An evolving simulation/gaming process to facilitate adaptive watershed management in northern mountainous Thailand

Cécile Barnaud, Tanya Promburom, Guy Trébuil and François Bousquet

Simulation & Gaming 2007; 38; 398 originally published online May 23, 2007; DOI: 10.1177/1046878107300670

The online version of this article can be found at: http://sag.sagepub.com/cgi/content/abstract/38/3/398
An evolving simulation/gaming process to facilitate adaptive watershed management in northern mountainous Thailand

Cécile Barnaud  
Paris X-Nanterre University, France

Tanya Promburom  
Chiang Mai University, Thailand

Guy Trébuil  
François Bousquet  
CIRAD, France

The decentralization of natural resource management provides an opportunity for communities to increase their participation in related decision making. Research should propose adapted methodologies enabling the numerous stakeholders of these complex socioecological settings to define their problems and identify agreed-on solutions. This article presents a companion modeling (ComMod) experiment combining role-playing games and multiagent systems conducted in a community in northern Thailand to support collective learning for adaptive land management. Researchers and local stakeholders collectively built a representation of the situation and used it as a platform to explore scenarios. This ComMod process initially addressed a soil erosion problem. The participants identified the expansion of perennial crops as a promising solution but also raised the problem of the unequal ability among villagers to invest in such crops. The researchers flexibly adapted the simulation tools to the emerging matter. The authors assess the learning effects of this experiment and identify two favoring factors: the increasing participation of local stakeholders and a flexible and adaptive modeling process suited to learning, which by nature is an evolving process. But to ensure sustainable impacts for the communities, stronger links with higher institutional levels are needed.

KEYWORDS: adaptive land management; companion modeling (ComMod); collective learning; decentralization; decentralization of natural resource management; decision making; flexibility; highland community; learning process; multiagent system; natural resource management; northern Thailand; participation; role-playing game; soil erosion

In Thailand, as in other countries in Southeast Asia, after many decades of highly centralized governance, the general policy-making framework for natural resource management (NRM) favors decentralization and public participation. The 1997 constitution was an important turning point. Article 79 provides measures to “promote...”

AUTHORS’ NOTE: We would like to thank Dr. Annemarie van Passen, of the Center of Communication and Innovations Studies, Wageningen University; Dr. Juliette Rouchier, of Centre National de la Recherche Scientifique; and Mr. Tayan Raj Gurung, of the Ministry of Agriculture of Bhutan. We would also like to thank the anonymous reviewers for their constructive comments on an earlier version of this article.

SIMULATION & GAMING, Vol. 38 No. 3, September 2007 398-420  
DOI: 10.1177/1046878107300670  
© 2007 Sage Publications
and encourage public participation in the preservation, maintenance and balanced exploitation of natural resources and biophysical diversity, and in the promotion, maintenance and protection of the quality of the environment” (Rutherford, 2002). Previous environmental policies had drastically restricted access to natural resources for the ethnic minorities populating the highlands of northern Thailand, because their agricultural practices were considered harmful to the environment (Ganjanapan, 2002). Therefore, the principle of participation embraced by the so-called “people constitution” and the establishment of elected tambon (subdistrict) councils provide opportunities for communities to regain control over NRM and to increase their say in public affairs.

But there is a need to develop innovative and context-adapted methodologies and tools to enable diverse local stakeholders to genuinely participate in decision making related to local NRM. The current debate in Thailand about the policy of decentralized rural credit implemented in 2002 is particularly illustrative of this need: Whereas some academics denounce its negative impact on communities, because of a lack of preparation of villagers to manage such funds, the government is moving ahead to implement this credit policy without more caution.

As in many parts of mountain mainland Southeast Asia, the highlands of northern Thailand are characterized by increasingly complex and dynamic agrarian situations, including frequent conflicts over the use of land, forest, and water resources among an increasing number of stakeholders with different and sometimes contradictory perspectives (Rerkasem & Rerkasem, 1994; Trébuil, Kam, Turkelboom, & Shinawatra, 1997). Recent publications demonstrate that sustainable NRM in such conditions requires coordination among concerned stakeholders; this coordination is all the more likely to lead to sustainability if it is based on trust (Pretty, 2003; Rudd, 2000) and recognition of interdependence (Leeuwis & van den Ban, 2004) and if it is reinforced by functional local institutions (Ostrom, Gardner, & Walker, 1994). Moreover, farmers in the highlands face increasingly uncertain and dynamic situations because of factors such as rapid agroecological changes, destabilizing price fluctuations on markets for cash crops, cross-border immigration, and the frequently arbitrary enforcement of environmental policies. Such dynamic socioecological systems challenge the adaptability of local farming communities and require adaptive management (Holling, 2001). We assume that this can be achieved through the facilitation of a continuous collective learning process (Röling & Wagemakers, 1998). In this study, learning is broadly defined as a change in the way people perceive their social and ecological environment (and consequently the way they act on it), according to their experiences, beliefs, values, intentions, and interactions with other people. Because stakeholders have multiple and sometimes conflicting interests, such a collective learning process also includes a negotiation dimension (Leeuwis & van den Ban, 2004). According to Van Paassen (2004), collective learning about NRM issues presents two interrelated dimensions: better insight into the various stakeholders’ perspectives on the problem (to negotiate a joint desired situation) and a better understanding of the system (to explore possible scenarios of changes to achieve this desired situation).
The companion modeling (ComMod) approach is an interdisciplinary approach combining the iterative use of multiagent system (MAS) simulations and role-playing games (RPGs) to facilitate such a learning process through the collective building of a representation of the situation (Bousquet, Barreteau, Le Page, Mullon, & Weber, 1999; Collectif ComMod, 2005). Because complex situations are highly uncertain, the objective is not to build a model to predict the future state of the system but to trigger discussions to explore possible scenarios of solutions. Because situations rapidly evolve, such a model should be adaptive and should continuously evolve to accompany not only the evolution of situations but also the changes in participants’ preoccupations. Throughout the learning process, discussions and agreement on possible solutions might raise new problems to solve and require adapted models to address new emerging questions. This is what happened in the case study presented in this article.

