drivers. Because the dynamics of land use and land cover can have biophysical, social, economic, or ecological drivers, we must use an interdisciplinary approach to analyse the different problems. Lest the work depart from the disciplinary perspective of traditional land-use studies it must maintain the specificity of each science.

Land-use change being one of the main issues integrating the debate on sustainable development, its analysis clearly demands an integration of spatial/ biophysical data with the socio-economic data. This paper deals with the identification of the required conditions for a real integration of disciplines, without which an integrated analysis may not be possible.

Integration underpins the success of the policy-making process and aids in defining research priorities relevant to policy decisions. It needs to involve the concerned stakeholders: for example, landowners and agricultural managers, local and national regulators, planners and governments, local and national pressure groups, the private and entrepreneurial sector, and the wider public.

The majority of studies tend to concentrate on the effect and impact of man's actions on the environment, dedicating little attention to the consequences of those changes on human activity. Studies on the role which humanity plays in global change are often carried out within the concept of an *analysis of the human dimension*. Thus, they lose the systemic perspective which considers society as a sub-system interacting with the natural sub-system within the far-reaching and integrated framework which is the global change system (Mesarovic et al. 1996). The use of this systemic perspective allows the complexity of the interactions defined by the social and natural systems to be incorporated in the analysis and prompts the development of a different view on the relationship of these two systems. In other words, the social systems are changed at the same time as they modify the natural system.

It is assumed that the reactions of the different land users will largely determine the impact of the policies in terms of constraints and opportunities for development. This conceptual approach should take into consideration the external driving forces, the general framework of measures which direct and rule society's intervention in nature.

Attempts at assessing environmental and policy change impacts on the sustainability of land-use systems in Europe have traditionally followed two approaches.

1 'Disciplinary approaches', developed from the perspective of a single discipline and using terms of reference and techniques most acceptable to that discipline, often with only a limited consideration of broader influences.
2 'Generic approaches', developed primarily within the impacts' community, which attempt to provide forecasts of likely scenarios that encompass the dynamics of complex systems.

Whilst disciplinary approaches provide scientifically exact methodologies for constructing robust frameworks within which assessments of sustainability and policy impacts may be carried out, they often underestimate the range of variability associated with complex systems. Conversely, the generic approaches attempt to encompass the breadth of complex systems, yet often lack the robust methodologies and process descriptions required to accurately forecast future changes, often failing even to predict the current observed variability.

The multi-disciplinary approach departs significantly from existing research addressing similar

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issues. Existing approaches distinguish between the biophysical and economic (Carter et al. 1994), reflecting both the disciplinary perspective of researchers and the difficulty in attracting funding from traditional sources when addressing cross-disciplinary research. The unified approach will more adequately address sustainability in terms of 'cost-benefit' analysis by developing a common baseline for both the economic and the physical attributes of the landscape. Furthermore, this baseline approach will allow a numerical appraisal of the concept of sustainability, which traditionally has been difficult to quantify (Pearce 1993). In addition, efforts will be made to incorporate social science research and stakeholder inputs, which cannot readily be translated into model form.

Another issue relevant to this kind of analysis is the integration of different scale analysis. If we search for answers at local level we must not forget the external driving forces in other levels of intervention, i.e., the regional and the global framework that influences the local or the individual level.

The issue of spatial scales is approached from a different perspective. It is current opinion that aggregation and desegregation between the smallest spatial unit of production decision-making in the landscape allows different spatial scales to be achieved. This is a conceptually coherent approach, given that aggregation can result in information loss. Furthermore, it allows the effects of large-scale phenomena, for instance shifts in market orientation or weather patterns, to be addressed through an assessment of modifications induced at the lowest scale of production.

For the integration of the socio-economic perspective in the study of land-use changes, it is not enough to collect socio-economic data and present its spatial pattern of distribution or even its combination with spatial data. The integration of different disciplines requires the close collaboration between these disciplines, even at the stage of defining the datasets needed.

The information to be collected depends on the questions each scientific perspective has to the same object, i.e., land-use change, and also on the scale of analysis. Based on the definition of the problems, each scientific approach has to identify the questions it may deal with as a contribution to this explanation. A dialog is necessary for the understanding of the different questions and of how the different approaches may contribute to each other's development within the subject.

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The European Union experience on groundwater vulnerability assessment and mapping*

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Introduction

In February 1991, the groundwater group of the ECC (European Community Commission) met in Brussels with the purpose of establishing an international agreement on common methodologies for the elaboration of a groundwater resource inventory for all member states. Such an inventory had been made between 1979 and 1981 for all countries that were members states at the time, but needed to be updated to include new members states. It was decided at the meeting to uniformize the criteria and procedures used by each member state to evaluate, rank, and map groundwater pollution vulnerability.

Groundwater vulnerability

The term vulnerability has been defined and used before in the area of water resources, but within the context of system performance evaluation. Hashimoto et al. (1982) present an analysis of system performance which focuses on system failure. They define three concepts that provide useful measures of system performance (1) how likely the system is to fail is measured by its *reliability*, (2) how quickly the system returns to a satisfactory state once a failure has occurred

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