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PARTICIPATORY SIMULATIONS FOR CREATIVE NEGOTIATION IN THAILAND HIGHLANDS

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Abstract — Despite the widespread use of the concept of sustainable development, interactions among its ecological, economic and social pillars are more often seen in terms of trade-offs than in terms of synergies. Drawing on the case of a conflict between a new national park and two villages about access to forest and land resources in the highlands of Northern Thailand, this paper shows that the concept of integrative negotiation can be used to reveal potential synergies between environmental conservation, farmers' livelihoods and social equity. In this case study, participatory agent-based simulations supported a creative and integrative mode of negotiation among different types of farmers from two villages, foresters in charge of reforestation and the national park rangers. They allowed the conflicting parties to reframe the problem at stake and to uncover mutual interest in stopping deforestation and the management of non timber forest products.

Key words: Integrative negotiation, participatory simulations, agent-based model, companion modelling, forest conservation, Northern Thailand.

Résumé — En dépit de l'usage croissant du concept de développement durable, les interactions entre ses trois piliers (environnementaux, économiques et sociaux) sont plus souvent pensées en termes de compromis qu'en termes de synergies. A partir d'une étude de cas sur un conflit autour de l'accès aux ressources foncières et forestières entre un parc national en cours d'établissement et deux villages dans les hautes terres du Nord de la Thaïlande, cet article montre que le concept de négociation intégrative peut être intéressant pour révéler des synergies potentielles entre la préservation de l'environnement, la subsistance des agriculteurs, et l'équité sociale. Dans cette étude de cas, des sessions participatives de simulations multi-agents ont favorisé l'émergence d'un mode de négociation créatif et intégratif entre différents types d'agriculteurs, des forestiers et des agents du parc national. Ces simulations ont permis aux différents protagonistes de reformuler le problème en jeu et de réaliser qu'ils avaient des intérêts en commun, notamment dans la limitation de la déforestation et la gestion des produits forestiers de collecte.

Mots clés : négociation intégrative, simulations participatives, modèle agent-centré, modélisation d'accompagnement, préservation de la forêt, Nord Thaïlande.

INTRODUCTION

In spite of the widespread use of the concept of sustainable development in both scientific and political arenas, achieving its main goal, i.e. articulating ecological, economic and social interests, remains a challenge (Sayer et Campbell, 2004). Drawing lessons from the numerous failures of experiments conducted in its name in the field of natural resource management (NRM), one can wonder whether the idea of a long term co-viability of farming, conservation of natural resources and social equity is a utopia. In some cases compromises can be found, but do win-win solutions exist? Are poverty reduction and environmental conservation not only compatible but also potentially mutually supporting? If yes, which contexts and methods could facilitate the emergence and use of such synergies?

We chose to address these questions from a stakeholder perspective, looking at their interests and interactions. Ecological, economic and social stakes are indeed hold by interdependent stakeholders such as farmers, companies, managers of protected areas, administrators, etc. To support sustainable development, those stakeholders need to interact, learn about each other and find mutual agreement. Röling & Wagemakers (1998) defined sustainability as « the outcome of interactions among stakeholders ». They see dialogue and collective learning as the key entry point for promoting sustainable development. Due to the growing interest for decentralized and participative approaches in NRM, such multi-stakeholder processes are nowadays frequent in the field of rural development (Chambers et al., 1989). However, in most cases, these processes take place in situations of conflicts of interests and power asymmetries. For those reasons, several authors suggest to analyse multi-stakeholder processes not only in term of collective learning, but also as negotiation processes (Leeuwis, 2000). In this paper, we use insights from negotiation theories to think about a way to articulate the above listed three pillars of sustainable development.

