Co-evolution of a research question and methodological development: an example of companion modeling in northern Vietnam

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In this paper, I present the itinerary of my research examining the emergence of local rules for access to land in the mountainous areas of northern Vietnam. To do this, I mobilize a set of tools ranging from interviews and participative observation to gaming-simulation and multi-agent systems. I show how this exploratory research is an iterative process going through different phases of field work, modeling, and theoretical development. This process is known as companion modeling.

Scientific methodology is often presented as a process that starts from a well-defined a priori hypothesis, goes through experiments (and/or modeling, surveys, etc.) to test the hypothesis, and eventually leads to (theoretical) results in terms of rejecting or confirming the hypothesis. Such a presentation may be somewhat caricatural but it reflects what can still be read in many scientific publications.

In this paper, I would like to describe an alternative methodological process that I followed in my (still ongoing) PhD research. More precisely, I try to show how my research question, and the methodology I developed to try to answer it, (co-)evolved over time, following a companion modeling approach (Barreteau et al 2003). The process started from a rather fuzzy research question inspired by a first field experience: How do collective rules for access to a resource emerge out of individual actions when the resource becomes scarce? This first question, which is also linked to my theoretical interest, may be called a first representation of the reality. I elaborated my first methodology to confront this representation with reality. I present this methodology and the outcomes of this experience. I then analyze the problems encountered but also how this experience made the question evolve and become more precise. This led to a new phase of methodological development, whose results I present. Once again, the experience led to the evolution of the research question. In conclusion, I present a preliminary synthesis of my approach and its still-ongoing development.

The original question

My original research objective, as noted in the first version of my research proposal, was to understand the (emergent) links between individual and collective levels in

the evolution of land-use systems facing increasing land scarcity in the mountainous areas of northern Vietnam. My idea was that, when pressure on the land increases, new collective rules (institutions) may emerge out of individual actions, and these rules may in turn affect individual actions through a second-order emergence process (Gilbert 1995).

This objective was first formulated after more than one year of work on the allocation of forest land to individuals (Castella et al 2002) in the framework of the SAM-Regional Program.[1] My impression was that, in spite of an apparently very strong top-down political system, there was enough room inside the village for the adaptation of the official rules or even for the emergence of informal ones. Actually, this impression is reflected in the popular Vietnamese saying: "The law of the king stops at the entrance of the village." The literature that describes very different land management systems, in spite of a common national law on land tenure, was also consistent with this impression (see, for example, Castella and Dang Dinh Quang 2002, Sikor and Dao Minh Truong 2001).

Nevertheless, in spite of an extensive period of field work in four villages using a methodology based on participative observation and interviews, no real clue was found to gain the understanding sought in my original research objective and what remained as an impression. But the apparent emergence of diverse systems, in spite of centralized rules, only made the original objective more challenging. I had to find another methodology to tackle this question.

At the same time, in the framework of the SAM-Regional Program, and following previous work by researchers at CIRAD (Centre de Coopération Internationale en Recherche Agronomique pour le Développement) (D'Aquino et al 2002, 2003, Barreteau et al 2001, Bousquet et al 1999, 2003, Etienne 2003, Etienne et al 2003), a multi-agent model called "SAMBA" had been developed to understand the dynamics of households' differentiation at the end of the collectivist period (Castella et al 2001a). This model offered a good description of land-use dynamics at the time of the land redistribution to individual households, but was too simple to capture the complexity of the current dynamics. Also, building on previous work (Barreteau et al 2001, D'Aquino et al 2002), the SAMBA multi-agent model had been transformed into a gaming-simulation (Greenblat 1981). The grid of the multi-agent simulation environment was represented by a game board composed of cubes painted with six different colors (each color representing a type of land use or land cover). Farmers were invited to use the game board and simulate the management of the land (Boissau et al 2001).

