Designing a livestock rearing system with stakeholders in Thailand highlands: Companion modelling for integrating knowledge and strengthening the adaptive capacity of herders and foresters

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1 Introduction

Farming systems design with stakeholders is context specific and requests participatory methods to reconcile the field, farm and watershed levels while integrating different knowledge systems. Rapid ecological and socio-economic changes in northern Thailand highlands have created land use conflicts between extensive cattle rearing systems and foresters in “protected forest” and replantation areas following past extended deforestation. Key stakeholders bearing different interest, agro-ecosystem management objectives and strategies, and operating at different scales of the system hierarchy, had conflicting perceptions on the effects of cattle grazing on vegetation dynamics at the field scale.
Suitable communication platforms do not exist for stakeholders to communicate and most of the concerned Hmong herders did not received formal education. A multi-level collaborative modelling and simulation methodology was tested to mitigate the land use conflict between local herders and public foresters.

2 Materials and methods

Main successive phases and their key characteristics

1. Combined on-farm diagnostic surveys were carried out at the field (to understand biomass dynamics), farm (to assess the diversity of types of production systems and their respective importance of the cattle rearing sub-system), and landscape (to assess heterogeneity and recent change in land use) levels. This information was used to initiate a Companion modelling (ComMod) process (Barnaud *et al.* 2008).
2. Interactive diagrammatic conceptual modelling with pictograms to facilitate knowledge integration was used to produce a key vegetation state transition diagram describing vegetation dynamics influenced by human activities. 3.The conceptual model was implemented as a role-playing game (RPG): gaming board conceived as an abstract output of the land use change analysis; two gaming sessions played with stakeholders to enrich and validate the model, calibrate the RPG, and facilitate communication between herders and foresters.
4. Identification of stakeholders preferred land use scenario for both technical improvement of cattle rearing and tree plantation. Implementation of a computer agent-based model (ABM) “playing the game” *in silico* to simulate these proposed management options. Participatory simulations of options by this ABM and results were used to feed the negotiation between the two parties. Integration of new stakeholders and kinds of knowledge (technical expert, administrators) was needed to design a joint action plan and to build trust.
5. Out-scaling of lessons learned by participating herders to the whole village community with the co-designed ABM tool. Participatory use of the ABM for herder to herder training to share lessons learned.
7. Use of a monitoring-evaluation system based on a log book (xls file) to assess (including quantitatively) the process effects on communication, knowledge sharing, stakeholders’ creativity and adaptive capacity.

3 Results and discussion

The first phase of the process focusing on co-constructing a representation of the agro-ecosystem facilitated knowledge (empirical, expert and scientific) elicitation and integration about vegetation cover dynamics influenced by cattle grazing: new pictograms of key vegetation states were added to the diagram proposed by the research team (Dumrongrojwatthana *et al.* 2011a) at the request of stakeholders.
The second round of gaming sessions was witnessed by new stakeholders (officials, technical support from the livestock extensionist) to build trust. A new livestock rearing system was designed based on *Brachariaruziziensis* artificial pastures planted on land provided by foresters (figure 1). It included a collective management of grazing cattle (provided by herders) as suggested by the results of participatory ABM simulations used to quantitative lyassess the effects of various options on animal husbandry and economic indicators chosen with the participants.

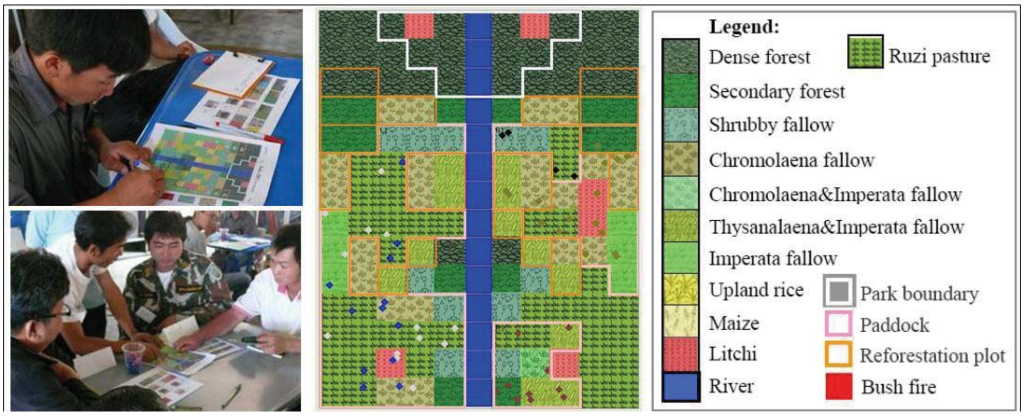

Fig.1. Stakeholders' interaction in the second round of gaming session and example of the ABM interface during a simulation displaying the land use heterogeneity and cattle grazing on *Brachariaruziziensis* pastures.

Herder to herder training supported by the computer ABM was used to out-scale the process, to facilitate the transfer of experience acquired by the participating herders, to promote a shared understanding of the proposed innovation, and to stimulate a collective engagement to respect the agreed-upon experimental protocol for the intensification of cattle rearing at the village scale. Trust building among stakeholders was an important outcome of the process, as well as procedures for out- and up-scaling such processes relying on the ABM tool. Figure 2 shows the intensity of exchanges among the different categories of participating stakeholders in the process. More than 40% of the time was used to elicit and share empirical knowledge (Dumrongrojwatthana *et al.* 2011b).

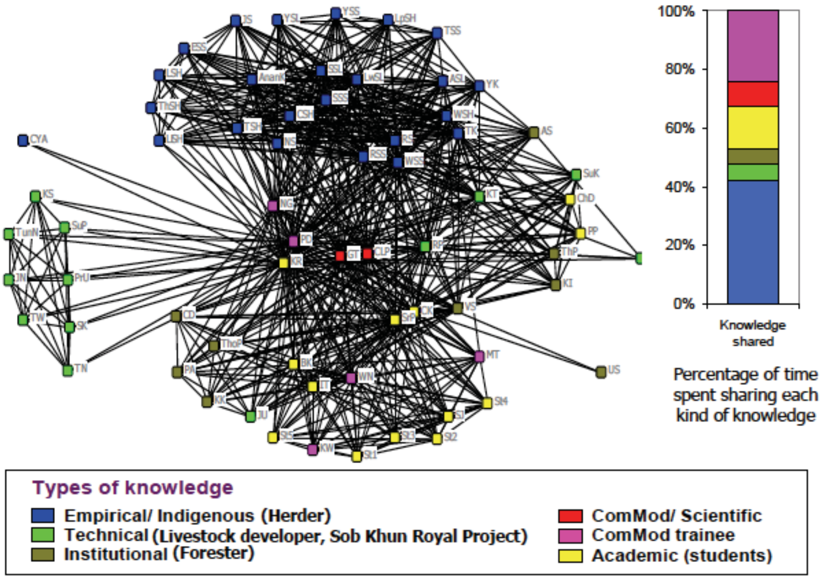

Fig. 2. Social network diagram displaying the communication and the kinds of knowledge shared among the participants during the whole process.

4 Conclusions

The lack of formal education among herders was not an obstacle to their participation because this constraint was well-taken into account when designing the collaborative modelling methodology. For such a process to succeed, a supporting policy environment is crucial to facilitate successful bottom-up design of farming systems and their subsequent experimentation in the field.

References

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