Enhancing Communities' Adaptability to a Rapidly Changing Environment in Vietnam Uplands: the SAMBA Role Play

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Abstract

The SAMBA role play is a participatory methodology that aimed at better understanding of the impact of households' paddy fieldendowment on land use changes and natural resource management issues in the sloping land of a mountainous province of Vietnam. The focal point of the methodology is a role play board game in which local farmer households make decisions about land use and labor allocation. This methodology builds upon the experience of previous participatory rural appraisals (PRA) conducted in the same province. It incorporated results of indepth landuse surveys that were conducted with farmers and other local stakeholders. The surveys investigated land use changes as well as their impact on landscape evolution and diversity of farmers' production strategies.

The main driving forces of recent land use changes were incorporated into the SAMBA multi-agent simulation model, which was used to test hypotheses about the consequences of lowland allocation on upland resource management. Two indicators (the first based on the ratio "household labor force / number of mouths to feed" up to the early 1990's, and the second based on modalities of the lowland allocation process in later years) captured most of the recent agricultural dynamics in the research sites. This rule-based model then was developed into a role play board game that is played by local groups of stakeholders. At the start of play, players are assigned families and paddy land holdings of various sizes.

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Researchers recorded the outcome of the game, and facilitated discussions among the players about the outcome and its relation to real life processes.

This role play method was used to simulate a range of local situations to test hypotheses that had been elaborated in other contexts. A case study focusing on the interactions between agriculture, livestock and forest systems at the village level illustrates the participatory simulation process. It shows how distribution of production means to farmers via land entitlement can lead to farming system differentiation and the emergence of new local governance systems. This methodology could serve as a tool to facilitate interactions among local stakeholders about natural resource management, conflict resolution, and diffusion of technical innovations as alternatives to slash-and-burn cropping practices.

Introduction

The regime that followed Vietnam independence in the early 1960's temporarily put an end to individual ownership of land. Land was declared to be common property of all Vietnamese people and a system of cooperative farms was set up.

In northern Vietnam, the collectivization process that followed independence in 1954 temporarily put an end to individual ownership of land. A system of cooperative farms was set up. The subsequent agriculture decollectivization process spread over more than a decade, from the early 1980's to the early 1990's. During this period, major land policy changes occurred at a rapid pace, requiring households to innovate constantly. In Bac Kan province, lowland fields were distributed twice to farming households. The first distribution, in 1982, was proportionate to the number of family members in a given household. Lowland fields were redistributed in 1986, according to the number of workers in a given household. At the beginning of the 1990's, families of the *Tày* ethnic group reclaimed the land that their ancestors had contributed to the cooperatives about thirty years before. Paddy fields then were shared among the heir households, depriving other ethnic groups of the land that they had cultivated collectively under the cooperative system and individually for several years thereafter.

From 1992, use rights for upland fields gradually were distributed to individual households, marking the end of the land use privatization process.

Dramatic changes in households' land endowment modified their individual production strategies as well as their relations of production with other farmers. A farming systems study conducted in Bac Kan province has shown how these policy changes contributed to a rapid differentiation among households (Castella et al. 2000). Sadoulet et al. (2000) showed how family labor force composition influenced individual farm resource endowment under the successive land allocation reforms. Farmers' production strategies were driven by the changes in land and capital endowments relative

to the family labor force and by the concomitant requirements for rice production needed to secure food self sufficiency. Depending on the resource endowments of various villages (for example, quantity of lowlands, forest quality, soil types, and population) the combination of individual households' strategies led to a high diversity of local land use systems. In short, a diversity of farm strategies applied to a very heterogeneous environment led to multiple pathways for land use change at the watershed level.

As a consequence, no single policy that can tackle the issues related to natural resource management have arisen during the past decade (Rambo et al. 1995; Jamieson et al. 1998). The viability of the whole agricultural system lies at the interface between two management levels: individual or farm on the one hand, and collective or watershed on the other hand. To help reconcile individual strategies with the common good, researchers must play the role of mediator between these hierarchical levels. Specifically, researchers can provide relevant information for groups of stakeholders to make informed decisions through an interactive learning process (Castella et al. 1999b). However, in Vietnam it is often difficult for stakeholders' groups to reach consensus on land use. The reason is, recent changes in land tenure have been too rapid for all stakeholders to develop a common perspective, based on a shared historically built referential, that could serve as the basis for setting future land use rules.

The extreme diversity of local situations resulting from these recent changes, also is challenging for classical participatory research approaches. To overcome these problems, we have developed a new methodology that combines role plays together with more classical methods. This new combined methodology will be illustrated in this paper by a case study conducted in Ngoc Phai commune, Cho Don district, Bac Kan province about the interactions among livestock, crops and forest systems in the uplands. This field experience raised new questions about how social scientists can adapt participatory research to such dynamic and diverse environments.

Towards a New Participatory Method in Integrated Natural Resource Management

A land use study was conducted in Bac Kan, a mountainous province of Vietnam, from 1998 to 2000. It combined several methods to understand current systems of land use based on their past evolutions and to prioritize natural resource management problems with local stakeholders. The main components of this iterative, multiscale process are presented in Fig. 1. The components were not always implemented one after the other. Rather, activities overlapped in time and also across sites, themes, and disciplines. This study identified three main driving forces of recent land use changes: (a) accessibility to market, education, and health services in marginal mountainous areas, (b) process of land entitlement to farming households during the decollectivization, and (c) interactions among livestock, crop, and forest systems at the watershed level. This last topic will be used in this paper to illustrate the successive stages in our approach to integrated natural resource management.

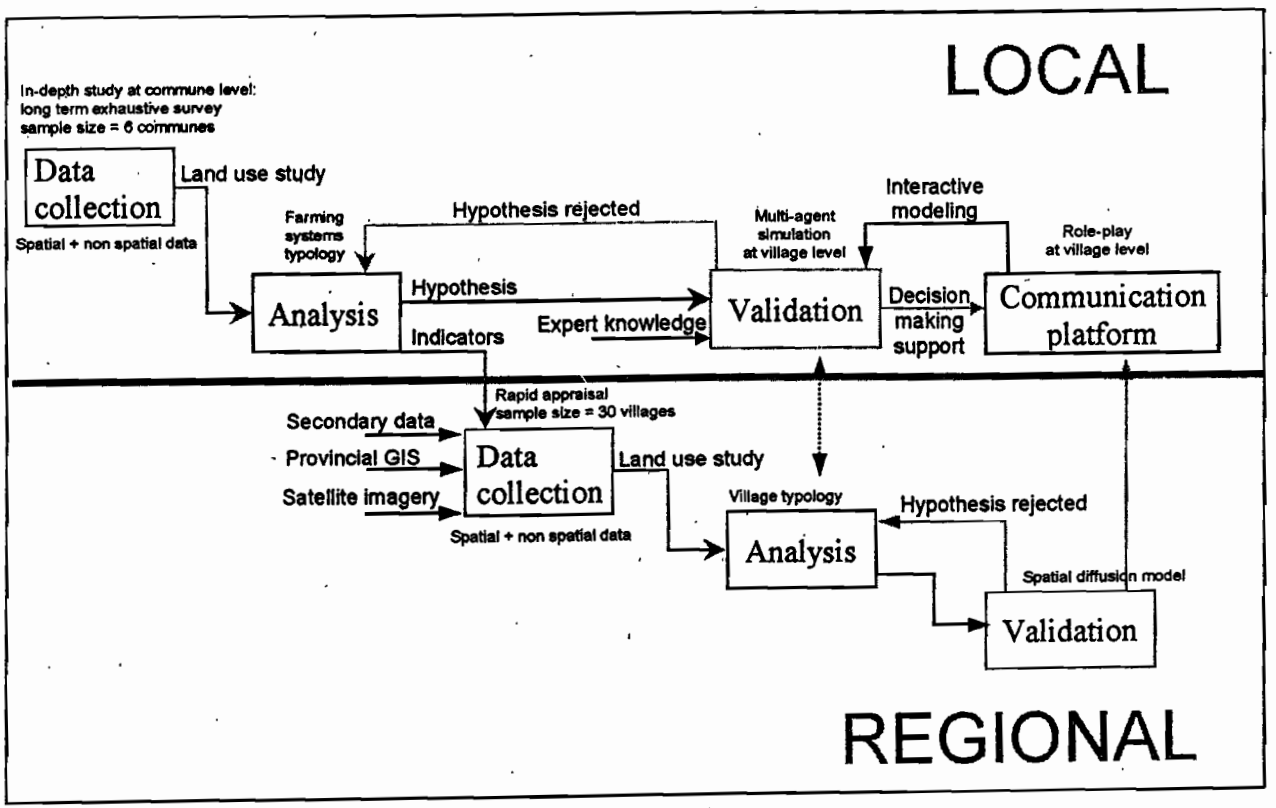


Fig 1. Diagrammatic summary of the multiscale approach to integrated natural resource management conducted in Bac Kan province.

Participatory Rural Appraisal

Prior to the beginning of our research program, several development projects had been conducted in Bac Kan Province. We reviewed their results and achievements in order to build our diagnosis upon existing experience. These development projects typically started with a one-week participatory rural appraisal (PRA) intended to assess community needs and to identify development issues and intervention points, based on local knowledge (Hung et al. 1996).