This game has been played twice and the experience has been very rich. Simulation-gaming proved to be a very powerful tool to observe the actions of the player-farmers and the land use resulting from their actions. However, it appeared that the observation of the game alone was not enough to understand what was happening in it. Especially during the second game we organized, we could observe the emergence of a collective pasture management system. Unfortunately, the observation and the

[1]SAM-Regional is a joint research program of the Vietnam Agricultural Science Institute (VASI, Vietnam), the Institut de Recherche pour le Développement (IRD, France), and the International Rice Research Institute (IRRI, Philippines).

analysis of the game did not provide enough information to really understand how such a system emerged. That is why the methodology has subsequently been extended to a 5-day process called "SAMBA-Week."

The SAMBA-Week methodology[2]

The SAMBA-Week methodology was a 5-day process organized as follows:

- The first day was dedicated to a gaming-simulation similar to SAMBA. About ten farmers were invited to participate as players. They were given a virtual family and some paddy fields and buffaloes. They then had to manage their production in order to feed their family. Through these actions, farmers changed the land use and the land cover represented through different colors on the game board (Fig. 1). About six years could be simulated through the game and the session ended with a collective debriefing.
- During the next three days, two processes were followed in parallel:
    1. Individual interviews were carried out with the players to understand the rationale of their actions during the game. Round after round, they were asked to justify their actions, for example, with regard to their economic

Fig. 1. Picture taken during SAMBA-week experiment.

[2]The evolution from SAMBA to SAMBA-Week took place in cooperation with the SAM-Regional Program and, apart from the objective cited here, the methodology also pursued other objectives within the framework of this program. Consequently, all comments presented here about SAMBA or SAMBA-Week methodologies refer only to the objectives pursued in my PhD research, and involve only me. For a more detailed description of the SAMBA-Week process and the different objectives it pursued, one can refer to Boissau and Castella (2003).

situation, their past actions, the actions of the other players, their actions and situation in reality, etc. Through these questions, we intended to better understand what happened during the game. The interviews also tackled the question of the comparison between the game and reality on both a general and a more individual point of view. Lastly, the interview ended with an assessment of the game by the interviewee.

2. A computerized multi-agent simulation of the game was implemented. The model, and especially the behavior of the agents, was based on the observation of the game and information drawn from individual interviews. This first model intended to replicate as faithfully as possible the sequence of the game, by specifying only general rules for individual behaviors and land-cover dynamics. These rules were then used to simulate potential scenarios identified by the participants (for example, scenarios with demographic growth or with additional rules governing land and/or livestock management).

- On the fifth day, a collective meeting was organized with the game participants to present them with the computer simulation. The session typically started with the presentation of the simulation that replicated the game session the players had a few days before. Through this presentation, the players could become familiar with the computer model and "learn to follow" a simulation on the screen. For example, they were able to describe the evolution of the landscape and were inferring the behaviors of the agents. Afterward, other scenarios were presented to the participants and then discussed. Computer-simulated scenarios allowed us to simulate, in a shorter time, longer periods than in the game and therefore showed farmers the implications of their choices in the long term. The discussion focused in particular on the similarity between the simulated scenario and reality (past, present, or future), its likelihood of happening, the problems that would result, and possible ways of solving them.

The whole SAMBA-Week process has been followed five times in five diffe ent communes of Bac Kan Province. In the following section, I will assess this experience.

Assessment of the SAMBA-Week experience

Regarding the methodology itself, the first point to mention is that participants accept playing. Even if the players may be surprised initially when the facilitator asks them to participate in a game, they realize very quickly that the game is not as trivial as it may first appear and they take it very seriously. Actually, the situation in the game is close to their reality: players (who are themselves farmers) play the role of farmers, the virtual landscape created on the game board is close to the landscape of the village, etc. These elements make the players quickly understand the connection between the game and reality and they typically feel very comfortable after only one round of the game. Very often, players incorporate by themselves features of reality into the game. We encountered many examples of this during the different sessions: players imagining a river running through the game board, players not intensifying their rice fields because there was not enough water for irrigation, whereas the availability of

water was not included in the game, and players imagining the slopes around the village and including this factor in their decisions. These examples show that, at least to some extent, the players "import" their reality into the game.[3] At the same time, since it is a game, players may feel more freedom to engage in different actions than they would in real life. For instance, one player tested a new production system during the game session, thus really using the game as a simulator.

