



# Spatial representations are not neutral: Lessons from a participatory agent-based modelling process in a land-use conflict<sup>☆</sup>



Cécile Barnaud<sup>a,\*</sup>, Christophe Le Page<sup>a</sup>, Pongchai Dumrongrojwattana<sup>b</sup>, Guy Trébuil<sup>a</sup>

<sup>a</sup> CIRAD, UPR GREEN, Montpellier F-34398, France

<sup>b</sup> Department of Biology, Faculty of Science, Chulalongkorn University, Bangkok, Thailand

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## ABSTRACT

The objective of this paper is to question the increasingly common choice to build and use spatially explicit models, especially in the case of participatory agent-based modelling processes. The paper draws on a combination of lessons from literature and the case of a companion modelling process conducted in the context of a conflict about land and forest management in Northern Thailand. Using insights from negotiation theories, we analyze specifically the influence of spatial representations on the way people interacted, discussed and learnt from each other in the participatory modelling process. We argue that models that are spatially too explicit and realistic can actually impede the exploration of innovative and integrative scenarios in which ecological, social and economic objectives are mutually enriching. Indeed, spatial representations might lead to think in terms of boundaries and segregated space, and therefore prevent from thinking in terms of multifunctional space and from finding innovative and integrative solutions.

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## 1. Introduction

Agent-based modelling allows the analysis of interactions between heterogeneous social agents and their environment and is therefore widely used in the field of natural resource management (NRM) (Bousquet and Le Page, 2004; Janssen, 2005). It can be used in a participatory way to involve non-scientific stakeholders in modelling and simulating processes (Voinov and Bousquet, 2010). Participatory agent-based modelling is then seen as an innovative way to enable various stakeholders to better understand each other and to explore scenarios that reconcile social, economic and ecological objectives in NRM. Examples of such participatory modelling processes can be found in various contexts such as fishery management (Worrapimphong et al., 2010), conflicts over irrigation water (Becu et al., 2008), floodplain management (Metcalfe et al., 2010), land-use planning (Lagabrielle et al., 2010), forest management (Simon and Etienne, 2010), soil erosion control (Souchère et al., 2010), labor migration (Naivinit et al., 2010), etc.

Many, if not most of these experiments share a common feature: their models usually rely on a spatial interface to visualize dynamics.

There are several reasons for that. First, many NRM issues and conflicts do have a spatial dimension, especially when they are somehow related to land-use and land-cover change (Bonnin and Torre, 2004). Second, we live in a world which is increasingly spatially explicit, and spatial planning, participatory or not, is nowadays one of the major tools of governance (McCall, 2003). The third reason, linked to the previous one, is the development of spatial information technologies (SIT) that are increasingly sophisticated and powerful (Fox et al., 2006). In particular, agent-based models have proven their efficiency to analyze and simulate land-use change and land-use cover issues, especially when linked to geographic information systems (GIS) (Parker et al., 2003).

In this article, we examine the non-neutral choice of using spatial representations in participatory agent-based modelling processes. In other words, we question the common assumption that having a spatially explicit model is a good thing to facilitate learning and negotiation processes among multiple stakeholders. Up to our knowledge of the literature, this issue has been hardly addressed in the field of environmental modelling. A few scholars discussed the pros and cons of more or less realistic spatial representations in participatory processes. Some authors argue that the more realistic the representations are, the more the stakeholders will feel at ease with them because they are closer to their everyday life (Lange, 2001). Others point out that spatial representations that are very

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\* Corresponding author.

E-mail address: [cecile.barnaud@toulouse.inra.fr](mailto:cecile.barnaud@toulouse.inra.fr) (C. Barnaud).

realistic such as those based on GIS or aerial photographs show more details and facilitates the expression of a greater diversity of perceptions, while a more abstract representation narrows the diversity of possible interpretations (Maurel, 2001). But several authors also highlight the disadvantages of using too realistic spatial representations with stakeholders. In the case of a participatory modelling process, the simpler the model is, the easier it is for the modeller to be transparent regarding its content vis-à-vis the stakeholders. A very realistic and detailed spatial interface leads to an increased “black box” effect (Dumrongrojwathana et al., 2009; Horlitz, 2007). Other authors have observed that less realistic and therefore more abstract spatial representations allow the stakeholders to create a distance from reality, which can be interesting when there are conflicts among them (Gurung et al., 2006) and/or when creative learning is expected (Dionnet et al., 2008).

