Governing sustainable land use: An econometric model approach

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Environmental conditions and the socio-economic setting are key driving factors behind land use and land use change. This complex set of different factors determines the land allocation and land management decisions by farmers. The result is a specific land use pattern that can be described by its production and income but also by its resulting effect on the environment through e.g. soil degradation, greenhouse gas emissions, etc. Policy makers aim to have control over the management decisions to control e.g. production and soil degradation but they can only intervene to a certain extent through the implementation of direct control measures like the limit on fertilizer applications in the European Union or indirectly through price policies. However, it is extremely difficult to predict the impact of particular interventions. How can we understand the system and its behaviour?

Econometric techniques have been developed in the past to describe the production system in terms of input demand and output supply equations. These techniques provide us with insight in the basic driving factors behind agricultural management. The production model can also be used to develop a simulation model describing agricultural management of a population of farmers. Subsequently, such a simulation model can be used to analyse the effect of agricultural policies or technological innovations on regional land use. The resulting land use patterns will have their positive or negative impacts on e.g. environmental quality. A linkage between the economic models and environmental impact models allow us to estimate the consequences of particular land use patterns.

The results of such a modelling exercise can be expressed in terms of relationships between various indicators dealing with e.g. land use, income, and environmental impact. Tradeoff curves can be constructed representing the change in the input parameters (*e.g.* prices). Scenarios can be formulated that represent the intervention by policy makers and can include the direct interventions through *e.g.* limits on input use or indirect through extension with the introduction of new practices.

The above procedures have been operationalized in the Tradeoff Analysis Model and applied in various cases. In the USA and Senegal the model has been applied to evaluate the potential effect of payments of environmental services for carbon sequestration. In Ecuador the human health effects and environmental impacts related to pesticide use have been evaluated. In Peru, the soil conservation service requested the evaluation of its current policy to support terracing. In Kenya, potential interventions to deal with soil fertility decline have been evaluated in relation to food security and poverty.

What can we learn from these cases? An integrated analysis provides us with insight in these complex systems. The results may confirm rather intuitive ideas about interventions but in other cases show us rather counterintuitive results. An integrated analysis is required to look at these systems and understand the underlying processes.