Role-playing games and institutional engagement for modeling land and water management in a northern Thailand watershed

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Abstract
The paper illustrates implementation of the companion modeling (ComMod) approach to explore stakeholders' interaction in managing land and water resources in a highland watershed in Northern Thailand. Increaed in crop production in upstream areas led to more frequent water shortage and conflict among water users living at different elevations. Role-playing games (RPGs) were played by resource users to facilitate their mutual understanding on individuals behavior contributing to land and water resources management and its collective outcome. The RPGs effectively stimulated the players to respond to certain constraints and collectively solve the management problems that emerged from the gaming sessions. Players and local key informants interviews revealed common concern toward water shortage and management conflict. Successive co-organizing and facilitation of local and inter-institution's activities to investigate and resolve the water management problems unveiled the characteristics of key actors and their interactions. These findings were used to construct an agent-based model (ABM) representing decision-making process of stakeholders managing land and water resources. It is composed of individual and social group agents, and the watershed environment including land, forest and water resources. Agents can observe, communicate with other agents and interact within this environment. Management scenarios combining various land, forest and water management practices were developed. Using this participatory modeling process, problem awareness, perception change and institutional engagement were obtained.

Media grab
Increased social awareness and institutional engagement, desirable for community-based land-water resource management, was achieved in a highland watershed in Thailand through a companion modeling implementation using role playing game and facilitated inter-institutional investigation.

Introduction
The highland watershed areas in northern Thailand have generally been perceived as a fragile, vulnerable, susceptible national asset and subject to protection and management by government. Meanwhile, the Thai constitution in 1997 provided a basis for empowering local stakeholders and institutions to participate in managing local resources in a sustainable way. Intensive and extensive cultivation and national pressure on conserving highland resources brought different management goals to meet. At present, common resources are located within multiple political layers, while practical and proper management frameworks are not formally provided.

The Maehae watershed is located 80 km southwest of Chiang Mai province, one of the major forest-covered areas in northern Thailand. This highland slope complex area is about 3,288 ha, with 15 villages (Karen and Hmong ethnic groups) and 550 households, scattered over three districts. The Maehae farmers are facing insecure land ownership as its utilization conflict with national forest and watershed conservation laws. Recent drought and increasing in crop production in its upstream part led to more frequent water shortage and conflict among water users living at different elevation.

Integrating participatory processes and tools facilitating dialog among involved stakeholders, knowledge sharing and acquisition, scenario development and experiment are essential to promote collective and adaptive social learning process needed to cope with the complexity of human-environment context, and to achieve agreed upon resource management plan. The paper illustrates the use of role-playing games (RPG) and other participatory activities such as focused group discussion, facilitating collaborative investigation, to acquire better understanding of the common problems, facilitate investigation and negotiation among stakeholders and inter-institutions in the Maehae watershed. The findings came out along implementation processes are necessary for developing an Agent-Based Model (ABM) which will be used for further joint scenario exploration.

Methods
The RPG is a mediating tool for understanding interactions among individual behavior contributing to the human-environmental dynamic and its collective outcome. It helps enhancing participatory rural appraisal, empowering stakeholders, and facilitating adaptive resource management (Forester, 1999). Although the RPG is an excellent modeling tool, it is costly and time consuming. To overcome this limitation, and to increase number of stakeholders contributing to resource management, the RPG has been integrated into the ComMod iterative process (Barreteau 2003). The RPG was used to improve the participants' common understanding of complex phenomena and allow the players to understand, modify, and validate the ABM model built

subsequently. Implementations that adapted the ComMod approach for integrated natural resource management are varied due to objectives and heterogeneities of study contexts (Bousquet et al., 2005).

This paper illustrates the use of RPG to acquire knowledge on stakeholders' behavior, and to enhance co-learning processes among them at the Maehae watershed regarding conflict in land and water resources use. Two RPG sessions were conducted to simulate and analyze resource management issues that evolved along the investigation, from land and forest issue to water sharing problem among upstream and downstream water users. To solve this inter-community water sharing problem, which could not be achieved by using the RPG only, a collective understanding and intervention at village and institution levels is required. Therefore, we co-organized and facilitated collective discussions and investigations, e.g. collective field survey, problem analysis workshop, negotiation and management scenarios development, with high level of stakeholders' participation and institutional engagement. The results and lessons learnt from the games and findings from participating in collective activities were analyzed and later on, used in building an ABM. The successive steps of the evolving ComMod process implemented in Maehae are shown in Figure 1.
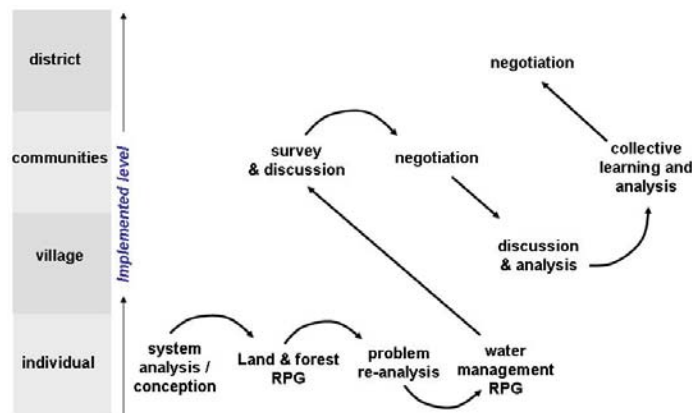