In the Akha village of Mae Salaep in northern Thailand, two successive ComMod cycles were implemented and accompanied changes in the focus of discussions along the learning process. In this highland community, in a context of rapid market integration and an associated switch from traditional subsistence agriculture to cash cropping, farmers are accused by lowlanders of increasing land degradation through soil erosion. As environmental policies are reinforced, the survival of their communities could be threatened by highly restricted access to farm land. The initial objective of this ComMod experiment was to facilitate a collective learning process in this highland community on the problem of soil erosion (Trébuil, Shinawatra-Ekasingh, Bousquet, & Thong-Ngam, 2002). At the end of this first cycle, participants identified the expansion of perennial crops as a promising solution and requested that the second cycle focus on the socioeconomic aspects related to their adoption.

After presentations of our methods and study site, we briefly describe the first modeling cycle, initiated from 1999 to 2002. This is followed by a detailed presentation of the subsequent cycle conducted in 2004 according to local stakeholders’ suggestions of changes. The results and the discussion show how the flexible use of simulation and gaming tools stimulated an evolving collective learning process. The article ends with an evaluation of the selected ComMod approach, lessons from this experiment, and suggestions for improvement.

Method

Multiagent systems (MASs) are particularly appropriate to represent and simulate complex natural resource management (NRM) problems because they focus on interactions among heterogeneous social agents and their common environment (Bousquet et al., 1993; Lansing & Kremer, 1993). In this study, a MAS was implemented using the CORMAS platform (http://cormas.cirad.fr), which was designed to understand and simulate complex resource management systems and is particularly open and flexible. We assume that its flexibility is a prerequisite for its use in an adaptive learning process.
To better involve local stakeholders in the modeling process and the validation of its outputs, we translated the MAS model initially built by the researchers into a role-playing game (RPG). The game helps the local stakeholders understand the structure and operation of the computerized model and its limits and gives them a chance to validate, criticize, or improve it. This translation is possible because MASs and RPGs have similar components: agents corresponding to roles, the spatial interface of the SMA corresponding to the gaming board, the time step in a simulation to a game round, and so on (Barreteau, Bousquet, & Attonaty, 2001). According to Duke (1974), gaming is a mode of communication more capable than others of conveying complexity. It allows multiple stakeholders to interactively apprehend the complex systems of which they are part. It triggers discussions among them because they share a common representation derived from the game. It is possible to test alternate scenarios in a game, but this quickly becomes very time-consuming. In the ComMod approach, the association of the RPG with multiple fast runs of MAS simulations can remove this constraint (Barreteau et al., 2001).

Various kinds of associations between MASs and RPGs have been tested (D’Aquino et al., 2002). The main methodological phases implemented in this case study are presented in Figure 1. At the end of the first ComMod cycle, which is described in detail elsewhere (Trébuil et al., 2002), local stakeholders requested several changes in the MAS and RPG models to focus on a new problem. The second cycle was implemented as follows:

1. A field survey was conducted to gather existing knowledge and local stakeholders’ perspectives on the new problem to be examined.
2. Observed dynamics were translated into MAS and RPG models.
3. A 3-day workshop in the village (including gaming and simulation sessions) was prepared. Two officers of the local Department of Public Welfare facilitated our activities. The animation of the game and group debates were conducted by a Thai researcher from our research team, and translation from Thai to Akha was undertaken by one of the two Department of Public Welfare officers originating in this village. This person was also in charge of convoking the villagers. Because we requested their presence for 3 days, and they might need to hire day laborers to replace them in the fields, players were given an amount of money equivalent to 3 days’ wages. The 12 players were chosen by the designer of the game to represent well the diversity of situations and interests within the community. To ensure continuity in the process, a majority had already played the first game. Thanks to previous field interviews, the players and the relations among them were well known from the research team, which facilitated careful observation, listening, and management of the collective discussions.
4. Gaming sessions were conducted on the 1st day. After a short presentation of the rules of the RPG by the animators, two gaming sessions were implemented. The first was played according to the researchers’ representation of the actual system and was followed by a short collective debriefing. Then players were asked to suggest changes to make the RPG more in touch with their representation of reality or to test a given scenario to solve the problem at stake. The second gaming session was played according to the suggested new features and rules.
5. On the 2nd day, individual interviews of the players were conducted to better understand their behavior during the game (e.g., in relation to their reality), to assess the model, and to evaluate the short-term learning effects of the game.
6. The MAS model was modified to integrate the new knowledge acquired during the game and the participants’ suggestions for improvement.
7. On the 3rd day, a plenary session of participatory simulations using the improved MAS model was conducted to support discussions and the exploration of scenarios.
8. More advanced simulations were conducted at the laboratory.
9. Finally, more interviews were conducted with several players to assess the impact of this ComMod cycle on their perceptions and behaviors and to evaluate their interest in the process and their possible wishes for a third cycle.