This leads to the broad question of the model, the way it is constructed through the gaming-simulation, and the computer simulations in which it results. Actually, the gaming session on the first day is a way to make people construct their own model of the system.[4] The only framework that is imposed on the players is the game board composed of cubes. The session typically starts by asking the players to draw the landscape around their village and this landscape is then represented on the game board. During the game session, players are free to propose new actions (for example, introducing new crops). The production levels of the different crops are determined after a discussion with the participants. Thus, to some extent, the model is constructed by the participants themselves. Also, on the fifth day, when the computer simulation was presented to the participants, we observed that they could easily understand it and comment on it. As mentioned, the first simulation presented to the participants reproduces the game they played a few days before and the grid of the computer simulation looks like the game board (same structure, same colors). A collective discussion on the evolution of the simulations can be held, even with people who are not familiar with computers or who may even be illiterate.

Another important aspect of the methodology is the high quality of the interaction we were able to have with farmers.[5] This is especially important in a country such as Vietnam, which is characterized by a very hierarchical political system and where decisions are often made before the meetings occur. The Vietnamese also tend to avoid conflict.[6] In such a context, it is very difficult to engage in a "real" discussion during a collective meeting. Another element to take into account is that one may easily encounter wariness toward strangers/foreigners. It may thus be difficult to gather accurate information. Through the game session of the first day, we were able to create a very different atmosphere without a dominance relationship but based on a players-facilitators relationship. Also, the fun aspect of the game helped to reduce wariness. In the context of the game, we could therefore substantially improve the quality of the information we obtained.

The game session, complemented with the individual interviews afterward, offered an overview of the agro-socioeconomic system. What is more, the overview was dynamic, because about six years could be simulated during the game. This was particularly interesting as actual field research allows one to observe only the present time. Observing the dynamics would only be possible through extensive field

[3]In our experience, these observations were quite anecdotal. A detailed study of the question and a methodology to test how reality is brought into the game can be found in Daré and Barreteau (2003).

[4]Another example of the self-design of a model can be found in D'Aquino et al (2002).

[5]Some of these aspects are described in more detail in Castella et al (2001b) and Boissau and Castella (2003).

[6]Cultural aspects may have a strong influence on the gaming-simulations as shown in Patamadit and Bousquet (this volume).

work over several years. Through gaming-simulation, the evolution of individual decision-making and the resulting evolution of the whole system could be explored in a few days' time. But, even if both the individual rationale underlying farmers' actions and the collective rules could be quite well observed and understood through this methodology, the precise mechanisms linking them, that is, the very process of emergence, could not be characterized.

Limitations of the SAMBA-Week methodology and evolution of the research question

The SAMBA-Week methodology aimed to examine the link between individual and collective levels, that is, how individual farmers through their actions collectively create a landscape or a land-use pattern. For example, farmers may practice shifting cultivation while the forest is abundant and then slowly shift to another agricultural system when the forest becomes scarce. However, the process by which individual decision-making evolves and gives rise to collective rules, and the way collective rules constrain individual actions, was difficult to observe.

I now try to explain why this process of emergence was difficult to capture through the SAMBA-Week methodology. The different games we played had a kind of common structure. They typically started with a period of "exploration" (about three rounds of playing corresponding to three years), during which the players were trying different options and observing each other. After that phase, the players would usually repeat their actions with minimal changes. Emergence, in the sense of a collective decision appearing during the game, could be observed in only one game as already mentioned above. In other games, players often tried to limit interactions that would possibly lead to conflict, even when we limited the size of the game board to try to provoke more interactions, because we believe that increased interdependencies may be one of the elements leading to change (Röling 2002). Because many elements were already included in the game and as players were free to introduce new features themselves, it seems that they could almost always find a way to avoid potential conflict.

