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# “PLUP FICTION”: Landscape Simulation for Participatory Land Use Planning in Northern Lao PDR

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A landscape simulation was designed and tested in Viengkham, a mountainous district in the north of Lao PDR. This social learning process was introduced by researchers affiliated with national research institutions to improve

land use planning practices and increase the ownership of local people in the planning process. Twelve members of the village land management committees participated in the role play called “PLUP Fiction,” which is part of a stepwise process of participatory land use planning (PLUP). This article introduces the principles of land zoning, the sequence of events presented during the role play session, and the lessons learned from a series of experiments conducted in remote upland villages. The villagers gained an increased understanding of the issues at stake during a zoning process, thus demonstrating the relevance of this learning simulation

tool. They were able to explore different zoning options, assess their respective advantages and constraints, and gradually improve their understanding of the consequences of land zoning on the environmental and economic values of the resulting landscape. The villagers also felt empowered by their newly acquired knowledge and well disposed toward negotiations to improve their current land use through more realistic plans. Long-term environmental concerns (ie biodiversity and carbon values) were fully integrated with shorter-term economic considerations in the collective decision-making process. Furthermore, “PLUP Fiction” has become a key tool for fully involving local communities in Reducing Emissions from Deforestation and Forest Degradation (REDD) through negotiations that are taking place during a land use planning process.

**Keywords:** Land use planning; participation; negotiation; role play; landscape simulation; uplands; Laos.

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## The challenges of land use planning in the uplands of Lao PDR

Land use planning (LUP) has long been used as a policy instrument to achieve the environmental and socioeconomic goals of developing countries that depend on agriculture and natural resources to sustain a mostly rural population. More recently, LUP has been embedded in international debates on biodiversity conservation and Reduction of Emissions from Deforestation and Degradation (REDD), that is, financial mechanisms that aim to reward local communities for biodiversity and carbon-efficient management practices. The concrete implementation of such mechanisms must confront questions related to land demarcation, tenure, and resource rights. By addressing these concerns, LUP is increasingly perceived as a key instrument for the implementation of financial mechanisms for conservation at the local level (Blom et al 2010).

Furthermore, LUP is a prominent policy instrument considered for use in preventing international “land-

grabbing.” Deeply rooted in the current food and economic crises, unclear land tenure in developing countries is putting rural communities at risk of becoming the victims of private investors instead of becoming partners in sustainable development (Cotula et al 2009; Godfray et al 2010). Land titles issued after local negotiations through participatory LUP could both prevent land grabbing and provide incentives for more responsible management of natural resources (Fitzpatrick 2005; Cotula et al 2009). Since the Rio Conference in 1992 and the advent of the sustainable development paradigm, LUP has been promoted as a method to “select and put into practice those land uses that will best meet the needs of the people while safeguarding resources for the future” (FAO 1993). Coherent and effective LUP is especially required in the mountainous regions of developing countries, where difficult market access entangles local communities in subsistence agriculture and insecure livelihoods (Millennium Ecosystem Assessment 2005).

In Lao PDR, despite the early promises of LUP in the 1990s, LUP has been criticized and depicted as a coercive

policy instrument that forces populations to halt shifting cultivation in the name of environmental preservation, without providing alternative livelihood options (Ducourtieux et al 2005). Today, the top priority of the Lao Government for the 75% of its national territory covered by mountains is to alleviate poverty while preserving the natural resource base (Lestrelin et al 2011b). LUP remains a key policy instrument to encourage resource use intensification, favor private investment, develop commercial agriculture, and, most importantly, reduce the rural population's dependence on forest resources. However, assessments of LUP implementation and its impact on landscapes and livelihoods have revealed certain deficiencies in the process, which result in a gap between expected outcomes and actual achievements (Ducourtieux et al 2005; Fujita and Phanvilay 2008; Lestrelin et al 2011b). Consequently, all stakeholders in the national "LUP arena" came to recognize the need to improve the LUP process through increased participation, scale integration, and harmonization of superimposed plans, together with enhanced coordination between the implementing agencies and other economic sectors (MAF-NLMA 2009; Lestrelin et al 2011b).

The principles of Participatory Land Use Planning (PLUP) have been promoted as an alternative to the previous, suboptimal practices. Lao implementing institutions and line agencies at different scales have been requested to use the new code of conduct described in great detail in the widely distributed PLUP Manual (MAF-NLMA 2009). In 2010, the implementation of these new guidelines by pilot projects showed that the translation of the new PLUP principles into concrete action remains awkward and that the participation of local stakeholders is still abusively taken for granted (Lestrelin et al 2011a). Asking the same people with the same means to do things differently on the basis of a new set of guiding principles resulted in serving the same old soup in a new pot, with the same limited results as before.