This paper examines these questions drawing on the case of a land-use and forest management conflict between two rural communities and a new National Park in Northern Thailand, with officers of the Royal Forestry Department (RFD) in charge of reforestation activities in the area sitting somewhat in the middle. Since these communities' livelihoods depend on land and forest resources while the Thai law forbids any human activity except tourism within National Parks for conservation purposes, the conflict opposing them was a vivid illustration of the contradiction between social, economic, and environmental objectives (Barnaud *et al.* 2008). A multi-stakeholder process was implemented to facilitate the emergence of a dialogue between those stakeholders and see whether they could find paths towards a way to articulate the objectives of farmers' livelihood systems, forest conservation and social equity. This process was based on the companion modelling approach (ComMod) combining, among other tools, the use of role-playing games and agent-based computer simulations. This paper focuses on the agent-based simulations of scenarios conducted in the final steps of the process that enabled the villagers, foresters and national park officers to jointly explore and discuss the economic, social and ecological impacts of various sets of possible forest management rules. The discussion section examines both methodological and theoretical questions. How far can negotiation theories help us think about trade-offs and synergies between the three pillars of sustainable development? And what are the potential and limits of participatory agent-based simulations to support creative and integrative negotiation processes for sustainable NRM by multiple users?

1. INSIGHTS FROM LEARNING AND NEGOCIATION THEORIES

To analyse interactions among stakeholders in a multi-stakeholder process, some authors use the concept of social or collective learning (Röling et 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 80s as a cognitive approach to analyse multi-stakeholder systems (Checkland et 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 analyse 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 analysing multi-stakeholder processes not only in term of collective learning, but also as negotiation processes.

Some 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 something, meeting midway between opening positions. They simply "share the cake" in a zero-sum outcome. On the contrary, in integrative negotiation, the stakeholders creatively reframe the problem to "enlarge the cake" and to identify "win-win" solutions. This process implies an important learning effort in which that both sides look beyond their initial positioning to examine the underlying interests determining them, or even their deeper values. Carnevale (2006) illustrates this with the case of two sisters who argue because they both want an apple (while there is only one). In a distributive negotiation process, the two sisters would cut the apple in two pieces. In an integrative negotiation process, with a closer look at their underlying interests, the two sisters would realize that one is interested in the flesh for cooking, while the other wants the seeds for planting. We suggest using these theoretical insights about distributive versus integrative negotiation processes to analyse a land use and forest management conflict between a new National Park and two rural communities in Northern Thailand.

2. A CONFLICT ABOUT FOREST MANAGEMENT IN THAILAND HIGHLANDS

A companion modelling process was conducted in 2006 in the highlands of Nan province,in the context of a conflict between the Nanthaburi national park being established and two Mien (or Yao) communities located near the future boundaries of the park. This conflict raised both environmental and social issues. On the environmental side, the objectives of the National Park were twofold: (i) to protect the area from deforestation to avoid flash floods and water quality problems in the lowlands (as this area is located in the upper watershed of one of the main attribute of the Chao Phraya river, a key national source of water for rice production, industries and large cities in the central plain), (ii) to protect the biodiversity in a special type of forest in the country. In particular, conservationists are sensitive to the preservation of the *Arenga pinata* palm, an endemic species of this region. On the social

side, these highlands are populated by ethnic minorities whose livelihoods are traditionally very dependent on forests. In this area, the farmers used to practice a pioneer shifting agriculture[1], but these farming practices have been discouraged since the enforcement of environmental policies in the 90s, and farmers have gradually shifted to permanent cultivation (at the same time, they shifted from self-subsistence to commercial agriculture). However, although farmers are not allowed to cut trees (except for building their houses), the lack of land still leads them to open new plots in the forest. Moreover, in local farmers' livelihood systems, the collection of non-timber forest products (NTFPs) is a key source of food and income, in particular for the poorest families. Most NTFPs are for self-consumption (bamboo shoots, mushrooms, medicinal plants, etc.), but some of them, especially the fruits of *Arenga pinata*, are sold on the market. Since Thai law forbids any human activity except tourism within national parks, villagers felt threatened by its establishment. They were more or less depending on the type of farm they managed. Indeed, in these two villages, three main types of farming households were identified and characterized by different socio-economic constraints, farming strategies and consequently contrasted interests regarding the national park issue. Type A households were very economically vulnerable landless or near landless households, highly dependent on gathering of NTFPs for the generation of cash income and family consumption. Without access to NTFPs, they would have to leave the village and work as urban wage earners. Type B farming households earned their main income from agriculture and were mainly concerned by the risk of loosing farm land. NTFPs were also a concern to them as it is a complementary source of cash to compensate for fluctuating farming incomes. Type C farming households had enough capital to invest in rather profitable off-arm activities allowing them to invest in large litchi orchards. Therefore, they did not feel threatened by the national park issue. The conflict between the two communities and the national park was also cultural and political. Indeed, there are several negative prejudices against ethnic minorities living in the highlands within Thai society (McKinnon et Vienne, 1989). These "montagnards" have long been considered by the government as trouble makers. They were accused of being potential communists and opium growers during the cold war, and more recently destroyers of the highland environment.