Site description: Land degradation in an Akha village, Chiang Rai Province

The study site was the main watershed (size 369 ha, elevation 500 to 850 m) of the village of Mae Salaep, a settlement made of two hamlets inhabited by Akhas people, the dominant ethnic minority in Chiang Rai Province (Figure 2). The border with Burma is just a 1-day walk across the mountains, and the village was established...
in 1907 by the first group of migrants who crossed the border. In the past two decades, Mae Salaep’s small-scale farmers have been integrated into the market economy, and their former agrarian system, based on swiddening, is being replaced by semipermanent and cash-crop-based agriculture (Trébuil, Thong-Ngam, Turkelboom, Grellet, & Kam, 2000). The perceived increase of the risk for soil erosion on steep slopes is becoming a major issue because lowlanders (Thai citizens living in the plains and the cities) complain about flash floods and sedimentation in their irrigation reservoirs. The Royal Forestry Department threatens highlanders to further restrict their access to farm land. But whether the risk for soil erosion is increasing or not and how to prevent this problem are complex issues. Land degradation is related not only to agroecological factors but also to socioeconomic ones, determining the choice and extent of cropping systems. Moreover, households’ integration into the market economy led to an extensive socioeconomic differentiation among farmers having different amounts of productive resources, socioeconomic objectives, and perceptions of the problem of soil erosion (Trébuil et al., 1997).

The initial objective of this ComMod experiment was to facilitate a collective learning process at this highland community focusing on the interactions between diversification into cash cropping and soil erosion, to identify, if needed, acceptable corrective measures with the stakeholders.

Results: The ComMod process in action

This section presents the results of the two ComMod cycles implemented in Mae Salaep (Figure 1). After a brief presentation of the role-playing game (RPG) and the two multiagent system (MAS) models built in the first cycle, its outcomes and the way participants requested changes for the second cycle are underlined. The results
of the second cycle are then presented more in detail, step by step: understanding the situation through on-farm surveys, a new MAS model and RPG built to focus on the new problem, and the results of the gaming and simulation sessions.

**First ComMod cycle initiated by researchers**

*The first “researchers’ MAS model” (MAE SALAEP 1).* The first phase of the research process consisted of the integration of (scientific and indigenous) knowledge on farming systems and soil erosion obtained with on-farm surveys into the first model, MAE SALAEP 1 (Trébuil et al., 2002). This model was linked to a geographic information system (GIS) focused on land use and land degradation dynamics. Considering that the validation of such a preliminary “researcher model” would be best done by Mae Salaep farmers themselves, the model was translated into an initial RPG that could be described as a simplified, noncomputerized version of the model.

*The initial RPG to validate the initial MAS model.* In the first RPG, each participant played the role of a farmer managing a set of fields located on different slopes of a 3D block model representing the watershed. The 12 player-farmers were given various amounts of land and capital according to the actual farming conditions of the three main types of farming households present in the village: (a) small and cash-crop oriented, (b) medium and conservative, and (c) large and diversified farming households. There were 3 players each with Types A and C and 6 with Type B, played by farmers who actually belonged to these categories. During each gaming round (corresponding to 1 crop year), the players successively assigned given crops to each of their fields, harvested their products, went to the market to sell them, received information on land degradation in their fields, drew “chance cards” (either exceptional off-farm income or a household expense), and finally went to the credit desk to ask for and/or reimburse credit if needed. Each year, the general climatic and market price conditions were determined by drawing a card at random. The degree of soil erosion that occurred in their fields was made public on a bulletin board. Four crop years could be played during each half-day gaming session.

*The second RPG-based model for communication (MAE SALAEP 2.1).* The knowledge about farmers’ land-use strategies acquired during the MAE SALAEP 1 gaming sessions was used to build the second and much simpler MAE SALAEP 2.1 model, much more similar to the RPG in its rules and features. Instead of the complex GIS maps used in the first MAS model, the visualizing interface was a simplified watershed similar to the gaming board (Figure 3). In this new model, as in the game, 12 agent-farmers managed their fields according to their available productive resources, and at each time step, they carried out the same set of successive actions and decisions.

Both MAS models were used to run simulations with the local stakeholders. But we observed that it was easier for participants to follow computer simulations with the RPG-based model.
FIGURE 3: Simplification of the Model Visual Interface From MAE SALAEP 1 (left) to MAE SALAEP 2.1 (right), Which Is Similar to the Gaming Board (center)

NOTE: GIS = geographic information system; MAS = multiagent system; RPG = role-playing game.
*Polygonal units are plots of various slopes (various colors).
**Square units are plots of agent-players located on the various slopes (various shades) of the catchment.
Outcomes of the first ComMod cycle and changes requested by participants. Mae Salaep farmers validated the researchers’ representation of the soil erosion problem (i.e., they found it realistic). During this first cycle, they collectively expressed the idea that the expansion of perennial crops was a promising solution alleviating soil erosion while providing more stable incomes. Therefore, they requested a greater focus on the socioeconomic aspects related to their adoption, because many small landholders do not have access to perennial crops. This first ComMod cycle allowed the researchers to better understand local stakeholders’ preoccupations. We decided to adjust the tools to follow this shift of focus from agroecological to more socio-economic concerns.

The second ComMod cycle on issues requested by Mae Salaep villagers

The objective of the second cycle was to set up a collective learning process on the socioeconomic conditions of the adoption of perennial crops to examine the problem of unequal access to this promising solution among the different types of farmers.