Methodology

Participants received a rapid explanation of the diverse techniques included in the PRA exercise (participatory resource mapping, wealth ranking, social diagram, seasonal calendar, priority ranking, etc.). Then, participants were divided into three groups focusing on (a) agriculture and natural resource management, (b) education and social factors, and (c) water and sanitation problems, respectively. Each group included villagers, community leaders, and commune and district officers. Each group worked in the Ngoc Phai commune for several days, carrying out the PRA techniques. Each group reported the results of their fieldwork to all participants. Finally, a plenary session ranked the problems, proposed possible solutions, and planned the next activities of the project (Hung et al. 1996).

Results of PRA

The PRA exercise provided a very rapid overview of the history and geography of the commune based on local knowledge and available statistics. One of the outputs was the participatory map (Fig. 2). The main results regarding natural resource management issues were as follows:

- Lowland rice was not sufficient to meet community needs. Average production was 200kg/year per person, which is considered 100kg short of 300kg/year per person required for rice sufficiency). Food shortage occurs in March and August, just before the rice harvests. To meet their food needs, farmers rely on upland rice, maize and sweet potatoes to complement rice production.

- A household's food sufficiency and wealth is directly linked to the size of its labor force. The more labor force is available relative to the number of mouths to feed, the better off are the households. Capital accumulation increases with the progression along family life stages: from young couple with young children to big families with children contributing to domestic activities. The poorest families are usually the ones having a disabled or sick member.

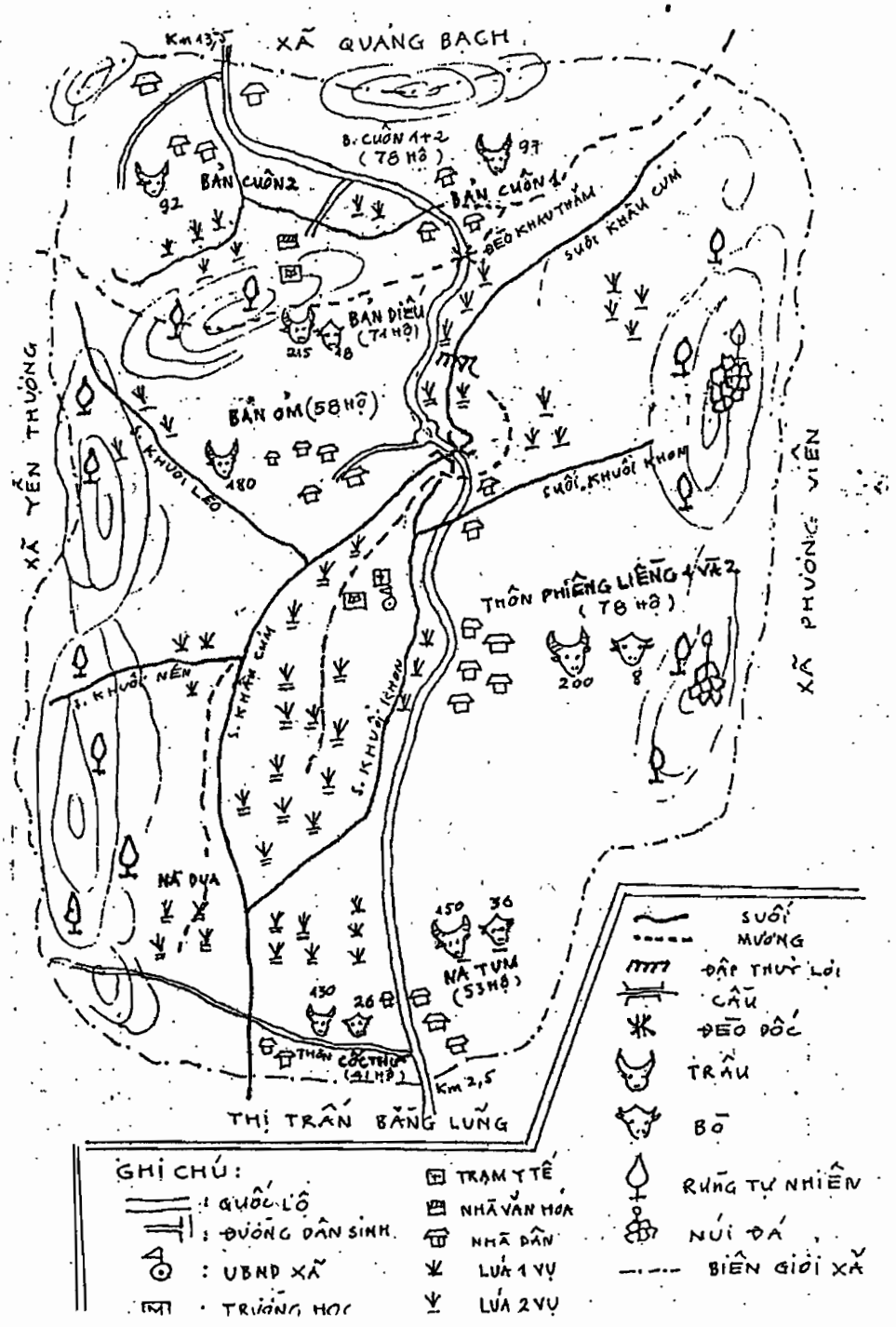


Fig 2. Participatory mapping output from a PRA in Ngoc Phai commune, Bac Kan province.

- Cultivable areas cannot be expanded further because the very steep slopes of surrounding mountains prevent the construction of new rice terraces.

- Lowland rice intensification is limited by water availability for irrigation. It would be possible to construct village level dams to irrigate larger areas. An irrigation canal system was constructed in 1983 in Ban Cuon village but has never functioned because of a technical problem in its design. Its repair would bring water to 11.3 ha of rice fields.

- Rapid deforestation occurred during the past decade reducing the forest cover from 80% of total area in 1985 to 68% in 1990 and 65% in 1995. Free grazing animals is seen as a major constraint to forest regeneration.

The plenary session of participants ranked the recommendations from the thematic group on "Agriculture and natural-resource management" as follows, from highest to lowest priority:

- Upgrade the irrigation system (lowland rice intensification);

- Reorganize the gardens to increase income generated by fruit tree production; a credit scheme should support required long term investments (income diversification);

- Reorganize the forest protection and animal grazing systems to facilitate forest regeneration and avoid livestock damage to upland crops. Develop sustainable cropping systems on the slopes (environmental concern, forest degradation, crop –livestock – forest interactions);

- Organize vaccination campaigns for livestock to avoid big losses due to epidemics (animal diseases);

- Open a marketplace in the commune to favor the development of cash crops (market opportunities).

Other thematic groups recommended improved information dissemination techniques in the village through loud speakers, upgrading school infrastructure, improving the sanitation system with latrines, supplying safe water for household consumption, and upgrading the community health station (Hung et al. 1996).

For those proposed activities that were both high-priority and feasible, a work plan was designed by the project team and then implemented under the supervision of a project steering committee. Because of the limited project period (i.e., two more years after PRA exercise) and the necessity to achieve measurable impact within the remaining time, emphasis was given to short term activities. They were easier to monitor

using objective indicators than activities aimed at building social capital. As a consequence, a latrine, water tank, and clean water supply were installed in all houses; livestock were vaccinated and new buffalo sheds were built close to the houses; new pig and poultry breeds were introduced; and credit was given to farmers without collateral. Alternative cropping systems were demonstrated on the slopes visible from the road, based on *Tephrosia* contour hedgerows and cinnamon trees on the tops of the hills.

Pros and Cons

The PRA conducted in Ngoc Phai commune raised the whole community's awareness about local development issues. Thereafter, it became easier to mobilize the villagers around activities that benefited the whole community. However, many issues involving coordination among households or community-based management were not tackled. Though ranked as priorities, the upgrading of the irrigation system, alternatives to animal free grazing, and the reorganization of forest protection regulations were not addressed by the project. There were three main reasons for this:

- The necessity for rapid, visible achievements that could be measured by the project impact monitoring system within the relatively short period remaining to implement planned activities;

- The PRA process led to new questions that would have required complementary research to be answered satisfactorily (e.g., sustainable cropping systems on the slopes, future market opportunities for different cash crops). Instead, the project gave priority to those problems that already had ready-to-use solutions. Further, the project simply followed farmers' desires, which often were influenced by the fashion of the moment relayed by agricultural extension services: new rice varieties or pig breeds, cinnamon, apricot, *Tephrosia* contour hedgerows, etc. Cash crop selection was not based on a preliminary market analysis, which resulted in a sharp fall in price due to saturation of a very small market, especially for apricots and cinnamon; and

- Coordination among stakeholders requires complex processes of social learning and consensus building. These processes take a long time, and tend to bring to the surface latent tensions or conflicts that perturb the social peace. As a consequence, the most successful activities were those that could be managed individually and that could rapidly improve households' well being (sanitation and clean water supply systems, etc.). Credit schemes also worked very well because no collateral guaranty was requested. Loans could be managed individually. However, the poor social control over reimbursement led to a very low repayment rate.