In 2006, when the ComMod process began, the relations between the National Park and the villagers were highly conflicting and the situation was unclear, with a lot of misinformation in the villages. The key questions of the future location of the park boundary on the village territory and the management rules to be enforced within the park had not been discussed yet beyond a limited circle of village leaders. But many of them (mainly type C farmers) were not preoccupied by this issue. There was a risk for the chief of the national park to make unilateral decisions or at best, after consulting a few village leaders only. In this context, the ComMod process was conducted (i) to facilitate dialogue between the villagers and the park rangers while taking into account the diversity of interests among villagers, and (ii) to support an inclusive negotiation process among them.

3. A COMPANION MODELLING PROCESS

ComMod is a participatory modelling approach aimed at facilitating collective learning among stakeholders (including researchers) about renewable resource management problems in

[1] Also called slash-and-burn or swiddening agriculture: farmers clear a piece of forest, burn the vegetation in the dry season and cultivate this plot for a few years before to let the forest regenerate while moving to another plot. Two main types of swiddening systems were practiced in northern Thailand, the pioneer one (practiced by the Mien people in particular) being more harmful for the forest ecosystem than the rotating one.

complex socio-ecological systems (Bousquet et al., 1996; Barreteau et al., 2003). Alternating field and modelling activities in an iterative way, its main principle is to develop simulation models integrating the different stakeholders' points of view on the problem at stake, and to use them within communication platforms to collectively explore and discuss various scenarios for the future. This approach is used with two possible aims: (i) to produce knowledge on the socio-ecological systems, and/or (ii) to accompany collective decision-making processes among the stakeholders. The case study described here falls into the second category.

Two kinds of simulation tools were combined: Agent-Based Models (ABM) and Role-Playing Games (RPG). ABM are particularly appropriate to represent complex socio-ecological systems because of their ability to represent interactions among heterogeneous social agents and between these agents and their common environment (Bousquet et al., 1993; Ferber, 1999). RPG is an appropriate mode of communication to convey complexity as it allows multiple stakeholders to interactively examine the complex systems they are part of (Duke, 1974). In a RPG, players can discuss about and test alternative scenarios of potential solutions, but quickly the use of this tool becomes costly and very time consuming. To remove these constraints, it is possible to build a simple computerized ABM, very similar to the RPG in its features and rules, but far more cost and time-efficient to simulate scenarios. Moreover, since the RPG is based on the same conceptual model than the computer ABM, the use of the RPG can be seen as a way to "open the black box" of the computer ABM (Barreteau et al., 2001). It allows players to understand, validate and/or criticize and enrich it and, later on, to be able to follow ABM simulations and to comment their results. While in this experiment such a combination of RPG and ABM was used, this paper focuses on the ABM simulations only.

This ComMod process started with a four-month long in-depth analysis of the initial agrarian and institutional situation through individual semi-directed interviews with some 30 farmers, village leaders, national park rangers and RFD foresters. This initial analysis was used to analyse the key NRM problem, the main concerned stakeholders, their initial perceptions of the situation and the social and power relations among them (Barnaud et al., 2008). This initial analysis was followed by two series of participatory field workshops conducted in parallel. Firstly, two workshops with villagers only were held in each village that allowed them to reflect about the establishment of the park, and one workshop was organized with the RFD foresters and the park rangers only for them to discuss about their NRM conflict with the villagers. A final workshop was conducted with villagers from both villages, RFD foresters and national park rangers to trigger more dialogue and better mutual understanding among these main parties in the conflict (Ruankaew et al., 2010).