Understanding the new issue through on-farm surveys. Two perennial crops dominate in the current local agrarian system: lychee orchards and small green tea plantations. Lychee orchards were introduced at the beginning of the 1980s, but large plantations could be adopted by the wealthiest farmers only. Compared to lychee, green tea (which was introduced more recently) is accessible to a broader range of farmers because it reaches maturity faster, requires no input, and has more stable prices. It is generally less profitable but also much less risky than lychee. Perennial crops are also interesting because they require less labor than annual crops and provide more time for off-farm employment, a major source of income and investment capacity in this area. However even green tea, the so-called plantation crop of the poor, is not accessible to all villagers.

Because perennial crops require a wait of several years before harvesting the first products, the rules for the allocation of formal and informal credit emerged as a key issue determining the ability to invest in perennial crops. Informal credit corresponds to loans settled among villagers, either without interest within networks of acquaintances or with high interest rates (more than 5% per month) with loan sharks. As for formal credit, besides a traditional village fund created 10 years ago, a new government fund was made available in 2002. The older village fund provides small amounts of cash to any household, with interest rates fluctuating between 2% and 5% per month. The government fund provides larger sums, without interest but is accessible to only well-off households because they are the only ones that can guarantee that they will reimburse the loans. This unequal distribution of the government fund is partially compensated for by its redistribution through informal loans within networks of acquaintances. However, because those networks are usually small and quite homogeneous, a number of small landholders are acquainted with households as poor as they that have no access to this source of credit.
A new focus in the MAE SALAEP 2.2 model. The understanding of the situation described above is a first form of conceptualization, a certain view on reality. Translating this understanding into a conceptual model and then into a MAS model was another step. Such a model is not neutral but depends on the question the modeler wants to analyze (i.e., the objective of the model). So we extracted from our first understanding of the situation the key interacting dynamics relevant to the objectives of the model, which were

1. to represent the interactions between investment in perennial crops by different types of farmers, the allocation of formal and informal credit, and off-farm activities;
2. to explore the interactions between individual decision-making processes at the farming household level and the resultant collective dynamics at the community level; and
3. to support the exploration of scenarios with all the stakeholders.

Because two models were available, we did not start from scratch to build this new model. We chose to modify the simplified model based on the role-playing game MAE SALAEP 2.1 instead of the initial one, because the stakeholders were more comfortable with it. The general structure of the new model (called MAE SALAEP 2.2 because it was a new version of MAE SALAEP 2.1) is displayed in Figure 4. This model was composed of several interacting social, spatial, and passive entities (e.g., the farmers, their plots, and precipitation). Those entities were assigned attributes (variable or invariable characteristics) and methods (possible actions).

Two main kinds of changes were made from MAE SALAEP 2.1 to MAE SALAEP 2.2: (a) updates (e.g., to take into account the new crops available or the farm differentiation process at work) and (b) changes to accompany the shift of focus from agroecological to socioeconomic processes. Two formal credit desks (government and village fund), loan sharks, and networks of acquaintances were introduced in the model, with their rules for the allocation of credit. Farmers’ individual decision-making processes regarding investment in perennial plantations and the decisions to send (or not) family labor off the farm and to search for credit were also modeled in detail. In the model, if credit was needed, a farmer successively tried to find the required loan with the government fund (no interest), his acquaintances, the village fund, and finally the loan sharks. Informal credit sources are also needed when a farmer cannot reimburse a formal credit fund. When an agent falls into debt with loan sharks, he sends part of his family labor to work in off-farm activities. If this is not enough, as debts keep growing, there is a moment when he is forced to sell his land and leave the village. A labor constraint was also introduced into the model. The farming households have one, two, or three workers. Each year, they have more or less profitable off-farm opportunities (the wealthiest farmers having the most profitable ones) which they take or not, knowing that this might introduce a labor constraint limiting areas planted with annual crops. Because of the change of focus, new relevant indicators were also selected to follow simulations and analyze their results (presented in a later section).

To confront this representation of the system to the villagers’ one, the new multi-agent system (MAS) model was translated into a new role-playing game (RPG).
FIGURE 4: Class Diagram (general structure) of the MAE SALAEP 2.2 Model Underlying the Main Changes Made From the Previous Model (MAE SALAEP 2.1)

**Feature added to the MAE SALAEP 2.1 model.
A new RPG to stimulate exchanges on adoption of plantation crops. The objectives of this new game (called MAE SALAEP RPG 2) were as follows:

1. to stimulate exchanges between researchers and local stakeholders (i.e., to decrease the gap between their respective representations of the problem of unequal access to perennial crops) and
2. to stimulate exchanges among the local stakeholders themselves (i.e., to facilitate dialogue among the three main types of farmers having different points of view and interest regarding the expansion of perennial crops and the rules for allocating credit within the community).

The changes made to MAE SALAEP RPG 1 to conceive MAE SALAEP RPG 2 were almost the same as those made to the MAE SALAEP 2.1 model to build MAE SALAEP 2.2 (see the previous section). Because a gaming session should not be too long to remain lively, we could not add more features and rules (i.e., the socioeconomic ones) without simplifying some other aspects. We chose to simplify agroecological aspects to accompany the requested shift of focus, as presented in the Table 1.

During gaming sessions, besides general observations of players’ behaviors, observers focused on particular aspects. Whereas in the first game, the focus was on the discussions among players about soil-erosion damage in their fields, in the second game, the focus was on informal exchanges of cash among them. Thanks to previous interviews, the actual relationships among the players were known in advance and allowed us to observe whether the exchanges occurred within networks of acquaintances.