Promoted as a method to translate strategic principles into actions (Rist et al 2007), collective learning is emphasized in this article as a way to effectively engage marginal upland communities in a participatory process of LUP. A learning tool called "PLUP Fiction" was developed to (1) simulate the changes in landscapes and livelihoods in relation to zoning, and (2) involve members of village land management committees (VLMC) in the exploration of alternative land use scenarios. The role play, based on a game board mimicking a typical landscape of the northern uplands of Laos, is a product of the companion modeling approach (Bousquet et al 2002; Boissau et al 2004; Etienne 2010). PLUP Fiction also has been designed to provide learning support for land zoning, which is a key stage in the LUP process (Bourgoin et al 2011).

After a presentation of the participatory simulation tool, illustrated by a case study in the mountains of

northern Lao PDR, this article discusses the quality of participation achieved through this innovative method.

## Case study sites

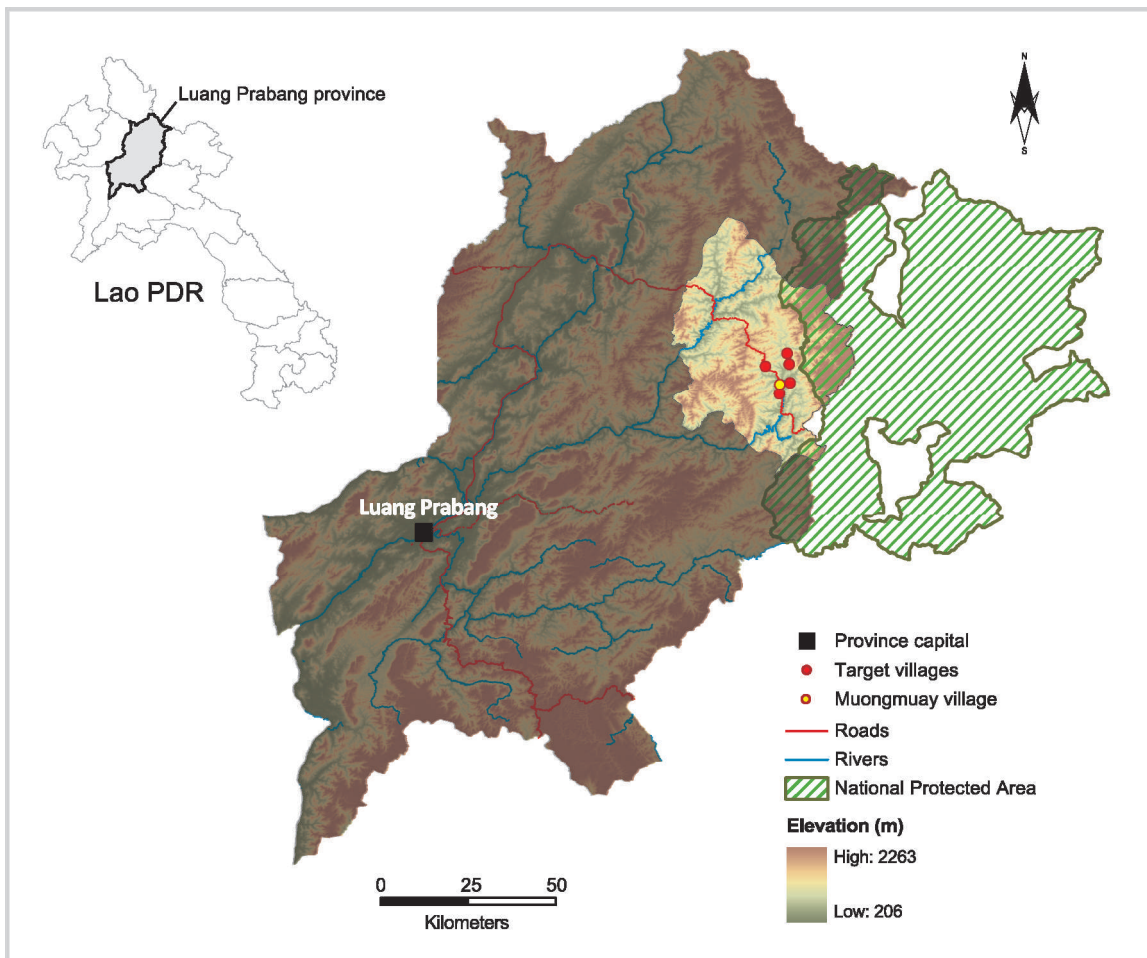
The study site is located at the border of Nam Et–Phou Loey National Park in Viengkham District, Luang Prabang Province (Figure 1). Since one of the objectives of PLUP is the integration of multiple scales and perspectives, it was decided to test it at the village cluster (*kumban*) level by including all 6 villages of the Muongmuay *kumban* in the PLUP process. The 2 main ethnic groups present in the study area are the Lao Lum (20%) and the Khmu (80%), which are known to settle on the valley floors and in the hillsides, respectively (Chazee 1999). The land use systems in upland areas are composed of rotational upland rice with limited areas of lowland paddy rice, and a range of other crops, that is, annual food crops (leaf vegetables), cash crops (maize, pigeon pea, cucumber, longbeans, and watermelon), and perennial commercial tree crops (tea, teak, agarwood, and rubber), large livestock (buffaloes and cattle), and small livestock (pigs and poultry). The collection of non-timber forest products (NTFP) also is an important component of the livelihood system and acts as a safety net in periods of food scarcity and a complementary income source for villages with sufficient market accessibility.