Although the process of emergence could therefore not be fully captured through the SAMBA-Week methodology, it suggested some new elements that helped me to refine the research question. Subsequently, I decided to limit the study to the emergence of rules for access to the land, as this issue appeared to be crucial throughout the different games. By rules, I mean the local rules at the village level that may be different from the official ones. These rules (formalized or not) are seen as the basis for decision-making (North 1990). At the village level, they constitute an institution that regulates access to the land for the different uses. To put it another way, I was looking for the evolution of rules, in the sense of a system of representations shared by a community, which may also be called institutional change (Aoki 2002). The idea behind this is that institutional change may occur when the institution as a collective representation does not reflect anymore the reality stakeholders experience, that is, a decreasing correspondence between the cognitive system of the actors and their domain of existence (Röling 2002). A case study based on this question would focus on the process of evolution of rules for access to land when the pressure on land increases.

Building on the lessons from the SAMBA-Week methodology, a new methodology had to be developed to focus on this question.

Development of a new methodology

To develop a new methodology, we had three sources of inspiration: gaming-simulation, game theory, and behavioral/experimental economics.

From a methodological point of view, the main lessons I drew from the SAMBA-Week were that (1) gaming was an efficient approach for working with stakeholders, (2) I had to try to keep the process as simple as possible, and (3) I had to focus the game on my particular problem.

Game theory provides interesting inputs. Game theory is a theoretical and analytical framework to describe and understand interactions among players. However, game theory often hypothesizes rational economic agents and focuses on equilibrium conditions reached under fixed conditions given by the payment matrix that is not subject to change during the course of the game. Attempts have been made to introduce dynamics into game theory in seeking to avoid these shortcomings and evolutionary game theory studies how boundedly rational agents attain an equilibrium through evolutionary processes (Young 1998). Behavioral economics uses economic experiments to show that human players do not behave as economically rational agents (Tversky et al 1982). These approaches have been applied to common resource dilemmas by Ostrom et al (1994), who studied the conditions of success or failure of collective institutions. However, they do not give an account of how these institutions may change.

Economic experiments have been transferred from the laboratory to the field (e.g., Cardenas 2000, Henrich et al, n.d.) and show that stakeholders can easily understand such abstract experiments and relate them to their own local experience. However, these experiments start from economic theory, generally show that individual behavior does not conform to the *homo economicus* hypothesis, and then try to link results from the experiments to ethnographic observation in order to explain observed behavior. My approach is different in the sense that I start from actual behavior observed in the field and afterward try to relate this behavior to existing theories, amending them if necessary. Instead of starting from the hypothesis to confirm or reject it, I try to reproduce a phenomenon through an experiment in order to better capture it.

From these different sources of inspiration, I tried to design new games having the abstract nature of experimental economics but the openness and degree of freedom to act in gaming-simulation. These games have to be adapted to the particular problem of the concrete situation in which they are implemented but still share some common features. They are organized around a whiteboard divided in cells representing the (renewable) resource. During the game, the pressure on the resource increases and players who are harvesting from the resource may change the rules of the game, that is, the rules for access to this resource. Two games were developed at two different locations, previously identified through the SAMBA-Week experiences, to try to capture the very process of emergence. The gaming-simulations carried out for these two case studies are described below.

Presentation of on-field experiments

The "EPP?" (Emergence of Private Property) game

This gaming-simulation has been conducted in Nghien Loan commune, Ba Be District, Bac Kan Province. The aim of this gaming-simulation was to understand how an open-access resource could be transformed into a common-pool resource or a private-property resource when the pressure on the resource increases, especially because of immigration.

To examine this question, the game was designed as follows: a game board consisting of a 49 (7 × 7)-cell grid was supporting the forest resource with levels from 0 to 3 (at the beginning, all the cells have three points of resource). Twenty farmers from one village had been invited to participate in the game but, at the beginning, only 6 had access to the resource; the other 14 were sitting in another part of the house. Players could harvest the resource (up to 4 cells each round) and received points according to the amount of the resource they harvested, corresponding to the harvest of upland rice fields. In each round, whenever a cell was not harvested, the resource regenerated and the level increased by 1 point (up to a maximum of 3).

At the beginning of the game, the rules regulating access to the resource were as follows:

- The resource was accessible by anyone but a cell might only be appropriated as long as the appropriator was not harvesting the resource on it, that is, from the time a cell was left "fallow," it could be harvested again by anyone else.
- At the beginning of each round, a new player was asked to enter the game.