The successive workshops of the ComMod process allowed the different stakeholders to become more aware of the diversity of interests and perceptions among them about the establishment of the national park and the resulting conflict. Villagers realized and acknowledged that they had different stakes. For example, the most important issue was the right to collect NTFPs for the poorest ones, but for some others, it was the risk to loose farm land, while a few villagers also emphasized the question of the right to carry a gun for hunting inside the park. The park rangers emphasized that to them, the most important issue was to stop deforestation. This process triggered a better mutual understanding and, more importantly, an increased awareness of the necessity to cooperate to solve the problems at stake. However, in the final workshop, the discussions had reached a standstill because the villagers and the rangers argued over the park boundary. This was a frontal confrontation in which they just fought to "share the cake" in a distributive or "zero-sum" negotiation mode. The following day, the team of workshop facilitators suggested thinking in a different way, i.e. to imagine that they had a common space to manage collectively, with no boundary. Agent-based simulations were proposed to the participants to facilitate a collective brainstorming on forest management rules in this hypothetic common space. The objective was to move from

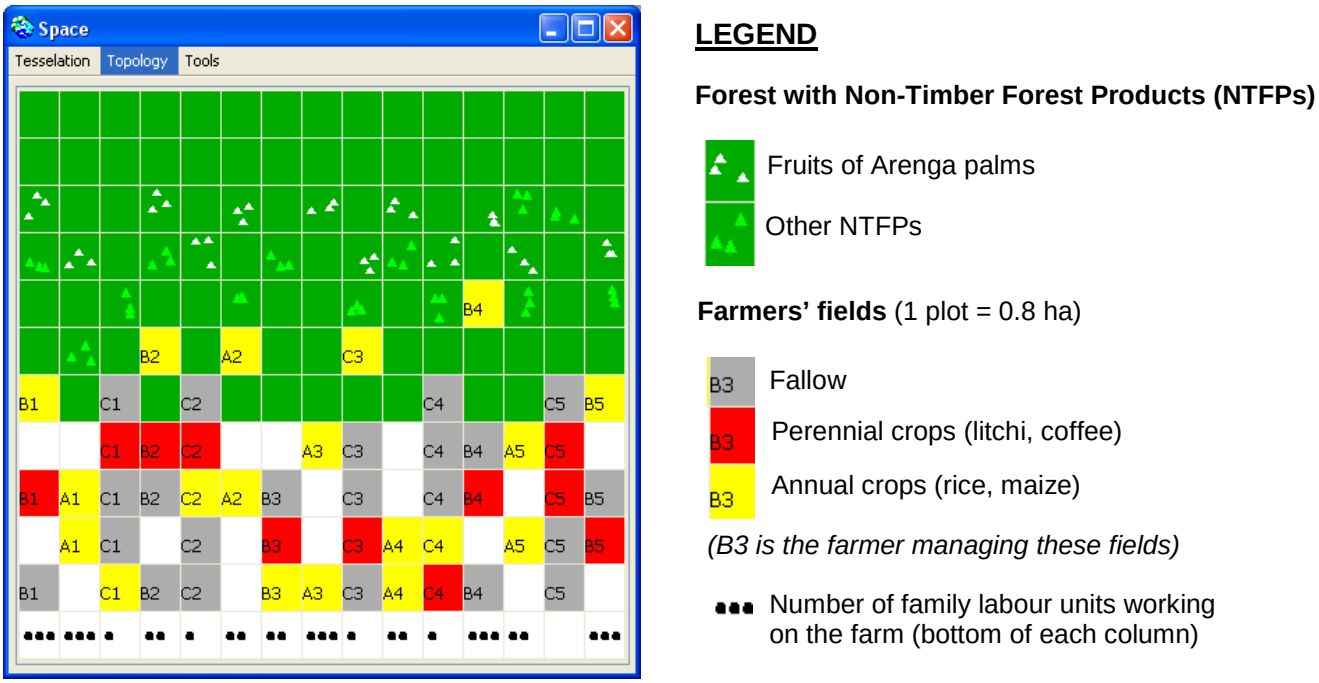
a debate on the boundary to a debate on the rules for access to resources. We made the hypothesis that this would lead the participants to realize that beyond the conflict about the boundary, they had some common interests, and that this would facilitate a move from a distributive towards a more integrative mode of negotiation.

The following sections provide a brief description of the ABM, then the scenarios discussed on that day are described exactly like they were presented to the stakeholders, and this is followed by an analysis of how the discussion of the simulation results led to the emergence of a more integrative mode of negotiation among the conflicting parties..

4. DESCRIPTION OF THE AGENT-BASED MODEL

The purpose of the model was to enable villagers, RFD foresters and park rangers to jointly explore and discuss the economic, social and ecological impacts of various sets of possible land-use and forest management rules. The general structure of the model is described in appendix 1 and its spatial interface is shown in figure 1.

