# Use of an abstract agent-based model to establish a communication channel between two parties in conflict in Eastern Bhutan

Christophe Le Page[1], Tayan Raj Gurung[2], Lhap Dorji[3], Guy Trébuil[1]

[1] Cirad, UPR Green, Montpellier, F-34000 France
[2] Ministry of Agriculture, CoRRB, Thimphu, Bhutan
[3] Ministry of Agriculture, RNR Research Centre, Wengkhar, Bhutan

{le_page, trebuil}@cirad.fr, tayangurung@yahoo.com, lhapdorji@druknet.bt

## 1 Introduction: the socio-ecological setting, conflict and objectives

Overgrazing and indiscriminate lopping of trees has been leading to the degradation of natural pastures in the upper catchment of Radi in Mongar District, eastern Bhutan. High runoff during monsoon accelerates ravine development leading to the degradation of crucial rice terraces downstream. More than 1,200 hectares of natural pasture situated in the Sheytimi area between Radi and Merak serve as traditional grazing ground for cattle of sedentary Radi farmers (Radips) during summer and yak from nomadic Merak herders (Brokpas) during winter. Serious conflict between these two herder communities has impeded local conservation of grazing land since the 1960s [1]. The contradiction emanates from the differences on livelihood source of two communities. While Radips practice commercial rice cultivation, Brokpas live a migratory life depending on pastoral system. Further the extensive pasture land belonging to one owner and granting user rights to few herders from Radi has created disparity in accessing the much needed resource to the extent that many reports mention of people injuring and killing cattle of another community.

In 2006, in collaboration with local development workers and administrators, the Renewable Natural Resource Research Center based in Wengkhar decided to organize a field workshop to better understand the grazing land conflict and to establish a communication channel between the two parties in conflict [2].

This paper describes the agent-based model (ABM) supporting the role-playing game (RPG) sessions played by representatives of both communities during the 2-days field workshop. We explain how a toy model has been tailored by the participants to represent an artifact referring implicitly to the conflicting situation on the ground but yet very much abstract and extremely simplified.

## 2 Methodology and tools

An initial situational analysis including visits to herders and discussions on the issue at stake with the concerned stakeholders was carried out to update the research team

understanding of the situation already analyzed several years before [3]. The Companion Modeling (ComMod[1]) approach [4], [5], previously implemented in another Bhutanese site [6], has been introduced to researchers and development workers involved in Radi during an in-country ComMod training course held in January 2006. During the course, the trainees conceived a prototype RPG representing the grazing land conflict in Sheytimi. The RPG output of this training was used during the following week to facilitate the exchange of perceptions about the grazing land management problem with the two communities of herders in a participatory field workshop held in Radi agricultural extension office. The conceptual ABM on which the RPG is based is first presented.

### 2.1 Conceptual ABM

The structure of the Radi ABM is depicted through the UML class diagram (figure 1) that shows the conceptual entities and their interrelations.

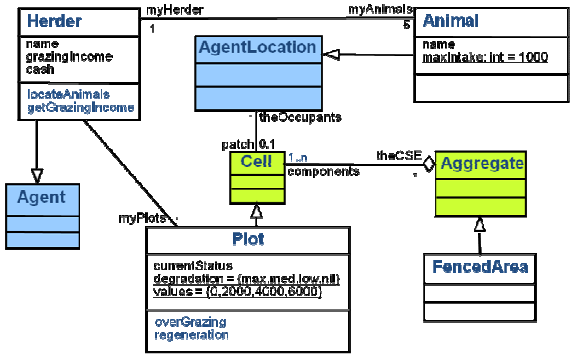



**Fig. 1.** The conceptual entities of the Radi ABM (white rectangular boxes) as a UML class diagram. The colored rectangular boxes represent generic classes of the Cormas simulation platform [7] that was used to implement the ABM.

The virtual pastureland of the model is made of 24 plots. The quantity of grass in a plot (0; 2000; 4000; 6000) corresponds to the status of the plot (totally degraded; mostly degraded; slightly degraded; not degraded). A herder owns a constant number of animals. Each cattle can graze a maximum of 1000 units of grass per time step. The only decision a herder has to make at each time step consists in distributing his animals over the virtual pastureland. The quantity actually grazed by an animal is set to the minimum value between 1000 and the quantity of grass in a plot divided by the total number of animals located there. When this ratio is lower than 1000, the plot is considered as overgrazed and its status will be downgraded to the preceding level at the next time step. Symmetrically, the status of a plot without any cattle located there will be upgraded to the next level with a probability of 0.5.