Though interesting discussions on integrated management of natural resources took place among stakeholders during the PRA, they did not lead to collective action. This can be explained by the nature of PRA itself. Although this method is very relevant to the generation of agro-ecological and economic information in a very short time, it is not a good instrument for the analysis of social interactions (Mosse 1998). Local configurations of power, relations of influence and dependence, and disputes cannot be captured through PRA even though understanding of these social interactions is essential for promoting community-based natural resource management. Several PRA conducted in the same province by diverse projects (e.g. Vietnam-Finland forestry sector project, UNDP-PARC project) showed how difficult it is to evade cooption by local politics (Richards 1995). It appeared that the whole PRA process was based on the assumption (shared by both sides) that local people knew what was good for them and would manage for the common interest whatever the project would give them following the prerequisite PRA exercise. However, regardless of the results of the PRA in a given commune, projects always decided to provide the same concrete interventions at the end of the exercise as the ones already appeared in the project document before its actual implementation. As a consequence, the observation of the PRA process itself often delivered more interesting information than the concrete interventions it led to.

There is a need to understand the mechanisms of land use changes before intervening in them. PRA outputs were not enough. Informed collective actions should build upon refined knowledge of stakeholders' current strategies. Relations of production are considered as social constructs inherited from the local history. This is the reason for the decision to investigate agricultural dynamics more carefully.

Land Use Systems Analysis

We began with a fairly conventional land use analysis phase that relied on a systems approach to land use changes, combined with a spatial approach to environmental dynamics (Castella et al. 2001). It was composed of four successive steps conducted by an interdisciplinary team.

1. Classification of the agro-ecological zones of the district based on available maps, statistics and stakeholders' meetings. Commune level sites then were selected for more refined studies, based on their representativeness of the district's diversity.

2. Study of the agricultural systems dynamics over the last five decades through open interviews with key local informants (elderly, officials, etc.).

3. Spatial dynamics were studied through interpretation of aerial photographs (1983, 1989) and satellite images (SPOT 1990, Landsat TM 1994, SPOT 1995 and 1998).

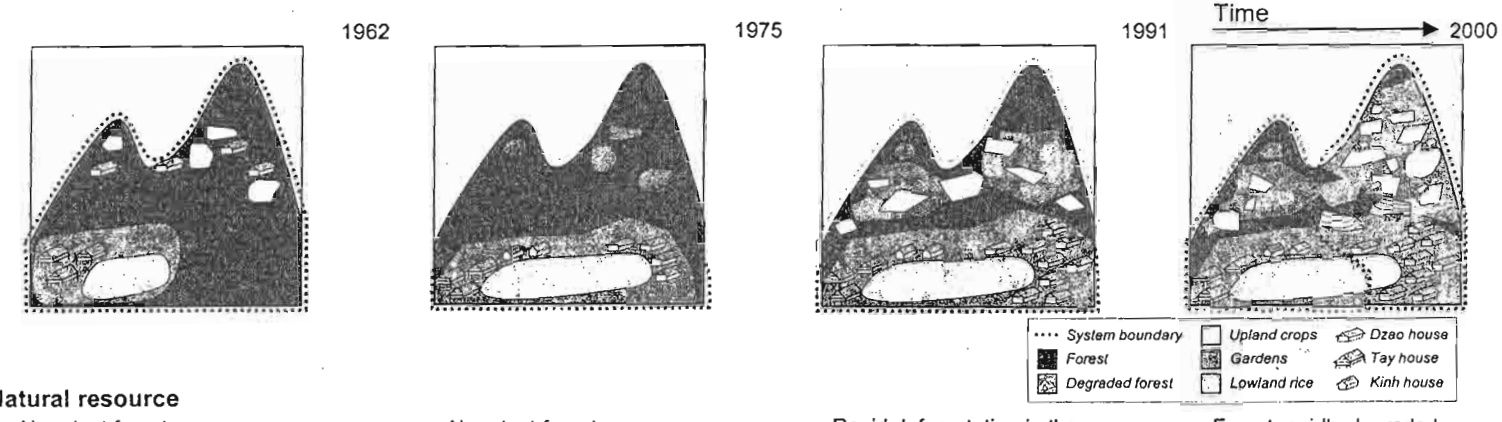
4. Finally, on-farm surveys were conducted with 250 households representative of the diversity observed in the previous stages. Semi-structured interviews were used to investigate farming system strategies. The analysis resulted in (a) a typology of the current farming systems strategies and (b) a trajectory tree displaying the differentiation process among households under the successive land policy reforms.

Results of the Land-Use Systems Analysis

Agricultural shifts were related to changes in the natural resource base and to changes in the socio-economic environment (Fig. 3). Natural resources management is driven by people's needs and strategies, which are affected by a rapidly evolving socio-economic environment.

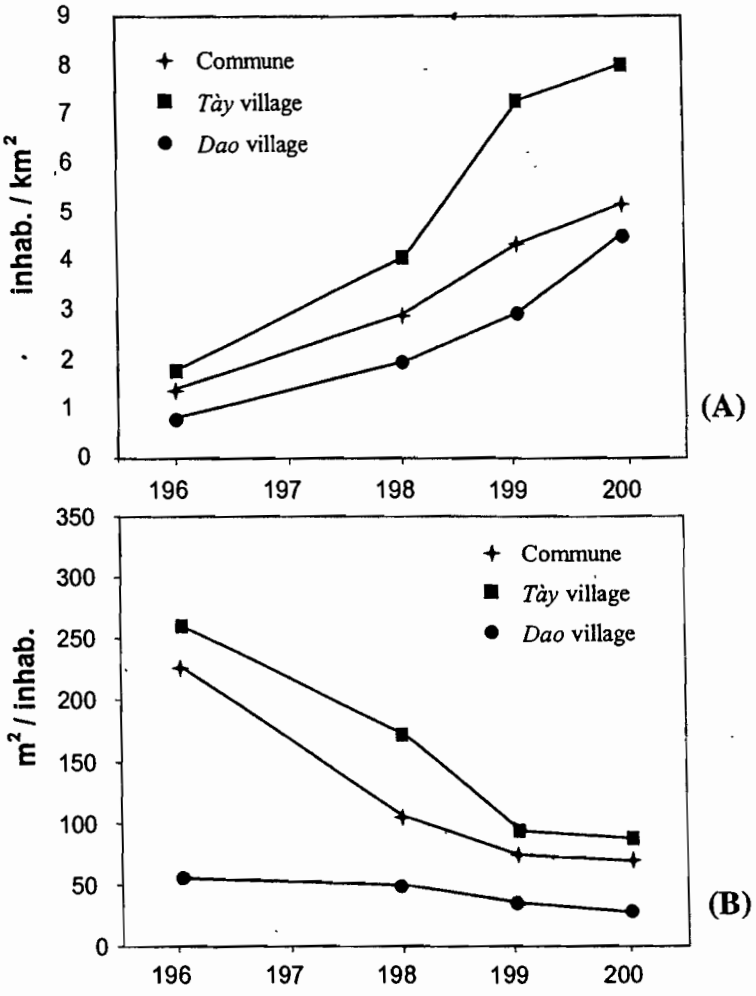
Agricultural transformations driven by land policy changes. Until 1962, the *Tày* ethnic group inhabited the lowlands. They cultivated rainfed lowland rice through traditional collective methods based on mutual help. The abundant lowland areas largely met the needs of the small population. In contrast, the *Dao* people mainly grew upland rice. They practiced shifting cultivation with long fallow periods (more than 20 years), allowing the forest to regenerate before they returned to the same piece of land. Their agricultural practices were mainly individual and household based. They had little contact with the lowlanders.

In 1962, the *Dao* people were resettled in lowland villages by governmental authorities. They contributed to the cooperatives together with some households of the remaining *Tày* villagers (others having decided to create a new village some distance away), and other new migrants to the area: the *Kinh* people from the overpopulated delta. This composite group of people formed the cooperative. Working collectively, they increased substantially the lowland rice area, and intensified its production system through irrigation, use of high yielding cultivars, and chemical inputs. The government prohibited agriculture in the uplands. Following the country unification in 1975 the cooperative became increasingly bureaucratic and highly structured. People's labor input decreased together with their motivation, and as a consequence agricultural production was barely sufficient to meet their daily needs. As population increased, lowland area per person was decreasing gradually (Fig. 4), which contributed also to the cooperative crisis. Farmers started to cultivate the uplands again, first in remote and inaccessible areas, then more openly in later years when almost every farm household had to cultivate on sloping forested land to meet its basic needs. Land was thus managed collectively in the lowlands, individually and intensively in private gardens, and individually and extensively in the uplands. Deforestation increased sharply. At the end of the 1980's all the accessible land suitable for cultivation had already been exploited. The environmental impact of land use changes over this period was severe (Castella et al. 2001).



	1962	1975	1991	2000
Natural resource	• Abundant forest • Lowland available for agriculture • High biodiversity	• Abundant forest • Lowlands and valleys completely cultivated • High biodiversity in the uplands	• Rapid deforestation in the uplands • Soil degradation in intensively cultivated hilly areas around villages • Floods	• Forest rapidly degraded • High erosion and soil acidification • Rapid biodiversity depletion
Agriculture/Gathering/ Hunting	• Shifting cultivation in the mountains: Dao ethnic group, long fallow periods • Irrigated lowland rice, community based management: Tay ethnic group • Subsistence agriculture	• Fixed agriculture in the lowlands • Collective natural resources management • Lowland rice intensification: high yielding varieties, manure, chemicals, etc.	• Saturation of land suitable for lowland agriculture • Collective management in lowlands, individual in uplands • Cultivation of upland crops (rice, maize, cassava, etc.) for subsistence in remote areas	• Fallow period shorten in uplands far from village • Household-based management of natural resources • Intensification of the uplands close to the village: terracing, contour hedgerows...
Socio-economic	• Little contact between upland and lowland ethnic groups • Low population density • Low market integration	• Uplands forbidden for agriculture and exploitation of natural resources • Increasing population density: Kinh migrants, concentration in the lowlands • Cooperative system	• Development of upland agricultural systems against established rules • Increasing population density • Inefficiency of cooperative system	• Lowland area not sufficient for food security after land allocation, • Tay ethnic group reclaim ancestors' land • New village boundaries

Fig 3. Changes in agriculture and natural resources management in Ngoc Phai commune, Cho Don district, Bac Kan province.



