Deutscher Tropentag, October 8-10, 2003, Göttingen

"Technological and Institutional Innovations
for Sustainable Rural Development"

Modelling the Development of Natural Pasture and its Sustainable Use

Hans-Jürgen Buss, Ernst-August Nuppenau

Justus-Liebig-Universität Giessen, Institute of Agricultural Policy and Market Research, Germany

Abstract

This paper reflects on a growing opportunity of interdisciplinary collaboration across ecological and economic sciences towards the dynamic modelling of complex ecological economic interactions. It uses rangelands as an example. The importance of interdisciplinarity in natural pasture research is highlighted, as most natural rangeland problems involve the interaction between social and ecological forces. Causes for overuse are identified as misperceived behaviour of farms and households, and the consequences can be measured in terms of changing production potential of rangelands. Therefore feed back effects, running in both directions, have to be considered. The paper considers two different developments: those based on perceptions from rangeland system ecology, and those based on the inclusion of vegetation dynamics in models of rangeland utilisation. The first one includes models simulating complex vegetation dynamics by cellular automatons and Markov chains. The second comprises on growing sets of models dealing with links between economy and biology. Normally, the links can be found as bio-economic rangeland models. Models are characterised by the fact that the economic optimisation problem is constraint by the vegetation dynamics of the natural pasture being exploited. The paper discusses two different approaches and provides related simulations. Possible future developments of natural pastures as sensible to a variable economic framework and the impacts of climate change are highlighted.

Furthermore, the paper shows innovations in modelling on discontinuous and more event-driven responses to semi-arid vegetation, in particular with respect to utilisation rates. In a case study on central Namibian rangelands we focus on bush encroachment and pasture quality. Within a typical optimal control approach in dynamic programming, a state-and-transition matrix serves as an interface to relate the biological system to the economic system, i.e. market prices and institutional constraints. As a useful by-product of this attempt one can derive shadow prices for scarce natural resources which can be regarded as an internal valuation of the environment. Thereby, the resource quality is referred to as state variables within a multi-equilibrium system. Finally, this paper describes possible suggestions for environmental policy to sustain natural pastures as derived from the different modelling approaches.

Keywords: Bio-economic, cellular automata, environmental policy, models, rangeland, state-and-transition

Contact Address: Hans-Jürgen Buss, Justus-Liebig-Universität Giessen, Institute of Agricultural Policy and Market Research, Senckenbergstraße 3, 35390 Giessen, Germany, e-mail: hans-juergen.buss@agrar.uni-giessen.de