Figure 1. Spatial interface of the NamHaenGame agent-based model.



In the model, there are 15 farming households (5 of each socio-economic type - A, B and C). At the beginning of the simulation, they have different amounts of money, land resources and family labour. At each time step (corresponding to a crop year), the model implements the following sequence of activities:

- the farming households decide how to allocate their labour force (working in town or on farm; in town, they can either work as low wage labour, or, if they have sufficient investment capacity, they can make and sell soymilk),
- they decide whether or not to open new plots in the forest,
- they decide land-use in their fields (knowing that there are (i) cash constraints since they have to pay for inputs and (ii) labour constraints for annual crops),
- they gather Arenga fruits and other NTFPs according to collective rules varying between scenarios,
- the model calculates the family annual net income by taking the basic family needs into account (if they have debts, they work in town as wage labourers in the following year),

- the NTFPs regenerate (if farmers leave at least one unit of NTFP on a cell, there will be three units the following year, and only one unit if they take all).

In this model, there are no direct interactions among the farming households (such as exchange of information, money, etc.). However, they interact indirectly through their environment, since their individual activities both modify and depend on the state of the forest and the quantity of NTFPs available.

To follow the dynamics of the simulation, there are ecological indicators such as the extent of the forest cover and the quantity of NTFPs left after regeneration. There are also socio-economic indicators, such as the number of households forced to leave the village, the level of farming households' monetary assets, or the composition of their incomes (products that are self-consumed are taken into account at their market price): income from NTFPs, from farming activities, and from off-farm activities.

5. PARTICIPATORY EXPLORATION OF THREE SCENARIOS

Three scenarios were simulated and discussed during the final workshop with villagers, park rangers and RFD foresters. These simulations are presented like in the workshop. This means that we do not present results from simulations run in the laboratory (like the averages from 50 simulations of a given scenario for example), but we present only the results of a single simulation for each scenario. Since there are stochastic elements in the model like in reality (price fluctuations for example), two simulations of the same scenario never give exactly the same results. Moreover, none of these scenarios claim to be realistic. They all represent a rather extreme outcome of a given trend. The objective was a learning one with simulations aiming at making the participants more aware of key interactions in the system and their consequences. A scenario representing more accurately the current actual situation would probably be made of components borrowed from these three scenarios.

The three scenarios correspond to different rules regarding the collection of NTFPs and forest encroachment. In the first scenario, NTFPs are collected without any collective management rules (individual farmers collect NTFPs as much as they want) but the ban on encroachment is respected. In the second scenario, NTFPs are collected according to management rules currently used in community forests (collectors never take all the NTFPs available and always leave some to regenerate) and the ban on encroachment is respected. In the third scenario, the NTFPs management rules are respected but the ban on forest encroachment is not.

In the first scenario, NTFPs are rapidly depleted. Incomes from NTFPs (including the self-consumed ones) of type A and B farmers are very high in the first year and then decrease abruptly and remain low during the nine following years (fig. 2.2). Since their livelihoods heavily depend on incomes from NTFPs, their level of indebtedness increases rapidly (fig. 2.1). In order to survive and reimburse their debts, they send family members to work in town as low-wage labourers (fig.2.3). Type C farmers are not affected by the decrease of forest products. In whatever scenario, they have enough cash to invest in the relatively lucrative soymilk business in town (fig.2.3). They reinvest this off-farm income on the farm, by planting litchi orchards, a kind of perennial crop more acceptable to foresters and rangers.

In the second scenario, type A and B farmers respect a collective rule regarding the collection of NTFPs to avoid the over-exploitation of the resource. Their incomes from NTFPs are slightly lower than at the beginning of the first scenario, but remain constant along the years (fig. 2.2). Their economic situation is much better than in the first scenario (fig. 2.1), they can invest more on the farm and they are less forced to leave the village for precarious jobs in town (fig. 2.2), and they finally need less and less NTFPs (their forest income decrease at the end of the simulation). This scenario shows that on the long term, it is in the villagers' interest to set up and respect rules to collect NTFPs in a sustainable way. Actually,

villagers have set up such rules in "community forest" areas. Although old villagers say that young people tend to break these ancestral rules, most of the time, they are well-known and respected. This is contrary to the national park rangers' belief considering ethnic minorities as forest destroyers who only pursue short-term benefits.

