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Response to Hersperger *et al*. 2010. "Linking Land Change with Driving Forces and Actors: Four Conceptual Models"

Feedback Loops Added to Four Conceptual Models Linking Land Change with Driving Forces and Actors

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Feedback loops that link the consequences of land change to agents and driving forces are essential in understanding the relevance of models. This aspect needs to be added to the four model types discussed by Hersperger et al. (2010)

Although we appreciate the efforts to develop a functional taxonomy of models of land use change, driving forces, and actors, we miss an important class: models with feedback from the consequences of land use change to actors, to driving forces, and/or both. Because the primary societal reason for a scientific analysis of changes in land cover is the consequences of land cover change on a wide range of stakeholder interests and the various ways stakeholders can try to modify land cover change in their favor, the utility of the conceptual models will depend strongly on the type of entry points the models provide for feedback (Fig. 1).

Four main types of feedback are:

1. Land use, or the direct benefits that agents derive from their impact on land cover; it usually involves direct learning and relatively short response cycles, although there is ongoing debate about how much an economic lens misses of real motivations of the agents (Villamor et al. 2011).

2. Land use planning, or the attempts by stakeholders of land cover beyond the land user, to change the rules that are part of the set of drivers influencing land users.

3. Agent-specific modification of incentive structures that are conditional on performance, as attempted in forms of Payments for Ecosystem Services and related institutions (Tomich et al. 2004, Van Noordwijk et al. 2004, Swallow et al. 2009, Van Noordwijk and Leimona 2010).

4. Generic changes in rules and economic incentives through policy change that is expected to enhance ecosystem services and/or economic performance at (sub)national scale, as currently discussed under the Reducing Emissions from Deforestation and Forest Degradation (REDD) umbrella where clarity on drivers and agents is needed (Blom et al. 2010).

A fifth component of the system is at the interface of numbers 1 and 5 in the form of Negotiation Support Systems (Van Noordwijk et al. 2001, Clark et al. 2010) in which multiple stakeholders, usually based on their own understanding and interpretation of the drivers-agents-change relationship, negotiate a range of options to manage the trade-offs between their respective stakes.

Regarding the claim of Hersperger et al. that most current agent-based models consider only one type of agent, that may be true numerically, but the exceptions are important and point to a way forward. Typically, agent-based models capture the 'heterogeneity' of a group that would be considered to be homogenous or represented by an average in other models. Brown and Robinson (2006) referred to heterogeneity in two types, namely (1) variability, which reflects continuous variation in agent characteristics across entire populations or within single agent types, and (2) categorization, introducing multiple types or groups of individuals with similar or differentiated preferences.

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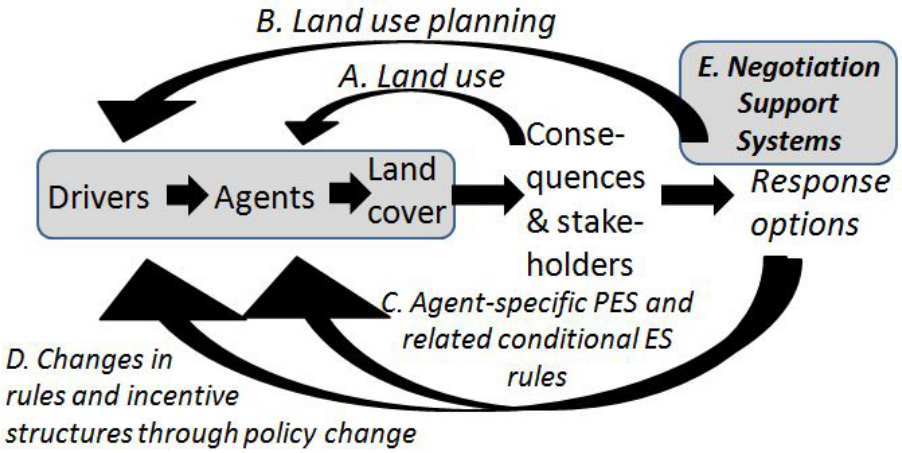
Fig. 1. Drivers, agents, and land cover as subset of a multistakeholder, multifunctional, and multi-institutional perspective that involves multiple feedback loops.



Accordingly, heterogeneity is represented through various agent characteristics, e.g., preferences on a number of different factors that are independent and uncorrelated, thus creating complex interactions. This method of categorization was applied in the LUDAS model, a multiagent system model applied in Vietnam, of Le et al. 2008 and in follow-up models that are currently in development. In fact, agent-based models can also apply to the drivers rather than to the actors, as is done in organization centered multiagent systems (Purnomo and Guizol 2006).

Current modeling efforts that take the driver-agent-land relationship as a subsystem of a dynamic feedback description (van Noordwijk 2001, Lusiana et al. 2010, Villamor et al. 2011) are challenged by the way models can be validated (Lusiana et al. 2011). However, important aspects that emerge from these efforts are that the degree to which models can be learning tools for multiple stakeholders and act as 'boundary objects' (Clark et al. 2010) is at least as important as their academic 'validation' as conventionally quantified.

The Hersperger et al. taxonomy does not really address the nature of multiple scale issues in overall system dynamics. Further work on the framework is needed before such categorization of models can help individual research projects, communication and generalizations beyond the individual project, as the paper claims.

Responses to this article can be read online at:
http://www.ecologyandsociety.org/vol16/iss1/resp1/responses/

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