In 2010, PLUP Fiction role play was introduced in the 6 villages of the Muongmuay *kumban*. Although PLUP Fiction does not explicitly refer to land management at the *kumban* level, it trained members of the VLMCs to manage their own village landscape. Some of them then dealt with higher-level land management issues as representatives of their village at the village cluster land management committee. Only 2 villages in this *kumban* had previously experienced LUP in 2006. However, by 2009, nothing remained of this LUP experience conducted by the district authorities with the support of a development project, except for a wooden board with a painted land use map at the entrance to Bouammi village. In the meantime, all written records and documentation had disappeared, and only a few people had a vague memory of a mapping exercise having taken place in their village.

## The successive stages in PLUP Fiction role play

The 7 member implementation team consisted of 2 local staff from the district line agencies (the Department of Land Administration and the Department of Agriculture and Forestry), 2 provincial staff members from the northern branch of the National Agriculture and Forestry Research Institute, and 1 staff member from the Provincial Agriculture and Forestry Office, and was facilitated by the 2 authors of the article, who are associated with international research institutions. The

FIGURE 1 Location of the case study site in Viengkham District, Luang Prabang Province. (Map by Jeremy Bourgoin)



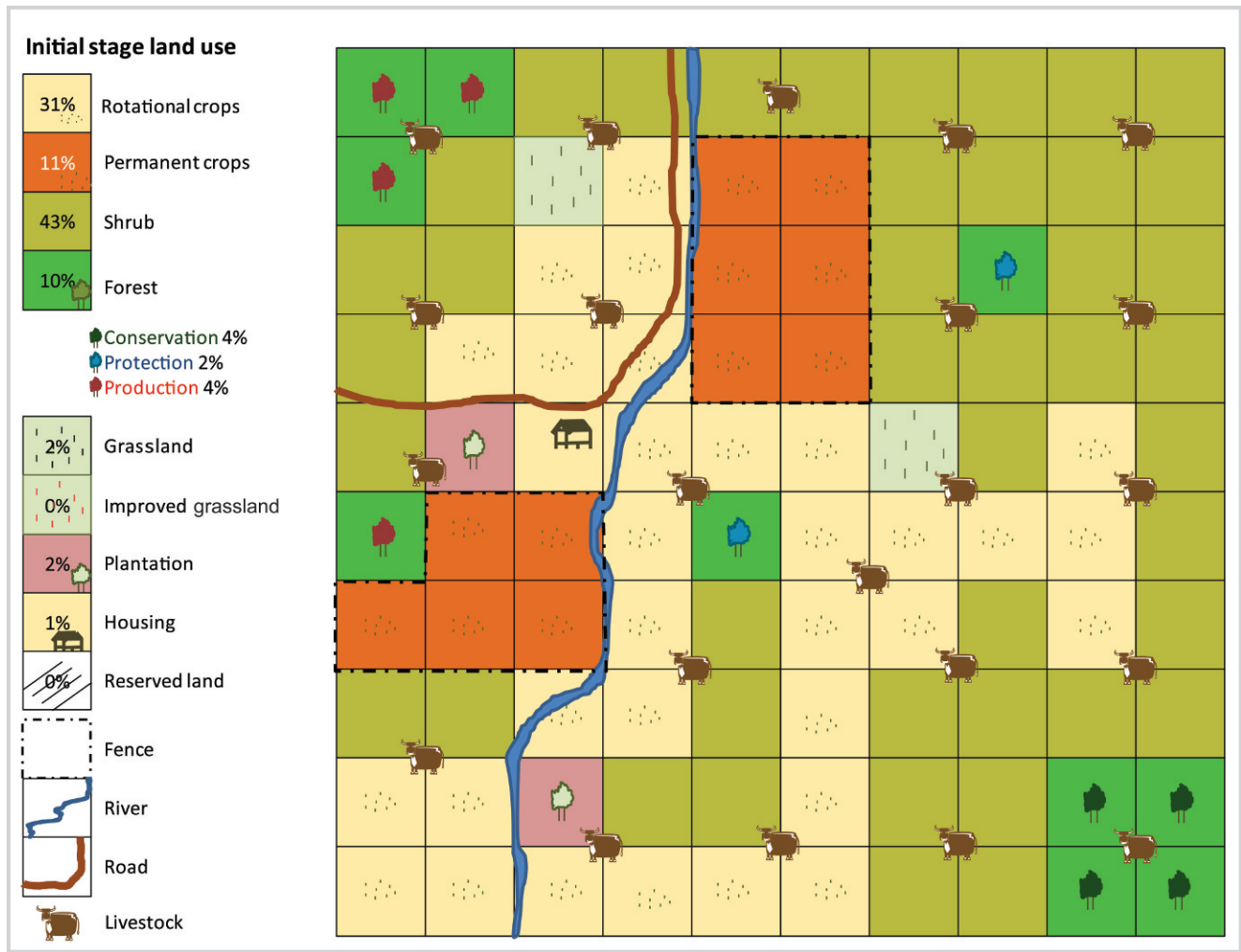
district staff was of Khmu ethnicity and, therefore, could introduce the role play and facilitate the discussions in the local language. The Provincial Agriculture and Forestry Office staff also could interact with local people in the Khmu language and, therefore, minimum translation from Khmu to Lao was required in 5 of the 6 villages that were predominantly of Khmu ethnicity.