Figure 2. Output of simulations of the three scenarios discussed with stakeholders.

Scenario 1
NTFPs rule: not respected
Encroachment ban: respected

Scenario 2
NTFPs rule: respected
Encroachment ban: respected

Scenario 3
NTFPs rule: respected
Encroachment ban: not respected

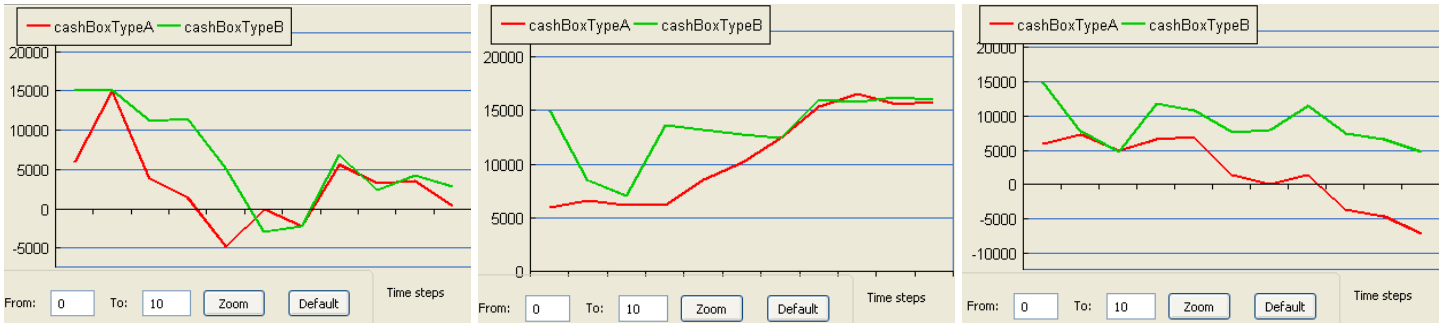


Figure 2.1. Evolution of cash for type A (green) and B (red) farming households.

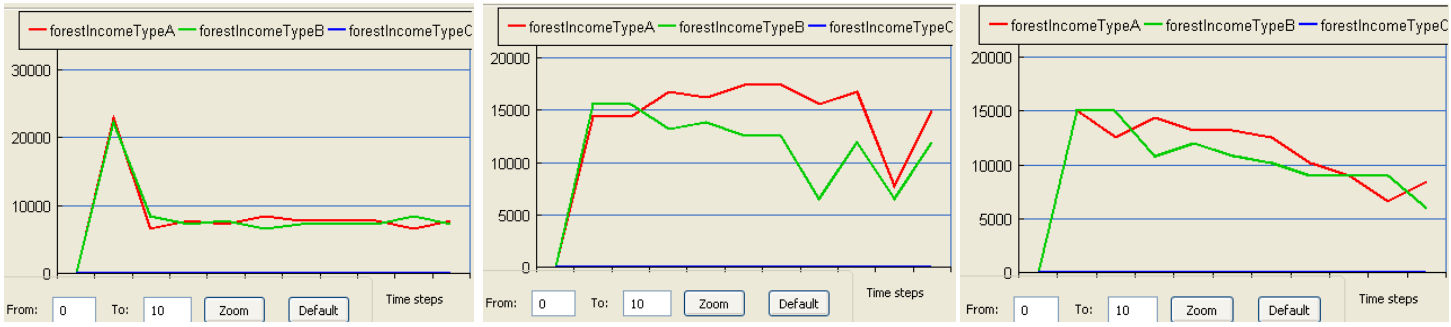


Figure 2.2. Evolution of income from NTFPs for type A (green), B (red) and C (blue) farming households.