Figure 1. Successive steps and implemented level of the evolving ComMod processes implemented in Maehae, Chiang Mai Province, 2004-2007.

Results
The initial question of this research was how land and forest resources are being accessed and managed under different interests of the Royal Forestry Department (RFD) who is responsible for watershed resource conservation; and the Maehae local people who are doing farm activities in the watershed area. Compared to other watershed areas having similar socio-agricultural context in Chiang Mai Province, the Maehae forest area was well-maintained (Ekasingh et al., 2001). However, key informant interviews provided inconsistent information and unclear explanation on how this situation emerged. In early 2004, the two sessions of land and forest RPG were conducted to acquire a better understanding of the relationships and interactions between farmers and the local forester representing the RFD performing their respective roles of farming and protecting the forest area. The RPG and player interviews revealed close relationship between Maehae people and forester in trying to balance the needs of farmland and forest conservation. Maehae villages have been coordinating the local watershed resource conservation network ("village network") for more than ten years, one of the main tasks is to manage and protect forest areas. Rules and regulations on access to forest resource were set up and agreed upon for all members. One objective beside this arrangement was to lower the degree of forest law enforcement, since most of the local farmland falls into reserved forest category. Villagers assume that the quality of their forest management performance would result in less strict law enforcement and more secure land use right for agriculture.

Due to a severe drought in late 2004, the farm and forest land issue evolved because of increased water scarcity and conflicts between upstream and downstream farmers. Further investigations and field survey were conducted to acquire knowledge on water uses and management practices. Different levels of water scarcity at various places in Maehae, and some conflicts were found and reported. The water management problem has been discussed in the village network monthly meeting. However, due to either the severity of the problem has not reached a critical stage yet or it was too complicated and required a long process to reach a practical solution and agreement, the problem remained unsolved and social tensions tended to increase. A RPG session dealing with water management by farmers in upstream and downstream areas was conducted in order to clarify existing local water management rules, and to facilitate discussions toward managing certain water scarcity situation. The players found that the game based on the 'first-come first served' rule leading to unequal water distribution among users, represented the actual water management well. They wished that an

agreement on water sharing could emerge as it happened during the game, but this was difficult to manage at the level of individual players and collective action among communities was needed.

Therefore co-organized collective activities facilitated by research team were conducted to stimulate a collaborative investigation among villages. The Maehae villages' leaders including committee members of sub-district (*Tambon*) Administration Organization (TAO, the official local organization established during Thai constitution period in 1990s) and a representative from Provincial Administration Organization (PAO) surveyed the upstream area where the conflicts occurred and then discussed to formulate alternative management solutions. Four meetings and discussions were conducted at the village level to brainstorm and re-formulate possible solutions. Information synthesized from these collective activities, overlaying of aerial photographs with other state-reserved areas in Maehae watershed, were presented to the village network committee as well as TAO committee members, to deliberate over the resources use conflict and to propose agreement upon common management rules. Thereafter, negotiation workshops were arranged among upstream and downstream water user groups. District government officers, members of local administrative organization and local forester were invited to participate. The common resolutions agreed upon by the villagers were proposed during negotiations among representatives of upstream and downstream stakeholders. They were dealing with the allocation of equal shares of water volumes, limits to irrigation pipe size, prohibition of cropping on very steep slope and/or close to a stream. No agreement was achieved since each group claimed the ownership of the conflict area, either by official village boundary or inheritance. Furthermore, quite often, some key representatives were absent at the meeting because either they did not have enough strong supporting evidence, or they thought that some agree upon rule might also put more constraints on land and water use to their people. The negotiation has been taking a long time, and it still in progress. Although it was difficult to agree upon all such management solutions, an agreement limiting the number and size of irrigation pipes in the upstream area was achieved in early 2008.

Along these evolving participatory processes, key stakeholders, their main characteristics and their interactions were synthesized and assembled into an ABM implemented under Cormas platform (Figure 2) to explore management scenarios resulting from previous collective investigation and analysis in a cost and time efficient way. Agents and their behaviors, major environmental components and attributes, as well as management scenarios derived from the implemented processes are presented in Table 1.