Sources : field surveys

Fig 4. Evolution of (A) Population density and (B) Lowland rice area per person in Ngoc Phai commune.

In 1991, allocation of lowland areas to farm households profoundly changed the local institutions established informally over the years. The *Tày* people reclaimed the land that their ancestors had contributed to the cooperatives in the early 1960's. The *Dao* group was deprived of the lowland rice fields that they had cultivated for nearly 30 years. They had to rely once again on slash-and-burn agriculture. However, in the years since the *Dao* came down from the mountains, environmental and socioeconomic conditions have been transformed dramatically. Currently, the high population density and the degraded forestland raised questions about the sustainability of current land use systems (Husson et al. 2001).

These successive changes in land use policies led to an extreme diversity of land use patterns from one watershed or village to another, according to their specific resource endowment, ethnic composition and demographic growth, and local institutions (Castella et al. 2001).

Differentiation in household strategies. The trends described above at the village or watershed level also had strong effects on farming system differentiation at the household level. Farm household trajectories as well as the resulting farming system types are displayed in Fig. 5.

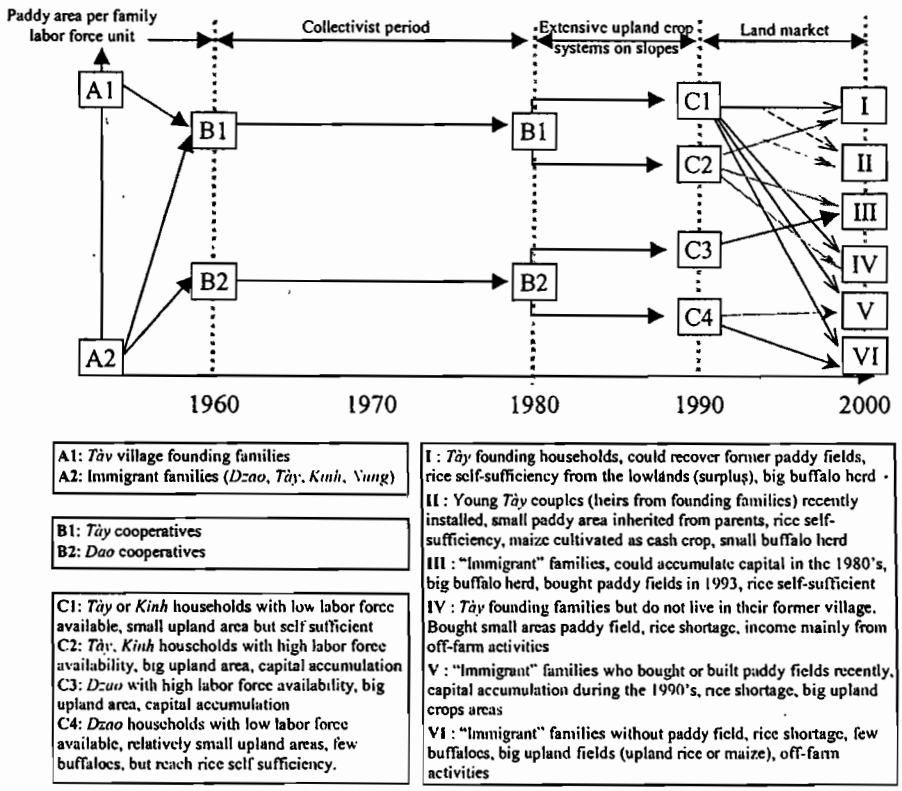


Fig 5. Farming system differentiation and typology in Ngoc Phai commune, Bac Kan province.

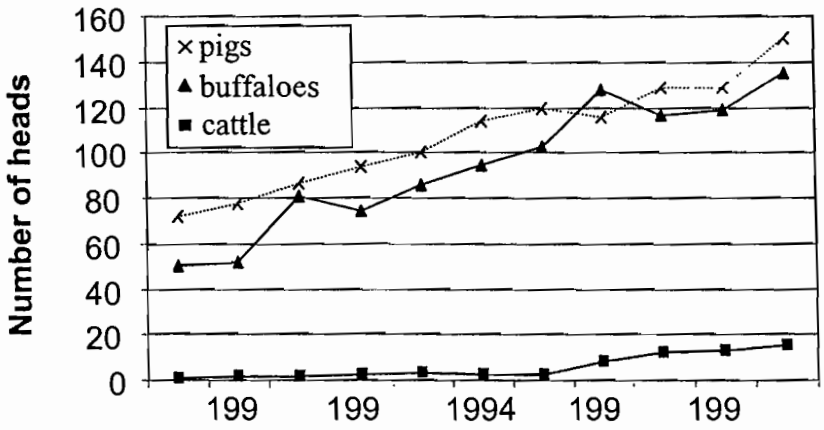
Because of the successive changes in rules regulating households' access to land, different production strategies emerged during the successive periods. The study has shown that differentiation of strategies was driven by two main factors:

- The ratio labor force / mouths to feed in the 1980's, especially between 1982 and 1986,

- The paddy field area inherited from the ancestors in the early 1990's (Castella et al. 2001).

As a result of diverging individual strategies, relations of production underwent tremendous changes at the village level.

Evolution of livestock – crops – forest interactions and agricultural sustainability. Interactions between livestock management and cropping practices in the uplands illustrate the problems arising from poor coordination between hierarchical levels of the agricultural systems. Households that could accumulate capital in the 1980's through rapid expansion of shifting cultivation systems invested in buffaloes. Livestock was used as living savings, because private markets did not exist within the socialist economy. Livestock herd growth was boosted by the creation of a market for beef and buffalo meat in the early 1990's to supply the delta area (Fig. 6). Households used the resulting "buffalo capital" to rebuy rice fields after the *Tày* ethnic group claimed the lowland of their ancestors. Farmers who did not receive enough paddy fields and who could afford to buy some from the *Tày* sold huge quantities of buffaloes.



Source : Statistical department of Cho Don district, Bac Kan.

Fig 6. Changes in abundance of buffaloes and pigs in Ngoc Phai commune, Bac Kan province.

The herd size increase combined with the shift from collective to individual livestock management led to dramatic changes in animal husbandry practices (Eguienta, 2000). For the *Tày* households, whose farming systems mainly relied on lowland rice cultivation, mobilizing a family member every day of the year to take care of a few buffalo became a real burden. Thus, most *Tày* let their buffalo roam in the uplands to graze in pastures and forest during most of the year, when animals were not needed to plough. They would check the status of their herd once a week or every two weeks. In contrast, the *Dao* typically assigned buffalo surveillance to a child or an elderly year round, except

some period during the winter. Because their agricultural production relied mainly on slope cultivation, the *Dao* required surveillance to avoid animal damage to the upland crops. But the number of conflicts between *Tày* and *Dao* villagers has multiplied in recent years because of crop damages by roaming animals. Livestock owners usually have to compensate crop owners for production loss. But sometimes victims took justice into their own hands, and animals were found killed or injured.

To avoid losses caused by roaming animals, *Tày* farmers started protecting their upland plots:

- They installed bamboo fences and dug ditches around their fields,
- During the entire crop cycle, they lived in a temporary hut close to their field to keep an eye on their crop,
- They planted crops in areas not accessible to livestock.

But *Dao* farmers could not protect their upland plots in those ways. Most upland fields cultivated by *Dao* farmers are scattered and of big sizes, because the traditional *Dao* farming system is based on four years of cultivation followed by three to ten years fallow. The time that would be spent to fence these fields would make their extensive system unprofitable.

Fencing is now a necessity for those farmers, *Tày* or *Dao*, who build terraces or who establish intensive short fallow upland fields close to the village. Beside directly damaging established upland crops or crop seedlings in regenerating forest, Husson et al. (2001) had shown that livestock shuffling degraded soil, reduced fertility regeneration during fallows, and reduced upland rice yields. Low soil porosity due to animal compaction led to low oxygenation of upper soil layers and in some cases to acidification and toxic levels of aluminium. The combined degradation of soil physical and chemical properties strongly reduced root growth and thereby reduced drought resistance of the whole plant (Fig. 7). Technical innovations have been proposed to restore heavily degraded soils and produce enduring increases in upland rice yield (Husson et al. 2000). The innovations included mulching, direct seeding (planting crop seeds directly into established cover crops), and no-tillage systems. Besides improving management of fallows and annual crop production, these innovative cropping systems can provide fodder for livestock and thus decrease the grazing pressure in the uplands. In the longer term, these new cropping systems could be associated with the introduction of perennial crops. But social control was even looser on forest or tree crop plantations than on upland crops. For example, roaming animals also can be considered a major obstacle to the development of agroforestry systems. When damage occurs on an upland rice field, the animal owner has to pay for the loss. But when animals destroy a tree plantation, the plantation owner is blamed for not having protected his or her plot. Nonetheless, upland fields need to be protected against roaming animals for the innovative cropping systems to succeed.