This set of two rules is characteristic of an open-access resource and reflects the situation of the commune where the role-play took place. Until 1991, the forest was an open-access resource and an important immigration rapidly increased the pressure on the resource.

In the gaming-simulation, at the end of each round, the players were given time to discuss the possibility of changing either of these two rules. If the first rule was changed, that is, the resource could not be appropriated by another player while one of the players left it fallow, the resource would become a private property. If the second rule was changed, new players (i.e., outsiders, people coming from outside the existing community of users) were not allowed to enter the game anymore, and the resource would become a common-property resource.[7]

The first (and only) experience with this gaming-simulation encountered several problems but some lessons could still be drawn from it. The main problem encountered was that the active participants never changed the rules! Even, as the end of the game was approaching,[8] they wanted new players to enter the game two by two!! The debriefing at the end of the game shed some light on this unexpected behavior. It appeared that the participants would have liked to stop the entrance of new players

[7]Actually, the ability to exclude outsiders from appropriating the resource is only one of the characteristics of a common-pool resource (see, for example, Ostrom 1990 for a description of the set of rules defining a common-pool resource). To keep the focus of this paper on the research process and the methodological development, this issue may be discussed in forthcoming papers.

[8]No precise time was given for the end of the game but participants knew I had arranged lunch!

but they were afraid that inactive players would become bored just waiting without playing.[9] It also appeared in the debriefing that at no time during the game did the participants want to change the rules of the game and establish private property even if, in reality, private property was governing access to the uplands for about ten years while the land was still officially property of the state. The question was then: Why did private property emerge in the actual situation but could not emerge in the game and was even categorically refused?

Subsequent interviews showed that private property in the villages did not emerge in a "natural" way but was in some way "imposed" on the villagers by another ethnic group. Before the collectivization of agriculture, the Tay ethnic group occupied the bottom of the valley. Their agricultural system was mainly based on the cultivation of irrigated rice complemented by swidden cultivation of rainfed rice and cassava in the uplands. Irrigated paddy fields were privately owned based on a system of inheritance, sharing the fields among sons. Swidden cultivation was taking place in the surrounding forest governed by open access and temporary appropriation by clearing until the field was fallowed.

Villages of the Dao ethnic group were located a few kilometers away, up in the mountains. These villages did not have any irrigated fields (or had only very marginal ones) and their agricultural system was based exclusively on swidden cultivation and regular migration. Swidden cultivation was governed by the same type of rules as in the Tay ethnic village—open access and temporary appropriation.

After the collectivization of agriculture and the establishment of the cooperative system, a sedentarization program was launched by the state. Dao people were encouraged to "go down the mountain" to join the cooperatives. The irrigated land belonging to the Tay villagers was shared between two cooperatives, one with the Tay people, the other one with the Dao people. At the termination of the cooperative system, the Central Committee of the Communist Party issued a directive for the redistribution of land. But, following a movement originating in Cao Bang Province, the Tay people from Cao Bang and Bac Kan provinces claimed the land of their ancestors, each family taking back the land they or their parents had contributed to the cooperatives.[10] Through this movement, the Dao and Hmong people, who had worked on this land during the cooperative, were excluded from access to the irrigated land and had to rely exclusively on the forest for swidden cultivation.

However, something happened in the commune studied that did not happen in other places. The Tay also claimed the uplands that they had previously cleared, that is, almost all the area surrounding the irrigated paddies. Consequently, they asked the Dao people to buy land the Dao wanted to exploit for shifting cultivation or even land on which their houses were located, just so they could sell irrigated paddies. The Dao people had the choice between moving to another place, opening swidden far from their houses, or buying the land at a reasonable price. Many of them chose

[9]The design of the game had been revised within the perspective of a repetition of the game and incorporated another game board located in another room to keep players who were not active busy.

[10]The precise means for the redistribution of land to households were under the responsibility of the province. This may explain why in Cao Bang and Bac Kan provinces, populated by a majority of Tay providing the provincial leadership, this movement occurred and also why the state did not intervene.

this last option. By entering the monetary sphere and being sold from one individual to another, the individual property was institutionalized in the uplands and the Dao people kept on buying land from the Tay people and selling it to newcomers, either Dao or Hmong households.