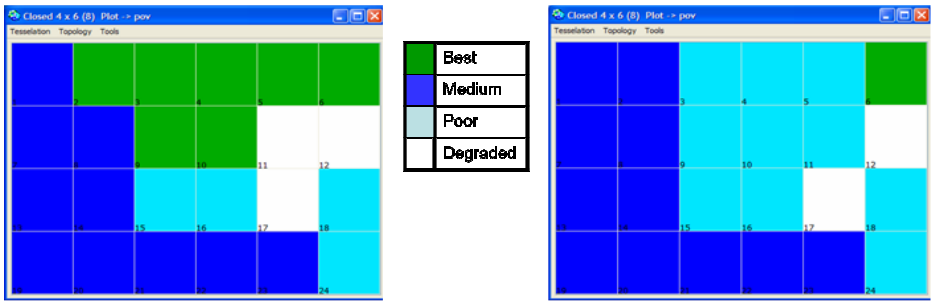
[1] http://www.commod.org/en

### 2.2 RPG

The ABM was calibrated to play a game with twelve herders, each of them owning five cattle, on a virtual pastureland proposed by the research team (see figure 2a). Three successive gaming and simulation sessions (each made of five rounds) were played with different modes of communication: first individual community mode (six Radips and six Brokpas playing separately), second session with the same mode but with the introduction by the research team of a land management option (fencing for pasture regeneration), and a final session with the two communities playing together with the land management option.

## 3 Social validation of the model

After a few rounds of the first scenario, the participants were requested to assess the model by mentioning any aspects they disliked or found confusing. Both parties agreed that the spatial configuration of the virtual pastureland was the main issue. After 10 minutes of collective discussion, they managed to adjust the game board (see figure 2b) in such a way that all of them were able to similarly relate it to Sheytimi.




a B

**Fig. 2.** The virtual pastureland made of 24 plots a) initially proposed by the research team; b) after reconfiguration by the participants of the field workshop

## 4 Discussion

Compared to the first scenario (community mode), the second one (introduction of the management option) helped to sustain the resource and to limit land degradation. The third one (collective mode) even ended with an improved situation. Moreover, players acquired new knowledge on potentials for collective management to sustain the resource base. By the end of the workshop, they started to envision a collective action plan based on fencing the degraded grazing land, but their plan could not be

implemented due to the scale of the problem. Currently development projects addressing this issue are being implemented.

This case study reinforces the idea that to initiate a participatory modeling process in conflicting situations, an artifact providing an abstract representation of the system is preferable. A high degree of abstraction is a mean to remain distant enough from the burning issue. At the same time, it is commonly assumed that abstraction is best suited for scientists and that involving local stakeholders in a modeling process requires designing realistic representations. In Radi, we showed that yak herders were able to establish connections between a chessboard-like game board and their pastureland.

**Acknowledgments.** Ecole Commod project, Asia IT&C programme of the European Union and PN25 project of CPWF – CGIAR.

## References

1. Tashi, K., Wangchuk, T.: The grazing conflict of Sheytimi: An analysis of the causes & recommendations for the future. Technical document n° 30, RNR-RC Wengkhar, Council of RNR Research of Bhutan, Ministry of Agriculture, Bhutan (2006)
2. Gurung, T.R., Le Page, C., Dorji, L., Choney, R., Trébuil, G.: Companion modelling to facilitate understanding of grazing land conflict in Sheytimi, Radi, Eastern Bhutan. Poster (2008)
3. Gurung, T.R. et al.: Diagnostic study: Geog level planning & perspectives, Radi, Trashigang. Technical document n° 14, RNR-RC, Khangma, Bhutan (1999)
4. Barreteau, O., et al.: Our Companion Modelling Approach. Journal of Artificial Societies and Social Simulation (2003) [http://jasss.soc.surrey.ac.uk/6/2/1.html]
5. Etienne, M. (ed.): Companion modeling. A participatory approach to support sustainable development. Editions Quae, Versailles (2011)
6. Gurung, T.R., Bousquet, F., Trébuil, G.: Companion modeling, conflict resolution, and institution building: sharing irrigation water in the Lingmuteychu watershed, Bhutan. Ecology and Society (2006) [http://www.ecologyandsociety.org/vol11/iss2/art36/]
7. Bousquet, F., Bakam, I., Proton, H., Le Page, C.: Cormas: Common-pool Resources and Multi-Agent Systems. Lecture Notes in Artificial Intelligence, Vol. 1416. Springer-Verlag, Berlin Heidelberg New York (1998) 826–837