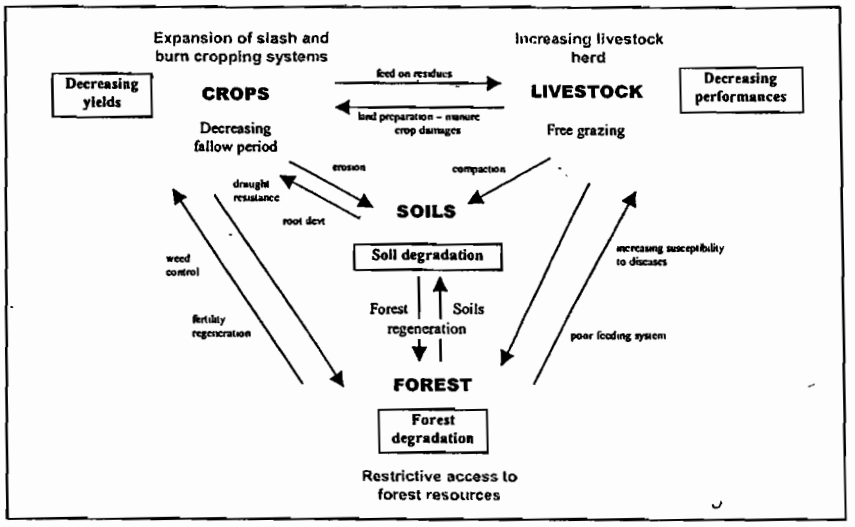


Fig 7. Interactions among crop – livestock – forest systems.

Outside the uplands, crop production also was becoming difficult in the lowlands, because of the lack of community control over free grazing. Farmers had to fence their plots with bamboo to avoid crop damage during the winter. In some villages, roaming animals also hampered the development of spring rice.

The key to agricultural intensification and diversification in the studied area thus lie in livestock management systems. Observed at the watershed – community level, the current agricultural system seems to be merely the sum of the uncoordinated strategies of many individual households. Successive changes in the rules defining household access to natural resources profoundly transformed traditional community-based natural-resource management. To an external observer, it appears that there is no remaining local institution that has enough power to steer the system towards one direction or another. Instead, the main strategy for managing natural resources seems to be restrictions imposed by individual landowners on livestock access to specific land units. The success of such strategies depends on the capacity of each household to enforce their individually imposed regulations.

The spatial fragmentation of the uplands also added to the apparent confusion. The government formally recognizing the village and commune boundaries as well as allocating forest plots to farmers increased upland fragmentation recently. This was why it is so important to understand the mechanisms of past land use changes in order to facilitate stakeholders' negotiations in designing new natural resource management rules. The viability and productivity of the current agricultural system depends to a large extent on the spatial organization of the crop, livestock, and forest subsystems at the watershed level. To induce changes in spatial patterns will require major changes in the underlying institutional patterns.

Strengths and Weaknesses of the Land Use Analysis

This comprehensive analysis of land use changes, the spatial aspects of which were presented elsewhere (Castella et al. 2001), did more than merely point out the importance of the livestock free grazing problem. By disentangling the complex mechanisms that led to the current crisis, the analysis provided guidelines for collective action and identified intervention points. In that sense, it went beyond traditional participatory approaches that sticking too much to farmers' discourses end by introducing technical innovations aimed at overcoming symptoms of the problem instead of tackling the problem itself. As shown in Fig. 7, in the case of the livestock free grazing problem, most projects emphasized the introduction of technical innovations such as drought-resistant crop varieties, chemical fertilizers, weed control systems or livestock vaccination campaigns instead of tackling the core of the problem: the need for new organizational patterns for managing livestock at the village / watershed level. Scientific methods are needed to reinterpret objectively what farmers say about their problems. Knowledge provided by the land use analysis can help reading between the lines of local people's speech.

The main drawbacks of the latter approach are as follows:

- It takes time. In a context of very rapid land use changes, researchers cannot afford to release their results too late. Results may already be obsolete when researchers are ready to share them with stakeholders. Or, rather than waiting for research results, stakeholders would already have found their own solutions to the problem. The problem is, these solutions usually are not the result of a coordinated effort and thus do not take care of the interests of all parties.

- It requires onerous interdisciplinary research work combining complex tools and methodologies. For example, land use analysis requires the involvement of specialists in GIS, remote sensing data interpretation, and intensive fieldwork by agronomists, geographers and social scientists. Most projects cannot afford the time or resources required to replicate it on a large number of sites.

- Its geographic scope is relatively limited. An agricultural systems study typically covers one commune and concentrates on a few villages that are selected for their representativeness. For example, six monographs of this type had been conducted in Bac Kan province by SAM-Regional Program in 1999-2000. But they covered only six communes out of a total of 122 that were investigated. In such very heterogeneous biophysical and socio-economic environments, innovative scale transfer methods needed to be applied to avoid ending up with a mere patchwork of unrelated studies (Castella et al. 1999b; Kam et al. 2001).

- Stakeholders are involved but are not really partners in the research process. During a study, stakeholders' meetings and surveys aimed at understanding individual and/or collective strategies or at validating research results. Nonetheless, during wrap-up meetings at the end of a monograph study, feedback from stakeholders can be very superficial. Most of the time they showed polite interest in the presentations about what scientists understood about stakeholders' life, problems, and proposals to introduce solutions. Then, stakeholders presented the official plans for development via feedback that builds upon the scientists' findings but that was clearly disconnected from the findings. The results and potential solutions presented by the scientists were external to the stakeholders despite being based on the stakeholders' knowledge and understanding of their own local circumstances.

To overcome problems inherent in the methods presented above, while benefiting from their positive aspects, a new approach had to been designed specifically for situations characterized by rapid land use changes. It had to build upon knowledge generated through diverse methods, and to link the two main hierarchical levels in natural resource management: the individual / household level and the community / village level. But most important, the new approach had to permit stakeholders themselves to formulate their problems and to be at the controls of the process. In short, it had to be integrative, adaptive, and participatory.

Towards a New Approach based on Role Plays

A multiagent model, called SAMBA and fully described elsewhere (Castella et al. 2000), was designed to mimic individual management of natural resources and the resulting impact at watershed village level on land use and local institutions. This model was parameterized based on the data collected during the land use analysis stage. It has been used to test the main hypotheses derived from field studies. For example, it helped to explain the impact of rules for distributing lowland to households in the early 1980's on the land use in the uplands during the same decade (Castella et al. 2000). This simulation platform made it possible for a group of scientists from different disciplines and backgrounds to better understand past, poorly documented land use change. They could conduct repeatable simulated experiments with no risk of negative consequences on the ecosystem or on the community relying on it.

Though it met researchers' expectations, this tool had to be made accessible to local stakeholders because of the shortcomings of other approaches as presented above (Barreteau et al. 2001). Thus, the multiagent model was converted into a role playing game. The first version of the role play aimed at validating with local stakeholders the hypotheses included in the multiagent model (Boissau et al. 2001). Then we modified

the role play slightly to better take into account interactions between livestock and cropping systems in the uplands. This second version of the role play, presented below, had as its main objectives to investigate in a participatory manner:

- How farmers manage their livestock,
- What interactions take place among cropping -- livestock – forest systems and how local people perceive the problems related to these interactions,
- How both problems and solutions emerge as a consequence of the social interactions at the village level.

Description of the Game[1]

The two main agents of the SAMBA model, i.e. the village environment and the households, had been simplified to keep the game manageable for a limited number of players during a one-day session.

Village environment. The village environment that was represented in the computer model by a 50 x 50 cells grid was turned into a game board composed of 1600 wooden cubes. Each cube corresponded to a plot of 1000 m^2 area. Each of the 6 cube faces was painted with a different color representing different land uses. Paddy fields were represented in red, upland rice fields in yellow, shrub fallow in blue, poor quality forest in light green, good quality forest in dark green, and residential areas in black (Fig. 8).

Fig 8. Photograph of the game board.

[1] In this document, the term "game" was used to designate the equipment used and the rules followed in the "role-play", which in turn designates the whole process including the players, observers, and facilitators.