Outputs of the MAE SALAEP RPG 2 gaming sessions and debriefing

In this section, we present the outputs of the gaming session of MAE SALAEP RPG 2 and the discussion it generated among stakeholders.

The first gaming session, highlighting social inequity. During the first gaming session, medium-sized and large landholders (farming households of Types B and C as described above) invested massively in tea and lychee plantations. They asked for credit from the credit institutions, but because this was not sufficient, they opted immediately for informal credit. The small landholders (Type A farming households) chose much less risky strategies. They planted mainly low-input annual crops, and their low agricultural incomes were not sufficient to pay for home consumption expenses. Because everybody needed cash, the players were eager to draw off-farm opportunities cards, with the wealthiest hoping to get the very profitable passport to work in Taiwan. Off-farm incomes were a main source of cash, and these revenues were extensively redistributed among players through numerous informal exchanges (mainly within networks of acquaintances).

This gaming session highlighted the problem of social inequity regarding investments in plantation crops because of unequal access to credit.
Collective debriefing: exchange of perspective on the problem and identification of solutions. In the individual interviews, participants insisted on the realism of what had happened during the first gaming session. This stimulated discussion among them to solve the problem. During the collective debriefing, they raised important questions, such as, How could they change the rules of formal and informal credit so that small landholders (Type A) would have better access to credit? Was it possible to change those rules? Would the small landholders benefit from such a change, or would they face too high a risk for bankruptcy? and What would be the consequence for the other landholders (Types B and C)? They exchanged their views on these questions, and two different solutions were proposed. An older participant suggested solving the problem with informal credit: “It is not possible to change the rules of formal credit. Informal credit is more efficient. They should ask me, I would agree to lend them money without interest.” On the other side, some younger participants suggested changes in the formal credit, more precisely the rules of the government fund: They proposed a 3-year grace period for small landholders. The latter said that to be able to reimburse this credit, they should be allowed to send all their family labor off the farm until the plantations reached maturity.

The second gaming session: test of a suggested solution. After discussion, participants agreed to test the second suggestion (new rules for the allocation of formal credit) in the afternoon gaming session. All the smallholders players invested in tea...
plantations and succeeded in reimbursing their loans. The other participants also had fewer cash constraints because most of their plantations had reached maturity. Because they considered that they had enough money, numerous players refused off-farm opportunities, even if they had “nothing to lose” because they had no labor constraints.

**Results of simulations of scenarios with the MAE SALAEP 2.2 model**

In the individual interviews of the 2nd day, players validated most of the game’s features and made a few suggestions for improvements that were integrated into the multiagent system (MAS) model. On the 3rd day, suggested scenarios could be tested with the participants through simulations with the model. Players could easily understand the functioning and the limits of the model because of its similarities with the game.

Three factors varied in the simulated scenarios: (a) the duration of the grace period of the government fund (1 or 3 years), (b) its distribution among the three types of farms, and (c) the characteristics of the networks of acquaintances for informal credit (Figure 5). We analyzed the effects of these factors on two main indicators at the end of each simulation (15 years): (a) the area under perennial plantation in each type of farm (an ecological indicator) and (b) the proportion of bankrupt farms among each type of farm (a socioeconomic indicator).

The three scenarios presented in Figure 6 were tested in plenary sessions with the participants to support collective debriefing:

1. The first scenario corresponded to the current situation (i.e., the rules for the operation of formal and informal credit were similar to the actual ones: 1-year loans from the government fund distributing 0, 10,000, and 20,000 baht to Types A, B, and C farms, respectively).

2. The second scenario tested new rules for the operation of informal credit corresponding to the suggestion of the older player: the lack of access to credit of Type A (small) landholders should be solved through informal credit. This is translated into a scenario with larger and more heterogeneous social networks allocating informal credit (Figure 5). This scenario was very efficient to reduce the number of bankrupt small landholders but did not allow them to increase their investments in plantation crops. This is because they borrowed money from their acquaintances only for urgent family consumption needs, not for investment. This scenario was quite theoretical because there was currently no explicit rule in the functioning of informal credit in the village.

3. The third scenario was implemented with a new set of rules for formal credit: 3-year loans of 12,000, 24,000, and 54,000 baht for Types A, B, and C farms, respectively. This option enabled the three types of farmers to invest significantly more in plantation crops. More simulations conducted in the laboratory show that small landholders managed to reimburse the loans only if they remained below a certain level. In this case, they faced less risk for bankruptcy than in the current situation thanks to the high and stable incomes from their plantations. However, the most efficient way to reduce their risk for bankruptcy in the model remained a change in networks of acquaintances for informal credit (Scenario 2).

These scenarios show the trade-off between ecological, economic, and social interests and triggered discussion on how to balance these competing interests.
Theme of a possible third ComMod cycle

During the final debriefing, the participants said that the idea of a 3-year grace period corresponded to an official request made to the government by hundreds of rural communities across the country: ‘If tomorrow the government agrees to lend us money for 3 years, we would have to adapt very fast to this new credit situation,
and these tools could be useful.” So a first perspective could be to explore more scenarios with local stakeholders to support them in this task. The role-playing game (RPG) would be important to ensure that the functioning of the model and its limits are known by local stakeholders, so that the results of the simulations are not misunderstood. The MAS model should not be seen as a tool to select a technical and quantitative decision but as a means to facilitate the exploration of different options beforehand.