Even if this experiment may be considered as a failure (nothing emerged!), some lessons can be drawn from it. Through this process, and in only a few days, I got insights into some historical processes that could not be made clear through individual interviews conducted before the game. One of the reasons is that, beyond human relationships created by the game, the players and I had shared a common experience through the game and this common experience could be used as a reference point in subsequent discussions. Also, in my study of the emergence of rules, the process of nonemergence may have as much importance as the process of emergence in determining the conditions for the emergence of these rules. I may come back to this last point later.

The "PAT" (pasture) game

The second gaming-simulation session was conducted four times in two villages of Duc Van commune, Ngan Son District, Bac Kan Province. This aimed at understanding how a common-property resource may become private when pressure on the resource increases.

The game board was a 5 × 5-cell grid representing a grazing land. Each cell had a level of resource ranging from 0 to 3, starting at 3. Five players took part in the game and they were initially allocated from 1 to 6 buffaloes randomly.

Each round of playing was organized as follows. Players located their buffaloes on one or more cells of the grid (Fig. 2), knowing that each buffalo needed to

Fig. 2. Picture of the "PAT" gaming-simulation.

"graze" one unit of resource, that is, a cell with a resource level of 3 might be enough for 3 buffaloes, a cell with a resource level of 2 could support 2 buffaloes, etc. If on a specific cell there were more buffaloes than the resource level, the facilitator drew randomly which buffaloes would "eat" the resource and which ones would not. "Starving" buffaloes were identified and any buffalo starving 3 rounds would "die." Also, the resource level of each cell was reduced according to the number of buffaloes on the cell. For example, a cell with a resource level of 3 and 2 buffaloes resulted in a resource level equal to 1.

The facilitator gave to each player the number of points corresponding to the number of nonstarving buffaloes the player had (1 point for each nonstarving buffalo).

Additional points (from 1 to 4) were "drawn" randomly by the players and these corresponded to the income from other activities (agriculture, hunting, etc.).

Players could buy or sell buffaloes at the price of 10 points per head.

The resource level was renewed and was increased by 1 point, with a maximum level of 3.

At the beginning of the 4th, 6th, and 8th rounds, 5 cells from the resource randomly chosen were declared unsuitable for pasture and could not be accessed anymore, so that, in the 8th round, only 10 cells remained accessible to the players. This decrease in the amount of resource in the game corresponded in reality to the planting of pine trees that occurred a few years ago in the villages where the game has been played. As the pine trees grew up, the grass underneath disappeared, thus reducing the grazing land available for buffaloes. Another cause of the shrinking of grazing land was the gradual decrease in the number of swidden fields: they were extensively used as grazing land during both wintertime and when the fields were fallowed.

A preliminary analysis of the games showed that, in any case, participants did not want to change the rules for access to the land to establish private property. They more or less adapted to the evolving situation of the game. If during the first rounds they tried to accumulate as many buffaloes as they could, starving buffaloes appeared soon after the resource area started decreasing. The players thus gradually sold some of their buffaloes to the facilitator (the players having the most buffaloes usually sold their buffaloes first). During the following rounds, if the players observed that the resource was sufficient, they might buy more buffaloes. The game invariably ended with 10 buffaloes as only 10 units of resource were still available, each player having from 1 to 3 head, and in most cases the game ended with each player owning 2 buffaloes.

During the game, two behavioral norms could be observed:

1. Avoid possible conflict: for example, having 2 or more buffaloes, belonging to different players, on the same cell.
2. The more buffaloes you have, the earlier you will be selling them when the resource becomes scarcer.

Elaboration of a new hypothesis

In this section, I propose the idea and hypothesis I want to test, which are suggested by the outcomes of the gaming-simulations presented above.

It appears that the evolution from an open-access resource (OAR) to a common-pool resource (CPR) is a "natural" and "logical" evolution of institutions to protect a community when its survival may be endangered, for example, by the overexploitation of critical resources as a result of immigration. The evolution from an open-access resource or a common-pool resource to an individual private-property resource (IPPR) seems to be a different process that may be neither necessary for the survival of the community nor a "natural" evolution.