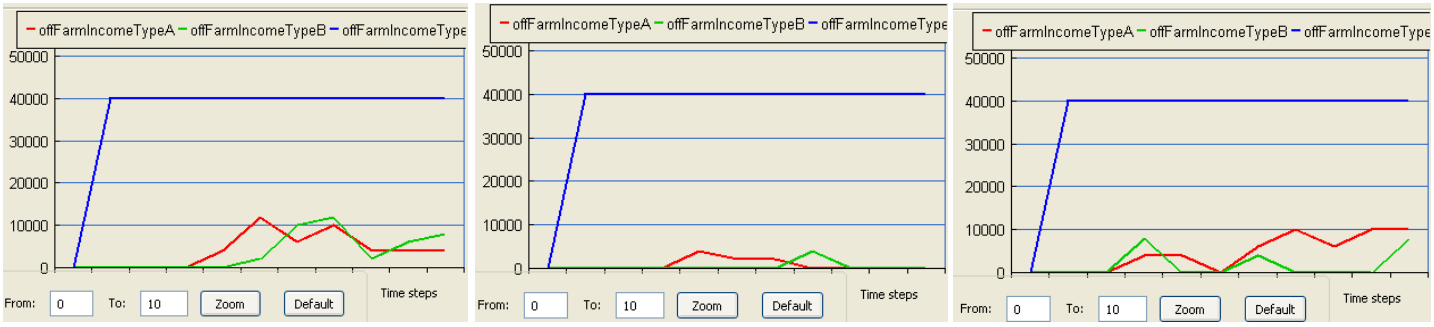


Figure 2.3. Evolution of off-farm income for type A (green), B (red) and C (blue) farming households.

In the third scenario, the farmers still respect the NTFPs rule, but they do not respect the ban on encroachment, and regularly open new plots in the forest. In reality, this is formally forbidden by law, but some farmers still do it. These are either very poor and landless farmers who encroach small plots to grow rice or maize, or on the contrary rather healthy and influential type C families who want to expand their litchi orchards. This scenario is more favourable to these type C farmers, but very unfavourable to type A and B farmers. Indeed, in this scenario, the forest area decreases progressively. As a consequence, the quantity of available NTFPs and related incomes of type A and B farmers also irremediably decrease

(fig.2.2). The most affected ones are the type A farmers who are the most dependent on the gathering of NTFPs (fig. 2.1).

6. DISCUSSION

The different categories of participants in the ComMod process (park rangers, RFD foresters and three types of farmers) ostensibly validated these three scenarios. We remind here that since they had played several gaming sessions of a RPG based on the same conceptual model, they could easily understand the computer ABM simulations. These participatory simulation sessions stimulated a constructive discussion leading them to conclude that beyond their differences, they had three major common interests: (i) the sustainable management of NTFPs (biodiversity conservation for the park, maintenance of a major source of income for most of the villagers), (ii) limiting deforestation (maintenance of forest cover for national park, maintenance of forest products for villagers), and (iii) protecting the forest from fire (for the same reasons as deforestation). The well-off type C farmers (including the village leaders) who participated in the workshop might have found that they had nothing to win under this agreement, but they actually supported it because it was in their interest to show to the national park that they were not "forest destroyers". Indeed, improving their relationships with the park rangers would give them a chance to increase their room for manoeuvre in future negotiations regarding the exact location of the park boundary on their village territory. The workshop facilitation team suggested writing down the ideas of this collective agreement as a kind of Memorandum Of Understanding that was signed by all the participants. Later on, several participants pointed out this MOU as one of the most positive achievements of the ComMod process.

Following the presentation of what happened in the Commod process, we can revisit the two questions that were formulated at the beginning of the article: how far can negotiation theories help us think about the trade-offs and synergies between the three pillars of sustainable development? And 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?

The conflict examined in this article is a typical situation of apparent incompatibility between ecological, economic and social interests. The various concerned stakeholders considered that there were no possible synergies (only trade-offs) between poor villagers' livelihoods, forest conservation and social equity. To analyse this situation, we chose to look at the various stakeholders' strategies, interests and values, and to analyse their power relationships. This led us to analyse their interactions in term of negotiation. At the beginning of the process, the protagonists of this conflict considered their interests as incompatible. "We have to fix the boundary, then every one will stay in its own area, and it will be fine", said a village leader. In other terms, "good fences make good neighbours". They confronted each other on a distributive mode, arguing over the way to "share the cake". In such a distributive mode, the power asymmetries are determinant, the least influential stakeholders have little chance to win the fight. In this case study, the national park could simply decide unilaterally both the boundary of the park and the rules within it. But by doing so, it would take the risk to see the villagers using their last option by setting up fire to the forest. In any case, this would remain a zero-sum outcome. It is interesting to notice that in this context, the ecological stakes are hold by the most powerful stakeholders, while in many other contexts, the conservationists are the least influential. This is often the case in France for example where agricultural or hunting lobbies are very strong (Mathevet, 2004). The most interesting concept from negotiation theories to think about synergies between the three pillars of sustainable development is the concept of integrative mode of negotiation, when the stakeholders reframe the problem to try to "enlarge the cake". In the negotiation process described here, we observed a move from a distributive to an integrative mode of negotiation: the stakeholders reframed their way to tackle the problem by accepting to stop thinking about the park boundary only. Focusing on the boundary corresponds to a