A second possible perspective was suggested by the officers of the Department of Public Welfare, who would be interested in launching a collective learning process on how villagers could organize themselves within a cooperative to process and sell their agricultural products. The aim is to limit the negative effects of important price fluctuations on the market for their horticultural products, and the topic corresponds to a project launched by the development agency with the villagers. This proposition illustrates the fact that the process could move in another very different direction, with a new companion modeling (ComMod) cycle based on a new RPG and associated model.

A third possible evolution was suggested by participants who were asked what other stakeholders should be invited to a future gaming session. They answered that Tambon Administration Organization (TAO; subdistrict administration) officers should be invited to play their own roles in the game, “so that they know what is happening in the village.” Apart from the local officers of the Department of Public Welfare, official representatives of administrations at higher levels were neither integrated into the model nor invited to the participatory workshops, because we thought that their presence could have intimidated villagers and brought the collective discussions to a standstill. The villagers’ suggestion to invite TAO officers means that they now feel rather confident in using the proposed tools. As discussed in the final part of this article, this underlines the need (in the eyes of participants) to reinforce institutional linkages to increase the impact of the ComMod process.

Evaluation of the process and lessons learned

In the following sections, we first analyze the collective learning process that was stimulated by the use of gaming and simulation tools in this ComMod process. Second, we identify the methodological aspects that contributed to the successes of this process, particularly the flexibility of the gaming and simulation tools. Third, we underline its current limits and some perspectives of improvements.

Evaluation of the collective learning process

How does one evaluate a learning process? With what criteria? According to Van der Veen (2000), such an evaluation depends on the type of learning. Van der Veen distinguished three types of learning: reproductive learning (the linear transmission of knowledge), communicative learning (constructing with others an intersubjective
understanding of the subject), and transformative learning (changes in perspectives leading to more inclusive views of the subject). In our case study, we aimed to facilitate a combination of communicative and transformative learning. In the case of reproductive learning, one can evaluate and measure how much new knowledge participants can demonstrate, if they use it in practice, and whether this influences their results. If this method still seems to apply in certain situations of communicative learning, Van der Veen stated that it is clearly more tricky for transformative learning. In this case, the only option is to adopt a rather qualitative self-assessment by participants (i.e., to ask them whether participation led to a perspective transformation, what kind of transformation it was, and how it changed their behavior and results). This is what we did in the interviews conducted the day after the game and again 3 weeks later.

To begin with, we propose to answer the question of what people learned and how. In particular, what type of learning occurred, and how was it stimulated by the association of the simulation and gaming tools? We distinguish between the researchers’ and the local stakeholders’ learning processes.

What did the researchers learn and how? In this process, researchers learned in three different ways. First, the ComMod process triggered an interactive exchange of perspectives on the system under study with the local stakeholders. The first game was a first representation of the situation by the researchers, focusing on agroecological aspects of soil erosion. The game allowed the players to understand this representation and to react to it. They found this representation realistic (a form of validation), but they requested some changes to better fit their representation of the problem of soil erosion and their preferred way to alleviate it (i.e., introducing socioeconomic dimensions related to the adoption of perennial crops). In the second ComMod cycle, the adapted representation of the situation triggered more discussions among stakeholders themselves. According to Duke (1974), this is the main validation of a game.

Second, researchers could improve their understanding of the situation thanks to the observation of players’ behaviors. They elucidated tacit knowledge about the local credit system, particularly the distribution of power among villagers in the decision-making process regarding the allocation of formal credit. Such tacit knowledge explains the difference between the way people say they behave (which corresponds to the limited knowledge acquired from previous interviews) and their actual behavior (whose several aspects were revealed in the game because of the spontaneity it triggers).

Third, the simulations run with the improved model (integrating the knowledge acquired during the game) allowed the research team to better understand the functioning of the complex system under study.

What did local stakeholders learn and how? The first ComMod cycle triggered exchanges mainly between researchers and participants, whereas in the second cycle, the participants emphasized in the interviews that the experiment allowed
them to better understand one another’s situations and points of views, by providing
a kind of “democratic” (in the words of one participant) platform for communication
that does not exist in their current social and institutional situation. They could in
particular better understand the kind of difficulties faced by others and could
exchange their different views regarding the credit issue. A community leader
declared that “in everyday life, everyone has his own problems; there is no place
where we can think all together like in the game.” The game triggered an initial
phase of communicative learning among participants that was facilitated by the fact
that they shared a common “language or jargon derived from the game event” (Duke,
1974, p. 64). This phase triggered the collective definition of a desired situation.

Second, local stakeholders could improve their understanding of the functioning
of the complex system by exploring “what if” questions. In the learning process, this
corresponds to a phase during which they wonder how they could reach the identi-
fied desired situation. This was triggered by the exploration of scenarios with the
game and with the multiagent system (MAS) model (a learning process based on dis-
covering and experimentation). As the community leader said, “The players can try
by themselves [how to plan to invest in plantations]. It is more efficient than speak-
ing.” According to another participant, the game was said to “help to think in
advance,” because during a session, players could observe six cropping seasons and
assess the effects of their choices. “In everyday life we do not have the opportunity
to think in advance. We can only think to grow maize each year to buy and eat rice.”

Argyris and Schön (1996) distinguished between single- and double-loop collec-
tive learning. Single-loop learning occurs when people change their existing practices
without changing their beliefs, norms, or values. In double-loop learning, changes
take place also in their underlying insights and principles. This corresponds to trans-
formative learning. In our case study, participants mentioned several times that this
ComMod experiment allowed them to think differently than in “everyday life.”
“Without the game, we would go on in our everyday life,” said a participant. This is
an evidence of transformative learning.