The role play was performed over one-and-a-half days in the meeting room of each village. A meeting of the whole village was held on the morning of the first day to inform the villagers about the PLUP process that would be organized in their village over a 5-day period. Once villagers had been informed about the process, the team proceeded to the selection of the 12 villagers who would become members of the VLMC after participating as players in the PLUP Fiction. The village authorities assisted in the selection so as to achieve a gender balance and to include people from different socioeconomic backgrounds and positions within the village governance system. The people chosen also had to be able to communicate easily and be knowledgeable about land matters.

### The simulation board

A simulation board with 100 1-ha cells was used to introduce the virtual landscape to the participants. Each cell can be used to show a different land cover or use. Landscape and household survey studies (Castella et al 2011) were used to derive the relative percentages of the different classes of land cover. The researchers designed the spatial distribution of the different land cover areas on a grid so as to recreate a “typical” landscape in the northern uplands of Lao PDR (Figure 2). All classes of land cover found in the region were represented: agricultural land, made up of permanent crops (eg paddy rice on the valley floors and maize and cassava on the hillsides) and rotational crops (eg upland rice); grasslands, generally used for extensive livestock grazing (eg cattle and buffaloes); tree crop plantations (eg teak and rubber); residential areas, including gardens; and natural vegetation of 2 classes, shrub and forest. A road and a river appear on the board to make the landscape look more realistic while ensuring that the configuration did not exactly match any of the 6 villages of our study site.

FIGURE 2 Landscape simulation board. (Design by Jeremy Bourgoin and Jean-Christophe Castella)



Such an abstract landscape representation aims to prevent participants from considering the situation of their own village and ensures that the participants remain focused on the simulation rules and principles instead of being distracted by any pragmatic local concerns.

#### Participants' roles in the land zoning simulation

The 12 players drew different cards to determine their various roles: 8 red cards for members of the VLMC, 2 yellow cards for representatives of the district economic development division, and 2 green cards for representatives of the district forest and environment division (Figure 3). The rights and responsibilities of the different stakeholder groups were introduced. The 8 village representatives do not play the role of individual villagers but must consider themselves as members of the agriculture and forest VLMC. As a rule of the simulation, the 2 district representatives involved in economic development find their satisfaction in the level of income

generated by the whole village. However, the 2 forest division representatives value biodiversity preservation and carbon storage.