Wooden chips symbolizing buffaloes could be laid on the cubes to locate them in the village space. In the absence of buffalo, land cover regenerated each year according to the following rules: upland crops were followed by 4 years of shrub, then 4 successive years of poor quality forest before reaching the status of good quality forest. In real life, soil quality (and therefore potential crop yields) are directly proportional to the number of years of forest regeneration (Husson et al. 2001). Buffaloes, located at the intersection of 4 cubes (plots), inhibited the natural regeneration of their cover (described in Fig. 9A). If two buffaloes have an influence on the same cube, then the land use status should have been decreased by one point (Fig. 9B)

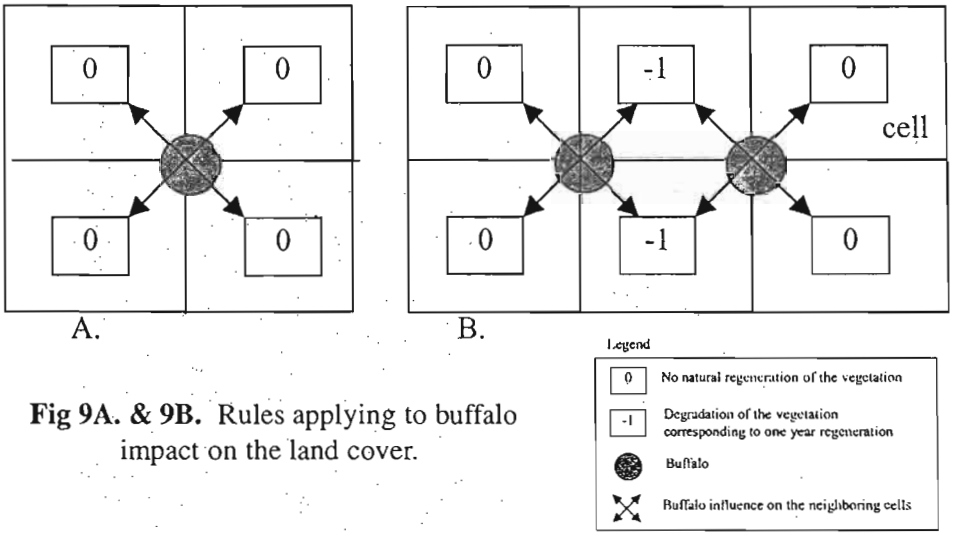


Fig 9A. & 9B. Rules applying to buffalo impact on the land cover.

Households. Although the SAMBA model could simulate fifty household agents, only ten households took part in the role play, each represented by a player. This downsizing aimed at avoiding repetitive actions by a large number of players that would slow the rhythm of the role play and make players bored. At the beginning of the role play, each player drew cards defining the resources endowment of their virtual household:

- The "household" cards determined the composition of the family in terms of labor force and number of mouths to feed. Indirectly, the "household" cards also determined the family's food requirements, set at 300 kg paddy/year per person.

- The "paddy field" cards numbered from 1 to 3 were used to distribute from 1 to 3 lowland plots of 1000m^2 each.

- The buffalo cards numbered from 0 to 3 were used to distribute from 0 to 3 buffaloes to a player.

In addition to these cards, which characterized the different households, a "land card" was associated with each cube to monitor the status of each piece of land: its successive land uses and which of the players (if any) was using it. The facilitators were responsible for updating each land card at each time step.

Time steps. Each time step represented one year, divided into two seasons:

- During the summer season, the plots could be cultivated and buffaloes were necessary to plough lowland rice plots;
- Land was not cultivated during the winter and each household had to select grazing areas for any buffalo that they own.

At each time step, each player decided how to allocate his or her household's labor force to different tasks according to his or her lowland endowment, number of buffaloes, and food requirements. Following is a list of possible tasks that players could decide to implement:

Tactical tasks. (i.e. that could be implemented on a regular basis)

- Grow paddy rice in the lowland (required 1 buffalo and 1 labor unit per 1000m^2 plot)
- Buffalo surveillance during summer season within a one-day walk around the village. There was no limit on the number of buffalo that one person could take care of, but big herds (more than 5 heads) had to be managed by an adult person. During the winter, buffalo surveillance did not require labor input as livestock could be left grazing freely.

Strategic tasks. (i.e. required land use conversion)

- Open new upland fields to grow upland rice. The player has to choose the number of plots to open depending on his or her available labor force (one unit of labor force could grow 4.000 m^2 of upland rice) and the location of his or her new fields on the board.
- Convert lowland paddy fields from 1 cycle (1 harvest/year) to 2 cycles. In that case, the required labor force for one plot shifts from 0.5 unit/year to 1 unit/ year.
- Open new paddy fields and choose their location on the board.

- Grow fruit trees in the uplands. As for upland rice, the player has to select the location of fruit tree plantations on the board. Fruit trees are less labor intensive than upland rice; for fruit trees, one unit of labor force could grow 5 plots (5.000 m^2) per year.

- Buy buffaloes from the facilitator at a price of 1000 kg paddy/buffalo, or from other players at a mutually acceptable price.

The ability of the different household members to accomplish a given task depended on their age. Children and elderly accounted for half a labor unit each and therefore could be used most efficiently if assigned to livestock surveillance tasks.

Agricultural production. At the end of each turn, once each player should have completed the previous steps, the facilitator should have distributed "equivalent rice coupons" to each player, representing the production of the player's various crops:

- For paddy fields, the production was fixed at 400 kg paddy/1000m^2/year for a 1-cycle field and 700 kg paddy/1000m^2/year for a 2-cycle field.

- For fruit trees, the production was fixed at the equivalent of 900 kg paddy/ 1000m^2/year from the fifth year of cultivation onwards.

- For upland rice, the production depended on the forest type and the number of cropping cycles (Table 1).

Table 1. Upland rice production (kg/1000m^2/year) according to the type of preceding land cover and number of cropping cycles. Based on data from Husson et al. (2001).

Years of Upland Rice Production	Preceding Land Cover:		
	Good-quality Forest	Poor-quality Forest	Shrub
1	150	90	50
2	120	60	0
3	80	0	0

The facilitator also collected from each player the food consumed by the player's family (300 kg paddy / person per year).

Buffalo herd reproductive performance and mortality depended on the kind of livestock management chosen by the player. For example, the facilitator increased mortality rate when a child took care of a very big herd or when the animals were left grazing for a long time on a poor environment (shrub). Female buffaloes gave birth to one calf every two years.

Organization of the Role Play

Location. The role play session presented in this paper was organized in the meeting room of the Ngoc Phai commune Peoples' Committee on August 23, 2000. A large room was necessary to install the game board and to allow enough room for players to move easily around the board.

Selection of the participants. Selection of players and observers was guided by a survey conducted in the commune during the same year. Through this study, focused on livestock – agriculture interaction issues, a number of household strategies had been identified as well as farmers representative of each strategy (Eguienta 2000). Seven persons of Phieng Lieng village were selected as "household" players, comprising six men and one woman. They all knew the commune well, from various perspectives: one was the commune doctor, and six were farmers of different ages and wealth levels.

One participant was selected to play the role of forest warden. This former soldier was known to be very strict about the rules and their implementation. He was expected to give his forester view about what the players' actions and to remind them about regulations. Several observers were also present, but were not allowed to intervene during the role play. Among them was the actual Commune Forest Warden, the Chairman of the Peoples' Committee, and the persons in charge of agriculture and land administration services at the commune level.

Sequence of play. At the beginning of the role play, the team facilitating it introduced itself. It was composed of (a) a facilitator, whose main role was to discuss the pros and cons of the choices with them without influencing them; (b) a production accountant, who computed family production, made sure that player choices were permissible, and distributed the equivalent rice coupons to the players at the end of each step; (c) an environmental accountant, who monitored the changes in cell land use; and (d) a reporter, who wrote down all interactions and internal discussions among players and with the facilitation team. In addition, the whole role play session was recorded via a video camera.

The facilitator explained to the players the game, its objectives, and basic rules. The players then drew cards to determine their family structure, paddy field and buffalo endowments. They introduced their virtual family and resource endowments to other players. Then, the role play started with players one by one deciding about their strategies with the help of the facilitator. After seven rounds (representing 7 years), a debriefing discussion allowed all participants to share their thoughts about the experience.

Results of the Role Play

Initial status. Households' resources endowments resulting from the random card draw are shown in Table 2. The game board represented a mixed forest surrounding the village residential area, located at its center. The initial land cover resulted from a

random combination of good quality forest, poor quality forest, shrub, and residential land, which then was modified by players' choices for the location of their paddy fields near the residential areas.

Table 2. Situation of the players at the beginning of the role-play.

Player	No. of Household Members	No. of Labor Force Units	Ratio Labor Force/Household Members	Paddy Field Area (1000 m²)	No. of Buffaloes
A	5	2	0, 40	2	1
B	4	2	0, 50	3	3
C	4	2	0, 50	1	3
D	5	2	0, 40	3	0
E	3	2	0, 67	2	3
F	5	4	0, 80	2	0
G	4	2	0, 50	2	0

First round. Different players realized that they were constrained from growing two-cycle rice on their paddy fields by their shortage of family labor force (***B*** and ***D***) and/or buffalo (***A***, ***D***, ***F*** and ***G***). Labor force shortage was the main reason given by players to justify why they practiced one-cycle rice on their lowland plots. Interactions among players started even during the first round, when some players decided to borrow or to rent buffaloes from others. Player ***C*** wanted to sell one of his buffaloes to buy a paddy field. But none of the players had enough money to purchase a buffalo at this stage of the role play. Players who could not cover their food needs from the lowland cultivation and had enough family labor force (***A***, ***C***, and ***F***) opened new fields in the upland. When choosing which upland areas to open, they selected mainly poor forest areas: 9 plots (of 1,000 m² each), against 2 plots in rich forest and 2 plots in shrubs. Players ***D*** and ***G***, who unlike the previous three players did not have enough labor force to open upland fields, had to borrow rice from player ***E*** and from the bank (role play facilitator) at the end of the first round to cover their food needs. Livestock management was quite homogeneous among players. During the summer, buffaloes were grazing close to the village under surveillance of a child. During the winter, they were roaming freely in the forest. An adult would look for them once every week to ten days to check their status and to prevent them from roaming too far from the village.

