iEMSs 2008: International Congress on Environmental Modelling and Software
Integrating Sciences and Information Technology for Environmental Assessment and Decision Making
4th Biennial Meeting of iEMSs, http://www.iemss.org/iemss2008/index.php?n=Main.Proceedings
M. Sànchez-Marrè, J. Béjar, J. Comas, A. Rizzoli and G. Guariso (Eds.)
International Environmental Modelling and Software Society (iEMSs), 2008

The Use of Environmental Modelling in Innovation and Policy Assessment: on Foresight, Insight and Hindsight

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Keywords: agricultural systems, integrated assessment, learning, policy-oriented research

Almost any scientific paper on environmental modelling, decision support systems or integrated assessment tools claims and argues that the management of land and natural resources can potentially benefit from such research efforts. Whether this potential is actually fulfilled is a question that only recently has been receiving some explicit attention (see McIntosh et al, in press for an overview from iEMSs 2006), and the relatively few documented analyses [e.g., McCown et al., 2002; McIntosh et al., 2005] show that the potential in terms of measurable impact is often not achieved. Also, impact is not easy to measure as the processes at which these research tools target are frequently highly non-linear and dispersed in time and space. This paper reports and reflects on the contributions of *land use* models, as one type of environmental models, to learning for societal problem solving, i.e., learning of farm managers and/or land use planners at local, regional, national or international level, to solve land use related problems. This is done through seeking a suitable opportunity to introduce a research model [e.g., Sterk et al., 2006], a comparative analysis of several cases where research models had a demonstrated impact [Sterk, 2007] and experiences from recent projects [e.g., Van Ittersum et al, 2008]

The research models that form the basis of this paper all attempt in some way to address the future, but with different purposes and methods. Foresight studies can be classified, for instance, as either projective, predictive, explorative or speculative [Van Ittersum et al., 1998] and their roles may be heuristic, improving understanding, symbolic, putting an issue on the political agenda, and relational, creating a community [Shackley & Wynne, 1995; Van Daalen et al, 2002; McIntosh et al., 2005]. These may be, implicitly or explicitly, targeted at different phases of innovation or policy cycles [e.g. Van Daalen et al, 2002]. Do computer models play such roles and if so, what kind of arrangements, conditions, model qualities, or other factors harness land use modelling to perform specific roles in contexts where different stakeholders play a role?

In our research, in successful cases, learning through modelling took the form of a new perspective on a land use system, frequently in combination with a better understanding of the position of other stakeholders, resulting in adapted problem definitions, a changed solution space and/or the formation of new coalitions to tackle a particularly land use related problem. Models were found to contribute not only to improving understanding (heuristic role) but also to agenda-setting (symbolic role) and the creation of communities (relational role). Literature suggests critical success factors for research models, such as the need for proper timing of availability, ease of graphical user interfaces, transparency and representation of uncertainties. In addition to, and at times perhaps instead of, such rather

technical, static and distinct factors, the study suggests that societal context, actors aspirations, experienced interdependency, network building and model contextualisation were explanatory variables for impact of computer models. Thus, we (researchers) need to anticipate the relatively fluid and fuzzy features of social contexts and problem solving processes to harness land use modelling for societal learning.

What do the findings imply for those who wish to pursue the use of science-based land use models to contribute to societal problem solving? First of all, the analysis demonstrates that the contributions of land use models to societal problem solving can be various and distinct. The contributions are not limited to learning about a land use system but are more diverse and extend to learning about the views, norms and values of other factors, mediation of conflicts between stakeholders and community building when the organization of stakeholders is desirable for coping with a problem. Furthermore, the research suggests that in designing a modelling strategy, equal attention needs to be paid to the requirements for model development, and the embedding of the work in a given/intended societal context. For policy-oriented research specifically, the notion 'boundary arrangement' of science and policy proved helpful in understanding the position of science vis a vis policy and its institutions and hence in better devising a strategy for contextualisation that enhances impact of model-based research [Sterk et al, in press].

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