Factors contributing to the success of this collective learning process

Increased participation of local stakeholders. At least two observations indicate
increased participation of local stakeholders in the ComMod process. First, whereas
following the MAE SALAEP RPG 1 sessions, dialogue between researchers and the
local stakeholders dominated, MAE SALAEP RPG 2 stimulated more dialogue
among local stakeholders themselves.

Second, whereas in the first cycle, the participants mainly suggested changes in the
model to better fit their representation of reality, in the second cycle, their suggestions
were oriented more toward explorations of what-if questions (scenarios of new credit
rules). This evolution can be seen as an expression of a phenomenon described by
Duke (1974) as “initial inertia”: “the initial difficulty of getting players involved into
a game” (p. 205). The first cycle allowed stakeholders to overcome this initial inertia
and become familiar with its language and representations. Once they got a global
picture of the complex system represented in the game, they were more at ease and could suggest changes. Then, in the second ComMod cycle, they had entered a stage in which their skills in the game allowed them to explore new options.

This increased participation of local stakeholders is a positive evaluation of the process, because its overall objective is to enable them to participate genuinely in decision-making processes in complex natural resource management (NRM) situations. Besides the phenomenon of initial inertia, two factors seem to contribute to this positive evolution. First, the research team considered participation a goal, not a means, and therefore paid attention to the evaluation of the process by the participants themselves. The research team adjusted its tools according to their requests, so that they focused on questions that local stakeholders themselves had raised. Second, the flexibility of the tools was important to achieve this, as discussed in the following section.

Highly flexible tools are needed to support evolving learning processes. Duke (1974) wrote, “Future’s languages are a dynamic communication form; they must respond during use to changing perceptions of the problem.” (p. 51). This experiment illustrates how the simulation and gaming tools were flexibly adjusted to the changing local context and stakeholders’ preoccupations to support the collective learning process.

The first models and game, focusing on erosion, were the researchers’ initial interpretation of the situation and problem. Then changes were introduced to match the representation and aspirations of the local stakeholders. We added new socioeconomic dynamics interacting with the existing dynamics, such as decision-making processes regarding investment in perennial crops or off-farm activities, and deleted some others. We introduced new stakeholders, such as loan sharks and government funding committees, and added new characteristics to the existing stakeholders. We created new socioeconomic indicators and representations and left aside some others. The flexibility of the modeling tool is partly because MASs are an object-oriented modeling approach that offers the possibility to add or delete agents or to modify the model features and object behavior without having to change the whole model. Moreover, the CORMAS platform, tailored to facilitate the modeling process thanks to a certain number of predefined algorithm, is a particularly “open” framework that does not constrain a modeler too much. The RPG tailored specifically for the experiment also presented the advantage of being completely adaptable. During the workshop, local stakeholders saw their critical remarks and propositions for the future included in the model and the RPG.

Another interesting point of this experiment is the fact the initial model was simplified to facilitate comprehension, ease of use, and a better focus on the issue at stake for the local stakeholders. When dealing with complex agroecosystems, researchers can be tempted to build more and more complex models. The transition from the initial very sophisticated GIS-based model (MAE SALAEP 1) to the much more simple MAE SALAEP 2.1 illustrates that the evolution does not necessary lead to an increased sophistication of the tools. The most useful models for local stakeholders are not necessarily the most exhaustive ones. Each model is a subjective extraction of the key relevant dynamics of the system at a particular moment of the collective
learning process among particular stakeholders. The generated family of models is a trace of this collective learning process among all stakeholders (including researchers).

The need for a stronger institutional linkage

Dialogue with higher institutional levels. Although the process led to changes in people’s perceptions, it did not lead to concrete impacts for the community, mainly because of a lack of institutional support thus far. This is quite evident in the suggestion to change the grace period of the government fund, because it is decided at the government level. But beyond this simple explanation, this raises an important question. A member of the government fund committee played the game, but he did not participate very much in the debates, because, as he said, “to change the rules, all the committee members must agree on them,” and he knew that “some of them would not agree.” Whether it is in the interest of local institutions to participate in a collective negotiation process with villagers is a crucial question. The need to establish dialogue with higher institutional levels is the reason why among the three identified paths toward a third ComMod cycle, we will opt for the third path (i.e., the integration of TAO officers in the game and model). Because villagers themselves requested their presence, we have a good opportunity to test the efficiency of the ComMod process to facilitate such a dialogue.

Involvement of a local facilitator. The way the member of the government fund committee expressed his reluctance to change also illustrates the fact that rules and institutions are deeply rooted and cannot be changed within a few weeks. This underlines the need for more continuity in the process, which could be achieved by the greater involvement of people from local institutions as facilitators. We initially envisioned an eventual involvement of the two officers of the local governmental agency (the Department of Public Welfare) that facilitated our research activities. The main one in charge of Mae Salaep village has a classical view of rural development, in which the effective participation of local stakeholders is limited. However, his attitude changed between the MAE SALAEP RPG 1 and MAE SALAEP RPG 2 sessions from a very interventionist attitude to a more listening one. The question remains as to whether he (and his agency) will be involved further in the ComMod process in the future. If so, another question will be raised that is related to the agency’s nonneutral position in the debates.

Conclusion

The combination of simulation and role-playing games (RPGs) explored in this study was flexible and accompanied a collective learning processes on complex natural resource management (NRM) issues within a community. It stimulated the exchange of viewpoints and dialogue between researchers and stakeholders and, more important, among stakeholders themselves. But what to do to ensure that this kind of
experiment does not remain only a dialogue among a few villagers that is admittedly very interesting for researchers but has no other repercussions for the villagers themselves? How to strengthen and extend the effects of ComMod experiments?