segregationist vision of space, with on the one side, a space where environment is protected, and on the other side, a space where environment is exploited. The agent-based simulations suggested a more integrative vision of space. This was obviously a very hypothetic and unrealistic scenario, since at the end there will necessary be a boundary. However, this exercise allowed the stakeholders to better understand each other's interests and values beyond their initial positions in the conflict. Like the two sisters who could find a better deal than cutting the apple in two pieces once they had made explicit what part of the apple they were interested in, the stakeholders could make explicit more precisely what they wanted and needed from the local forest environment. This allowed them to recognize that a co-management was possible to satisfy their respective needs, and that they were potential synergies between ecological (biodiversity conservation, maintenance of forest cover), economic (better farming households incomes), and social preoccupations (less inequalities, less villagers forced to leave the village to take precarious jobs in town). Beyond this single area, this case study questions the pertinence of a segregationist vision of space to deal with environmental issues in Northern Thailand. This reinforces the statement made by Roth (2004) who highlighted that the National parks' perception of space in Thailand is at the origin of endless conflicts in this country.

In the negotiation process described in this paper, the use of participatory agent-based simulations facilitated the move from a distributive towards a more integrative mode of negotiation. What are the potential and limits of these tools to support such integrative processes? Because agent-based models offer an intuitive representation of socio-ecological systems, with social agents interacting with each other and with their environment, they are particularly appropriate to assess the ecological, economic and social effects of different scenarios, and therefore think about the synergies between the three pillars of sustainable development. The participatory nature of the ComMod process, i.e. the specific combination of role-playing games with agent-based simulations, allowed the participants to fully understand both the model features and operational rules and the key ecological, economic and social interacting dynamics at stake. Finally, the ABM offers a virtual laboratory to better understand the way different dynamics of the system interact and to explore the functioning of this complex system under different scenarios. However, in order to allow stakeholders to be free and creative to explore various prospective scenarios, the degree of realism of the model is a key factor to take into account. In this process, the ABM represented a very simplified version of the actual circumstances. It was voluntarily unrealistic to allow participants to step back from their current interpersonal conflicts. Because the initial model was not realistic (in particular its representation of space), they could easily project themselves in an imaginary common space with no boundary which helped them to reframe the problem and enter in a more integrative mode of negotiation. However, the unrealistic and highly simplified nature of this model is also its main limit. Indeed, such models are not appropriate to discuss concrete action plans for NRM. They are more like brainstorming tools that are useful before the design of such technical action plans. But as a forester said, "a seed has been sown…"

CONCLUSION

Drawing on the case of a conflict between a new national park and two villages about access to forest and land resources in the highlands of Northern Thailand, this paper shows that the concept of integrative negotiation can be useful to reveal potential synergies between the three pillars of sustainable development, in this case between environmental conservation, farmers' livelihoods and social equity. In the described case study, participatory agent-based simulations supported a creative and integrative mode of negotiation among different types of farmers, national park rangers and foresters in charge of reforestation. While the conflicting parties were arguing over the future boundary of the park in a "zero-sum" mode of negotiation, the participatory process allowed them to reframe the problem at stake, to adopt a less segregationist perception of space and to acknowledge that they had mutual interests.

However, this remained a very local process, with only informal potential arrangements between national park rangers and villagers, and therefore no guaranty for the villagers since the national law remains against them. Next step should be to use the concept of integrative negotiation process to analyse interactions between stakeholders at local, regional and national scales and to reveal the synergies between the three pillars of sustainable development at scales that are pertinent for the government stakeholders also. Such up-scaling of participatory approaches is needed for deeper and more sustainable change.

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APPENDIX

Apprendix 1. UML class diagram of the NanNam HaenGame agent-based model