Second round. As yield decreased in the upland plots cropped for the second year, the players who did not open new upland fields during the second round could not cover their food needs at the end of the second round. The forest warden decided that he would restrict the opening of new upland fields in the third and subsequent rounds. But he would allow players to continue cultivating their existing upland fields (opened during rounds one or two). As a consequence, two players, who did not open new upland fields during the second round and whose upland crop production would have

decreased sharply during year 3, requested to diversify their agricultural production through constructing a fish pond or raising pigs. Other aspects of livestock management did not change. Mutual help developed between players ***B*** and ***F*** in that ***F*** borrowed a buffalo from ***B*** in exchange for working in ***B***'s paddy fields.

Third round. The facilitator announced that due to exceptionally favorable weather the paddy yield was increased by 100 kg per plot. This enabled all players to cover their food needs and some could generate a surplus. However, more than half of them still relied on upland crops and three of them had to open new plots from secondary forest. Two of them were fined 200 kg per plot by the forest warden because they had cultivated new upland plots. On the other hand, the birth of four buffalo calves added to the pressure on the forest. The players decided that they wanted to elect a village head. Player ***A*** was selected because of "his widely recognized wisdom and technical skills".

Fourth round. The main changes that occurred concerned livestock. Player ***C*** wanted to sell a young buffalo, but the other players either already had their own buffalo, or could not afford the requested price (250 kg rice). Player ***F*** finally bought it by paying half the price in cash and promising to pay the other half after selling rice the following year. Player ***C*** exchanged one buffalo for one of ***D***'s paddy plots. Players ***B*** and ***C*** sent their buffaloes to graze in rich and poor forests because "there is more to eat" while ***E*** sent his buffalo to old pastures that had two years' fallow because "grass had enough time to re-grow". ***A*** kept his male buffalo at home because "it is safer and easier to manage". He cut grass around the village to feed his buffalo.

The forest warden explained that "it is not necessary to fine farmers who let their livestock graze in the forest because they feed on grasses and low leaves and thus do not degrade the forest". But the village head stated that "roaming animals are harmful for regenerating forest and, in addition, poor fodder resources in shrub / regenerating forest have a negative impact on animal health status". Everyone agreed to send the buffaloes alternately to two collective pasture areas designated by the village head. Further, the village head requested the villagers not to deforest anymore to increase upland crop areas, except in special cases with approval from the forest warden. He also promoted the introduction of a new rice variety that would increase the lowland rice production to 800kg per year with two cycles.

Fifth round. The facilitator announced the death of three buffaloes from an epidemic. This epidemic motivated players to discontinue following the rules established by the village head regarding the use of the officially designated pastures. The village head explained that the disease had had heavy consequences because of the poor nutritional status of the animals. Therefore, he advised players to (a) intensify paddy production through introduction of the new high yielding variety, (b) vaccinate their buffaloes, and (c) temporarily stop bringing the herds to pasture No. 2 to let it recover from overgrazing.

But players did not follow the last part of his advice. Instead, the epidemic triggered the emergence of four different livestock management strategies:

1. As before, player ***A*** kept his buffalo at home all year long and grew fodder crops.
2. ***B*** brought his buffaloes to pasture no. 1 as instructed by the village head.
3. ***E*** let his buffaloes graze in pasture no. 2. Both ***B*** and ***E*** requested the village head to enlarge by 20.000m^2 each of the common pastures.
4. Player ***F*** took his animals to the same pasture as ***B*** during the summer but kept his herd at home during the winter.

Despite the livestock problems, most of the households could generate production surpluses on account of increasing yields in the lowland and increasing labor availability. Some of the children family members had reached the working age after five time steps. However, player ***F***, who could not cover the household food needs from the paddy fields, requested and obtained from the forest warden the authorization to open two upland crops plots from poor forest.

Sixth round. Player ***B*** proposed relocating the common pastures to other larger areas. The village head requested and received authorization for this move from the forest warden.

Seven round. Player ***G*** finally had enough rice surpluses to purchase a buffalo from ***C***. Player ***F*** again opened three upland crop plots from poor forest. Player ***E*** decided not to let his buffalo herd graze in the common pasture during winter because he feared diseases spread through the pasture. Players ***A***, ***D***, ***E***, ***F*** and ***G*** kept their animals at home during the winter and close to the village during the summer season. The players' situation after seven round is summarized in Table 3.

Table 3. Situation of the players after seven rounds of play.

Player	No. of Labor Force Units	Paddy Field Area (1000m^2)	No. of Buffaloes	Capital Accumulated (equivalent rice)
A	4	2	1	700
B	2	3	7	3970
C	3	2	7	2600
D	2	2	2	360
E	2	2	9	4640
F	4	2	2	540
G	2	2	2	350

Debriefing session. This very important stage in the role play sequence aimed at collecting the reactions of the players after a whole day session. Only the main points of the discussion are reported below.

The first question asked to the players was: *Was the role play similar to the reality of their own village*?

All players agreed that they found the game very consistent with their reality and that it helped them learn about the organization of crop – livestock – forest interactions at the village level.

What was missing in the game that would make it more closely resemble their reality?

Players replied that agricultural diversification options were missing, such as poultry, pigs, or fish on the animal husbandry side. Another missing option was to intercrop annual crops within a developing perennial cash crop. By selling the annual crop production, farmers could offset part of the cost of establishing a perennial cash crop. Players insisted that all components of the farming system are highly interwoven and to them it seemed a bit artificial to consider the components separately from each other.

In the game, players selected mainly poor forest when choosing where to open new upland fields. In reality, do you choose only poor forest to open upland fields?

Two players described their own practices on upland fields based on successions of upland rice, then maize intercropped within young fruit tree plantations. They stated that they do not have access to rich forests anymore as they were very remote, and the government forbids clearing them. Then the real Commune Forest Warden stated that he would have fined farmers who opened upland fields from poor or regenerating forest, if not he would not have been doing his duty, nor would he have been able to make a living from collecting fines of only 400kg paddy during the seven years that the role play lasted. He then revealed that he often fine farmers opening upland fields and that it was very difficult, or almost impossible for them to hide their actions from him. Within three days after the opening of a new upland field he would know of it because farmers discuss among themselves about where they open their new fields.

The facilitator remarked that none of the players proposed the construction of new paddy terraces.

Players replied that in their commune, there is no remaining land suitable for constructing terraces. But some farmers often rent some of their paddy plots to relatives.

In reality, is there an exchange of labor force between households?

Players emphasized the similarities between what happened during the role play and their real behavior in terms of mutual help and hiring labor for specific tasks such as land preparation, rice transplanting and harvest.

Then, the discussion came to the livestock management problems that the players faced during the role play.

Players agreed that buffalo accumulation patterns during the game were similar to reality and that current livestock management systems were causing problems. Buffaloes and to a lesser extent cows were relying on shrinking fodder resources. This

tended to limit livestock development and put pressure on the environment (direct damage to crops and forests, poor forest regeneration, etc.). On the other hand, players stated that livestock herds in the village were relatively small (from 5 to 10 head per household), and therefore did not yet cause extensive damage. Further, livestock herds served as an essential money saving system for many households. They sell buffalo whenever they want to invest in house building, wedding, funeral ceremonies, or even to send their children to school.

In reality they also had two common pasture areas that were established in 1992, after the first round of forestland allocation. But with the increasing number of animals relying on the same resources, the mortality rate of young buffalo is increasing during the winter season. Thus, they explained, during the role play they felt the need to have common regulations imposed by a higher management level. That was why they proposed to elect a village head. They felt that the village head played a key role in designing and implementing new rules. A person who failed in this crucial aspect of his or her function would not be reelected. They pointed out that the real problem lie in the coordination between households for livestock management.

They knew about ongoing research on improved fodder and cover crop systems conducted by the SAM Program within their commune (Husson et al. 2000). But they wondered how they could coordinate among themselves to allocate their labor to common tasks, given that each family has a different number of buffaloes. At the end of the discussion, the "virtual village headman" said that they could gain good awareness about the problem through the role play. But they would need more consultation among themselves and with the village advisory committee on what policy to develop to adapt technical innovations to the villagers' perspective.

Interpretation and Discussion

Key role of lowland rice in farmers' strategies. Different strategies emerged among players depending on their initial resources endowment. The role play clearly indicated that lowland rice production is central to farmers' strategies. Their first objective was to meet their food requirements through paddy field cultivation (Fig. 10). Whenever buffalo availability limited the cropping intensity or the number of cropping cycles in the lowland, farmers would try to borrow a buffalo from a relative or to rent from a neighbor (e.g. ***D*** rented a buffalo from ***C*** until he could buy his own buffalo at the sixth round; ***F*** rented from ***B*** for the two first rounds and then contributed labor to ***E*** in exchange for a buffalo ***E***. Farms lacking labor force started hired workers from other households, as was between ***E*** and ***D*** from the fourth round onwards.