Table 1. Model elements and their characteristics resulting from previous investigations.

| Investigation tool	Outputs used in the model
• Preliminary system analysis	- Key agents, spatial components (farmland, forest, water), market, climate - Simulation output parameters
• Role-playing game	- Agents' behavior: decision, communication, interaction - Management scenario - Simulation output parameters
• Focused group discussion and interviews	- Common concerned & problem (water scarcity and conflict)
• Participation in the village network meetings	- Group interaction and collective decision-making process
• Co-organizing and facilitating collective investigation and negotiation meetings	- Alternative management scenarios for solving resource use conflict. - Agents' interactions in a negotiation process
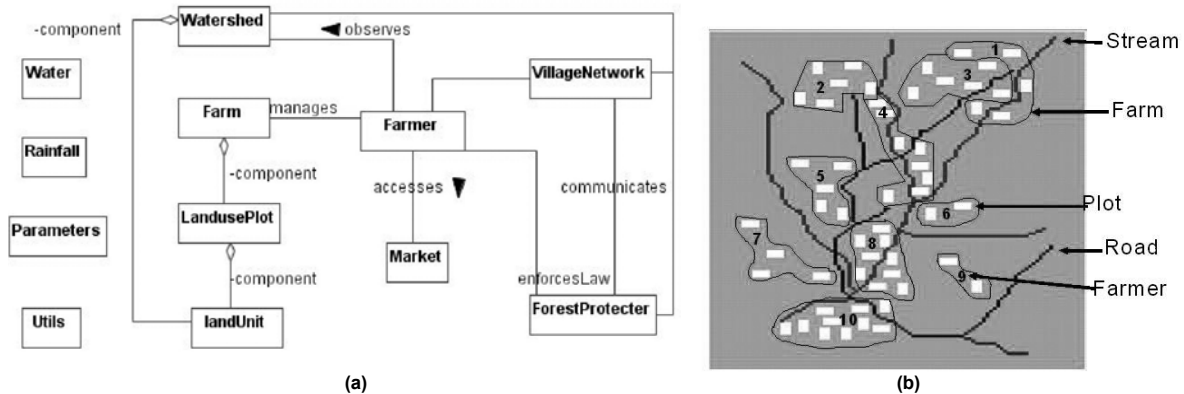
Figure 2. UML class diagram (a) and the spatial interface (b) of Maehae ABM.

At present, the model is used to explore alternative management scenarios combined from proposed management rules e.g. allocation of equal shares of water volumes, limits to irrigation pipe size, prohibition of cropping on very steep slope and/or close to a stream; and possible watershed and forest laws enforcement mentioned by the local forester.

Discussion

The RPG used in this study proved to be effective mediation interfaces leading to better understanding on the inter-dependency among individuals, their action and consequences toward land, forest and water use management, as well as to facilitate resolution of a collective water use problem. Thus, it increased awareness on water uses inequity, more conflict tension, and need of collective action to solve the problem. This kind of finding and outcome could not be obtained through the previous key informant interview.

Co-organizing and facilitating collective investigation and brainstorming helped broadening common view on factors, conditions, and other stakeholders' influences contributing to the situation and possible changes. Better communication and acknowledgement of these matters among individual villager and the village network were required to create awareness and better collaboration in seeking common resolutions. Because of their lack of legitimacy to implement such formulated resolution, the village leaders managed to incorporate TAO, PAO and district government officers into subsequent deliberative and negotiation processes. However, increased number of stakeholders required more time and efforts in organizing such collaborative workshop.

The resource use problem could be solved by applying simple management rules such as equal water sharing suggested in the water RPG. This kind of scenario does not require ABM simulation to quantify amounts of water for each user, but it raised the questions of how to formulate, agree upon and implement such a rule. Therefore, a collective intervention at the community and institutional level is needed. During these collective processes, most of the activities and outcomes in this case study were determined by the stakeholders and some local circumstances, (e.g. a severe drought), ensuring a high level of stakeholders' participation; promoting social learning, awareness and engagement. At present, the developed AMB can be used to explore other suggested management rules. Some of these such as cropping on steep slope and near a stream requires model simulation to provide the quantitative outputs for further negotiation and decision-making. However, such collaborative simulations will be run when the propose scenarios will be agreed upon by all the concerned stakeholders.

Conclusions and recommendations

This paper presents and application of the ComMod approach to promote mutual understanding and support collective water management in a complex social-ecology system. The implementation incorporates individuals' participation and linkages with institutions at higher level of organization. The RPG was effective for knowledge acquisition and perception exchange among individuals, while at inter-institutional level, awareness and change in perception and action evolved through institutional engagement mechanisms. The ownership of the process initiated by researchers was gradually shifted to local stakeholders. Although management rules were collectively proposed and one was agreed upon, and all can be further assessed by the ABM, however, supportive community-based resource management policy is crucially needed to legitimize this valuable outcome and to enhance and ensure local participation for sustainable water resource management in the future.

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