The underlying idea is that evolution from OAR to CPR is a process involving the whole community in devising rules to restrict access to the resource from outsiders.[11] It implies interaction between the whole community and the outside world to protect the community.

On the contrary, evolution from OAR or CPR to IPPR involves interactions inside the community or new institutions imposed from outside the community, for example, by the state or a more powerful group. This is what we observed in the first case study, and also what happened with the allocation of forest land to households decided by the state in its effort to protect the forest resources. Another example of such an "emergence" of private property is described in Angelsen (1995) regarding indigenous communities in Sumatra as a consequence of state projects (migration, logging, etc.) and the nonrecognition of customary laws by the state.

For these reasons, I propose to focus on the evolution from OAR to CPR as this process appears to be a more endogenous and general one, that is, it may not imply power relationships such as the evolution to IPPR, with these relationships being more context-specific and more difficult to capture.

The next step of my research will consist of developing a multi-agent model to be used as a virtual laboratory to explore the process of emergence of common-property regimes, as well as the conditions under which emergence takes place.

Conclusions

The itinerary of the research presented in this paper is still ongoing, so these conclusions can only be preliminary. By presenting the process of co-evolution between my research question and the methodology to examine it, I tried to show that this is a construction process. First of all, it is the construction of a research question that is linked to the representation of the reality one may have. It is also the construction of a methodology to examine this question. It is based on existing tools and methodologies that are used as building blocks. This methodology is used as a tool to confront the reality with our representation of it. Out of this confrontation, our representation may be modified and the research question refined or clarified, leading to an (endless) iterative process.

The other point I would like to make is how such research starts in the field and evolves toward more theoretical questions. Starting from a real-world situation and an open question, the research progressed gradually toward a more precise but

[11]Here, we deal only with the evolution from an open access to a common pool as an autonomous process and not as the establishment of a common-pool institution imposed from outside the community, which is much more likely not to succeed (Ostrom 1990). In this latter case, there is no institutionalization in the sense of Aoki (2002).

also more abstract and theoretical question (see Fig. 3). The first model (SAMBA) was very close to the reality and was examining a local problem, a particular land-use system in the mountainous areas of northern Vietnam. The research evolved toward more abstract models examining a theoretical question, the evolution from an open-access resource to a common-pool resource management system. Subsequently, such a research process may provide a better foundation for theoretical questions because real-world situations are not illustrations of a theory but they constitute the very basis on which the theory is built.

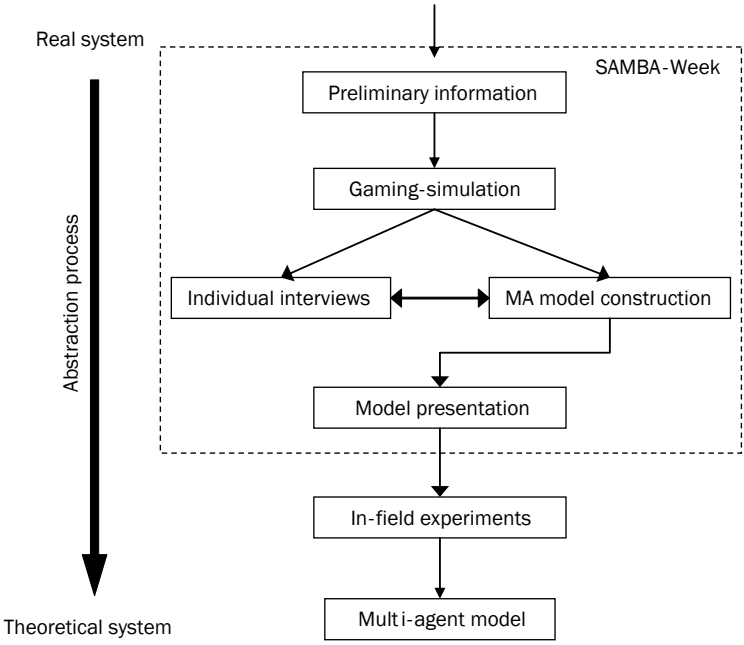

Fig. 3. The overall methodology.

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Notes

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