If the almost systematic use of spatially explicit models has hardly been questioned in the field of environmental modelling, the question has been raised by a few scholars working in the field of community mapping and participatory GIS (Fox et al., 2006; Roth, 2007; Sirait et al., 1994). Of course, using spatially explicit representations has several advantages. In the context of conflicts over resource use between communities and state administrations in developing countries (for example in the case of the establishment of a conservation area), community based-mapping that enables the villagers to make maps of their lands and resource uses (such as in “counter-mapping” processes) have the potential to increase the legitimacy of their claims in the eyes of state administrations (Peluso et al., 2008). Participatory GIS has also been used to solve such conflicts through processes of mutual learning and increased mutual understanding (Kyem, 2004, 2006). However, the impacts of the widespread adoption of SIT are not limited to the intended objectives. This is what Fox et al. (2006) called the “ironic effects of spatial information technology”. SIT are indeed based on a particular conception of space, the one of resource managers, administrators and the state, which consists of “a measurable plane with boundaries delineating homogeneous zones” (Roth, 2007). This conception of space is very different from the one used by many rural communities in developing countries, especially the spatiality of community resource management which is by nature overlapping and flexibly bounded and therefore more complex than what can be represented on simplistically bounded two dimensional patches. As a consequence, among the unintended consequences of using SIT with rural communities have been the loss of indigenous conceptions of space, increased conflicts<sup>1</sup> between and within communities, and increased pressure toward the privatization of the land (Fox et al., 2006; Roth, 2007; Sirait et al., 1994).

Beside these debates, little has been written about the influence of the choice of spatial representations on the contents and dynamics of participatory processes, especially in participatory modelling ones. This paper addresses this issue drawing on a combination of lessons from literature and the detailed analysis of a participatory modelling process conducted in the context of a conflict about land and forest management in Northern Thailand. Using insights from negotiation theories, we analyze the influence of spatial representations on the way people interacted, discussed and learnt from each other in this participatory modelling process. We argue that models that are too spatially explicit and realistic can

actually impede the exploration of innovative and integrative scenarios in which ecological, social and economic objectives regarding land management are mutually enriching. Indeed, spatial representations might lead to thinking in terms of boundaries and segregated space, and therefore prevent from thinking in terms of multifunctional space, and from finding innovative and integrative solutions.

The paper starts with a few theoretical insights from learning and negotiation theories that were used to analyze interactions among stakeholders in the described participatory modelling process. The three following sections present the social-ecological context of the process (a conflict between two communities of farmers and the board of a national park), the main methodological principles of the participatory modelling process that was implemented (a companion modelling approach combining role-playing games and agent-based models), and a short description of the agent-based model that was built and used with the local stakeholders. Dedicated to the presentation of the results, the fifth section focuses on the scenarios simulated with the agent-based model and the effects of these simulations on the learning and negotiation among farmers and national park officers. In the subsequent discussion section, we take a step back, addressing the following question. How far can negotiation theories help us think about trade-offs and synergies in NRM? What are the potential and limits of participatory agent-based simulations to support creative and integrative negotiation processes for sustainable management of renewable resources by multiple users? And in particular, what is the influence of the use of spatially explicit models in such negotiation processes?

## 2. Insights from learning and negotiation theories

To analyze interactions among stakeholders in a multi-stakeholder process, some authors use the concept of social or collective learning (Röling and Wagemakers, 1998), while others prefer talking about negotiation processes (Leeuwis, 2000). The former refer to the soft-systems approach, while the latter belong to the critical systems approach. Soft-systems thinking emerged in the 1980s as a cognitive approach to analyze multi-stakeholder systems (Checkland and Scholes, 1990). These authors emphasize the fact that stakeholders have different perceptions of reality, according to their personal background, activities and specific interest. They consider that the lack of communication and mutual understanding among stakeholders is the main problem of multi-stakeholder processes. This is the reason why they emphasize the need for more dialogue, and analyze multi-stakeholder processes mainly in term of collective learning. People learn about the situation and about the other stakeholders’ perceptions, and reframe their own perception of the situation. This is seen as a key preliminary step before to search for mutually acceptable solutions.

The 1990s saw the emergence of critical systems approaches emphasizing the existence of conflicts and coercion among stakeholders (Ulrich, 2003). They consider that dialogue is not sufficient for stakeholders to find mutually acceptable solutions, because the most influential stakeholders could impose their views. They suggest strategically taking into account power asymmetries in multi-stakeholder arenas to enable the least influential stakeholders to express and assert their interests. Consequently, they suggest analyzing multi-stakeholder processes not only in term of collective learning, but also as negotiation processes.

Authors such as Leeuwis (2000) point out that these two approaches are very complementary because a “successful” negotiation integrates much learning. But what is a “successful” negotiation? Scholars commonly distinguish between compromise and integration (Carnevale, 2006). In a compromise, each side gives up

<sup>1</sup> Fox et al. (2006) report cases where customary boundaries that were traditionally flexible became less flexible after experiences of community mapping, causing disputes when these boundaries overlapped with the neighbour’s boundaries. Moreover, since mapping is about delineation of boundaries, it created a sense of exclusion, and in several cases, led to land privatization that exclude others.

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