None of the farmers who had lowland surpluses relative to their cropping capacity were willing to rent their surplus land to farmers who lacked sufficient paddy land. Instead, farmers chose to keep their surplus land idle. For example, players ***B*** and ***D*** each kept one paddy plot idle, instead of renting the plots to other players with available labor force. At the fourth round, ***D*** traded his surplus plot to ***C*** for a buffalo, but ***B*** kept

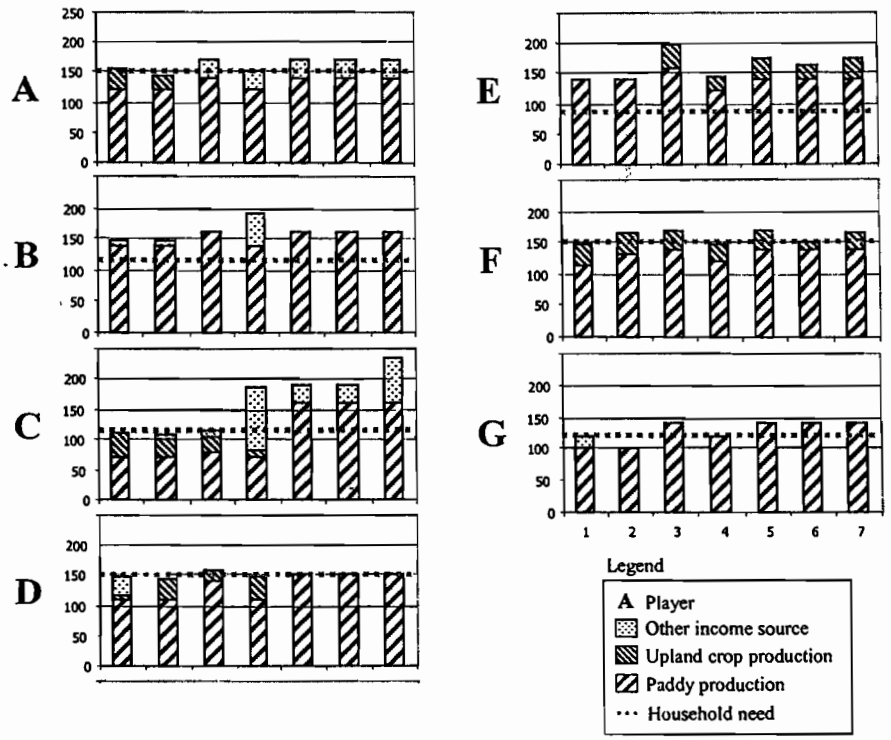


Fig 10. Players' income and number of buffaloes during the course of the role-play session in Ngoc Phai commune, Cho Don district, Bac Kan. province.

his surplus plot idle for all seven rounds. Such decisions reflect the very high status of lowland rice plots in farmers' consideration.

Upland crops. Only the players who could not meet their food needs from lowland rice cultivation opened upland fields (Players ***A***, ***C***, ***D*** and ***F***, Fig. 10). All of them computed how much rice they needed to complement their lowland rice production. Then, this figure guided their choices in the number of plots to open and from which forest quality to exactly meet their food needs. But restrictions imposed by the forest warden on the opening of new forest plots favored the development of off-farm activities (player ***A***'s son got a job in a small cottage industry in the neighboring commune) and the decrease in upland crop production as soon as intensification in the lowlands (through buffalo renting, mutual help and new rice varieties after the fifth round) allowed self-sufficiency (players ***C*** and ***D***). Player ***F*** had to rely on upland crops throughout the role play to meet his family's food needs. On the other hand, player ***E***, whose lowland rice production sufficed to meet his family's food needs, started cultivating upland crops in the third round as a capital building strategy. Player ***G***, who was neither self-sufficient

in rice from the lowland nor had enough labor force to open upland fields, had to borrow rice from other players.

Interaction between upland crops and forest. With the exception of player E, most of the players were very respectful of forest regulations and usually opened the minimum area necessary to meet their production objectives. During the discussion, they confirmed that this was their strategy in their real life but also admitted that this had not always been the case. They stated that in the 1980's they relied heavily on the upland crops (rice and maize) to meet their food needs and also to accumulate capital. This led to rapid deforestation, which explains why the only remaining rich forests were very far from the village.

Livestock management strategies evolved throughout the role play as the increasing number of buffaloes increased the pressure on the fodder resources. We first observed a quite homogeneous strategy similar to the one commonly practiced by *Tày* farmers in the area: buffaloes graze under the surveillance of a family child during the summer period and were allowed to roam freely during the winter with a visit from the owner once every 7-10 days (Eguienta, 2000). After player ***A*** became village head (round 3) he changed his buffalo management strategy and kept his buffalo at home during the winter to set an example. However, as households with big herds could not change their management, the village head decided to establish new regulations: farmers had to confine their animals to the two official pasture areas. All households complied with the rules until an epidemic occurred that triggered the emergence of four different livestock management strategies. However, it was clear from the role play that livestock management practices depended to a large extent on the role assigned to livestock in the production system. Small buffalo herds mainly devoted to land preparation could be kept close to the farmer's house during the winter whereas big herds mainly considered as "living capital" were allowed to graze freely at the periphery of the village.

Emergence of coordination among players. One very interesting feature of the role play was the emergence of informal exchanges and coordination, and then more formal local institutions. Players constrained by their resource endowment sought help from other players. They started renting buffaloes (***D*** and ***F***), then hiring people from other families (***E***) or borrowing rice (***F***). As early as the second round, mutual help started with the son of player ***G*** taking care of the buffaloes of ***E***, and ***F*** exchanging family labor with ***E*** for buffalo labor. Then a local institution emerged with the election of the village head and the regulations that he rapidly proposed to overcome collective issues related to livestock management.

About the process. We consider the role play process itself to be a very important result. It was captured through video recording. By comparing different role play sessions we expect to better understand (a) how people actually make decisions, (b) the events

that trigger changes in players strategies, (c) the conjunction of factors that can steer a collective process toward one decision or another, and eventually (d) how local institutions emerge. The following are some preliminary observations based on a single role play session.

Initially, most of the players were a little confused by the components of the game and numerous rules that they were afraid they could not remember. But it was amazing to see how fast they got into their roles. As soon as they had drawn their household cards, they made fun of themselves when presenting to other players their virtual family. They could play more freely under their new identity, as it was often very different from their real life family situation. Even in the first round, most of the players realized that they had to define their own strategies. They took paper and pen and started calculating and assessing different options. Lively bantering discussions started among the players. A few players passively followed others during the first round. Then they got more confident and developed their own strategies. Sometimes, many discussions were ongoing simultaneously, with people arguing about the need for regulation or not, or the fact that some players did not follow the rules. As the role play progressed, the players moved from mainly individual strategies to collective ones. They felt more confident with the existing rules and wanted to help define better rules.

The role play session finished with a lively debriefing session in which players referred to their real life when justifying their decisions during the role play. They concentrated on the reality simulated by the game and not on the game itself. They started conceptualizing their constraints in a more structured, systemic way and proposed potential solutions for the group to consider. They also could interact more freely with the scientists, as by then we should have built together a shared history to use as a basis for discussion about reality.

Conclusions and Perspectives

Having experienced the limitations of current development practice, including:

(a) The heavy atmosphere and the precooked discourses of official stakeholder meetings,

(b) The shopping list of PRA outputs in the form of "*we need this, we lack that*" that most of the time are beyond the scope of the R&D projects,

(c) The limited relevance of standard tools for mobilizing local knowledge in an extremely diverse and rapidly changing environment, we thought there was need for a new kind of participatory tool. PRA builds upon local stakeholders' worldviews whereas land use analysis stresses scientists' perspectives. The SAMBA multiagent model provides a tool for interdisciplinary teams of researchers to integrate knowledge and to reach a common representation of

the systems they study. Besides, the SAMBA role play provides a common platform for two-way communication between scientists and stakeholders.

The role play should be seen merely as one addition to the toolbox of useful participatory methodologies. It will not take the place of other methodologies but will complement them as part of a participatory diagnosis – intervention process. The role play methodology is still at an initial phase of its development and documentation. But beyond any specific methodology, we would like to draw attention to the importance of attitude. We call on researchers to change their attitude from one-way learning to two-way communication. And we believe that the role play methodology can help bring about this transformation.

The SAMBA role-play, as presented above, has been developed to tackle broad natural management issues in a particular environment: the northern Vietnam uplands. It has been designed for use at the village level because ultimately, *it is communities that manage natural resources*. Indeed, the village level often coincides with a small watershed, which is an inherently useful scale for natural resources management (Castella et al. 1999a). When applied to many villages and player groups, the role play will give different results with both local and regional relevance. The repetition of the exercise will help to differentiate between the two levels of knowledge. It will allow refining the diagnosis and defining its domain of validity. In this sense, the role play can be considered as a research tool. Theories and hypotheses can be developed and tested in the virtual laboratory of the role play (Barreteau et al. 2001). There is no risk to participants, as their decisions and actions do not have any impact on reality.

Nonetheless, participants in the role play can change their perception of reality. Thus, the role play can be used as a training method to help participants formalize their knowledge in a more structured, holistic way. At the same time, participants may become better able to communicate with other stakeholders because they all have lived through the same learning process. The role play can also be useful as a training method (a) to sensitize local stakeholders about the impact of individual actions on the whole system, (b) to facilitate the diffusion of technical and organizational innovations, and (c) to help communities define their own pathways towards more sustainable natural-resource management.

Lastly, a role play session provides a very powerful communication platform for exchange between scientists and local communities. Both groups build together a common story, a common outlook that they can then use as a basis for discussion. During the role play process, scientists and local communities learn about each other, which is arguably the most important prerequisite for truly participatory development.

In summary, role play can enable researchers to learn from local communities (research tool), enable local people to learn from researchers (training method), and enable both groups to learn from each other (communication platform).

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