When thinking about an extension of ComMod approaches in northern Thailand, one limitation that comes to mind is the fact that it is not reasonably possible to invest as much time as we did in this experiment in many villages across the region. This region is characterized by an important heterogeneity in space. The three main mountain chains dividing this region have supported the implantation of various isolated minority communities that have all developed their own local agrarian histories. Despite their heterogeneity, many communities are confronted by the same kind of NRM problems. The tools designed to support dialogue to solve conflicts over land, water, or forest resources in one community could be useful to other communities. The flexibility of the tools would be a very valuable characteristic.

One way to scale up the ComMod approach is the training of a network of practitioners interested in this approach and the multiplication of local ComMod experiments. A complementary way to strengthen and extend the approach would be dialogue with organizations at higher levels. If, within a community, people want to change things, they need the support of these higher organizational levels. In return, the changes at these levels of organization, in particular government agencies, can be to the benefit of several local communities.

The ideal would be that these organizations themselves adopt such approaches. The effective adoption of participation by government agencies is a challenge in a kingdom such as Thailand that has traditionally had a highly centralized form of governance. However, the current process of decentralization, particularly the 1997 constitution and the establishment of elected tambon councils at the subdistrict level, constitute important opportunities to remodel the institutional framework in a way that favors dialogue between local communities and the once untouchable bureaucracy. Our future challenge is to test and adapt the ComMod approach to facilitate such a dialogue.

Notes

1. In April 2005, 1 baht = 0.0193 euros.
2. The set of rules tested in the game, which included a 3-year grace period only for small landholders, was not thoroughly analyzed because afterward, the participants considered this scenario unfair and unacceptable. They believed that medium-sized and larger farmers should be awarded similar long-term credit.

References

Journal of Artificial Societies and Social Simulation, 4(2). Available at http://jasss.soc.surrey.ac.uk/4/2/5.html


D’Aquino, P., Barreteau, O., Etienne, M., Boissau, S., Aubert, S., Bousquet, F., et al. (2002, June). The role playing games in an ABM participatory modeling process: Outcomes from five different experiments carried out in the last five years. Paper presented at IEMSS, Lugano, Switzerland.


D’Aquino, P., Barreteau, O., Etienne, M., Boissau, S., Aubert, S., Bousquet, F., et al. (2002, June). The role playing games in an ABM participatory modeling process: Outcomes from five different experiments carried out in the last five years. Paper presented at IEMSS, Lugano, Switzerland.


Cécile Barnaud is a PhD candidate in human, economic, and regional geography at Paris-X University. A laureate of a full PhD scholarship from the French Ministry of Research, she is hosted by Centre de Cooperation Internationale en Recherche Agronomique Pour le Développement (CIRAD) and is working under the CU-CIRAD ComMod Project, based at Chulalongkorn University in Thailand. Initially trained as an agricultural economist at the National Agronomic Institute in Paris, her PhD work focuses on the use of the companion modeling approach for accommodating multiple interests in local communities and with higher institutional levels for sustainable renewable resource management in the highlands of northern Thailand.

Tanya Promburom was a researcher at the Multiple Cropping Center, Faculty of Agriculture, Chiang Mai University, in the sustainable agriculture unit. Her professional experience is in the socioeconomic aspects of agricultural systems and natural resource management. She is now a research administrative officer in the Faculty of Business Administration at Chiang Mai University.

Guy Trébuil was trained as an agronomist and an agricultural economist. He obtained his doctoral degree from the National Agronomic Institute in Paris in 1987. He is a senior researcher at the GREEN (Management of Renewable Resources and the Environment) research unit at Centre de Cooperation Internationale en Recherche Agronomique Pour le Développement (CIRAD). He is also director of research in human, regional, and economic geography at Paris-X University. He is presently working on a collaborative research and teaching project on the use of companion modeling for integrated renewable resource management in Southeast Asia (the CU-CIRAD ComMod Project) based at the Faculty of Science of Chulalongkorn University in Bangkok, Thailand.

François Bousquet is a modeling scientist with Centre de Cooperation Internationale en Recherche Agronomique Pour le Développement (CIRAD). He is focusing on the development and use of multiagent systems for the simulation of renewable resource management issues. Through the development of a specific platform for building multiagent systems to simulate common-pool resource systems, CORMAS, he has taken part in many experiments dealing with simulation and environmental management, mainly in developing countries. His present interest is in the development of the companion modeling methodology.

ADDRESSES:  CB: Chulalongkorn University, CU-CIRAD Project, Bangkok 10330, Thailand; telephone: +66-2219-2057; fax: +66-2219-2057; e-mail: cecile.barnaud@cirad.fr. TP: Chiang Mai University, Faculty of Business Administration, Chiang Mai 50200, Thailand; telephone: +66(0)53-942109; fax: +66(0)53-942103; e-mail: thanya@chiangmai.ac.th. GT: CIRAD, UPR Green, Montpellier F-34000, France; and Chulalongkorn University, CU-CIRAD Project, Bangkok 10330, Thailand; telephone: +66-2219-2057; fax: +66-2219-2057; e-mail: guy.trebuil@cirad.fr. FB: CIRAD-TERA, UPR 47 GREEN, Campus International de Baillarguet, TA 60/15, 34398 Montpellier cedex 5, France; telephone: +33-4-67-59-38-32; fax: +33-4-67-59-38-27; e-mail: francois.bousquet@cirad.fr.