#### The sequence of the role play

As previously mentioned, the purpose of the role play is to support the participants in negotiating (not to predict future changes) and reach a trade-off outcome that is satisfactory to all the villagers and the government representatives responsible for both the environment (biodiversity/carbon) and village economies. Emphasis is placed on the need to consider and integrate socioeconomic data in the land zoning process (see next section). Through the role play, that depicts an abstract version of the village situation, the objective is to train the 12 villagers to take up the function of VLMC members responsible for zoning and planning activities on their real landscapes. To this extent, the players need to learn how different landscape patterns generate contrasting

**FIGURE 3** Landscape simulation board with caps representing livestock. The cards, drawn by the players, assign different roles to the players during the simulation. The “smiley” faces show their level of satisfaction. (Photo by Jeremy Bourgoin)



economic and environmental returns. The parameters of the simulation tool are discussed with all participants, for example, agricultural and NTFP income in kip (1 US\$ = 8000 kips as of April 2011), livestock carrying capacity, and labor force required for each land use. The team calculates the income associated with the different land uses from crops, livestock, and NTFP collection. Then, biodiversity and carbon values are computed for each land use and compiled for the whole landscape.

Finally, with the help of the facilitators, the participants assess the future land use plan on the basis of the economic and environmental value of each land use type. If all are satisfied with the plan compared with the current land use situation, they can then reach an agreement. If one or several stakeholder groups are not satisfied (ie they lose something in the new plan in comparison with the previous one) or have identified room for improvement, then the whole group engages in a new round of negotiations. Several iterations of land zoning simulations can be performed before a general consensus is reached and the final plan is collectively agreed upon.

### Learning the principles of land zoning

Assessing the environmental and economic value of a landscape is core to the iterative process of land zoning during the role play. The facilitators introduce the notions of economic returns from land and labor, village labor capacity to implement a land use plan, and environmental returns to assess the progress or the regression made between 2 successive zoning simulations.

#### Economic returns

All parameters used for the landscape simulation are elicited from the villagers in an interactive process of individual justification and collective validation of the proposed values. For each land use type in the village (eg forest, grasslands, permanent crops), 4 parameters are

requested: agricultural income (kip/ha), income from gathering non-timber forest products (kip/ha), livestock carrying capacity (ie the number of head of livestock that can be raised on 1 ha without depleting fodder resources), and labor requirements in man/y/ha. In some cases, the participants engage in a collective discussion to determine the “average” value of the parameter for their village, which is then set as the common basis for further calculations.

To estimate the economic value of a land use plan, the income derived from all income-generating activities (ie cropping, NTFP gathering, and livestock raising) is computed for each cell according to the land use type assigned during zoning. Several approximations are made. For instance, estimating the return from NTFPs is not a straightforward process because NTFPs’ spatial distribution in the landscape is irregular and the patterns of NTFP collection depend on their distance from the village. Consequently, NTFPs are assumed to be distributed evenly in the landscape with an economic return that depends solely on the land use type. Livestock presence on certain land use types was considered to be detrimental to agricultural productivity and thus to have a negative effect on income from NTFP collection and agricultural activities. Cattle and buffalo, unless kept in fenced plots, usually roam freely in a continuous space around the village. To estimate the potential number of livestock in the landscape, we associated a carrying capacity with the different land uses. Defined by experts, this potential number of animals per hectare for a given land use is associated with the average income for an animal in the calculation of livestock returns on land.

An example of village parameters for the role play is provided in Table 1. These approximations avoided making the calculations too complicated. They had no influence on the negotiation and decision-making process. The same village-specific parameters were used for the real land zoning activity the following day.

#### Labor capacity as a limiting factor

The labor force available at the village level is a major constraint on the realization of a land use plan. In nonmechanized mountain agricultural systems, a single value of return on labor and labor requirement is associated with each land use type because these 2 parameters are directly related to the amount of manual work people can provide. In spite of physical constraints (eg elevation, slope, distance, soil), a fixed value has been assigned to the labor requirement: the number of people needed to farm 1 ha under a given land use. The total village labor force obtained from household surveys is systematically compared with the labor requirement of each land use plan. The latter is computed by multiplying the labor force value associated with each land use type by the area of each land use type for the zoning simulated across the village landscape. The players then can assess by themselves the realism or feasibility of a land use plan.

TABLE 1 Parameters in the role play.

Land use	Agricultural income (kip/ha)	Returns on NTFPs (kip/ha)	Livestock capacity (head/ha)	Labor requirement (man/ha)	Biodiversity index	Carbon index
Conservation forest	0	3,000,000	0.5	0.0	4	4
Grassland	0	100,000	1.5	0.1	1	1
Permanent crop	2,500,000	200,000	0.5	1.0	1	1
Shrub	0	0	0.5	0.0	2	2
Production forest	2,500,000	5,000,000	0.5	0.0	3	3
Protection forest	0	2,500,000	0.5	0.0	4	4
Rotational crop	600,000	1,500,000	1.0	0.25	1	1
Plantation	4,000,000	100,000	0.0	0.10	1	2
Livestock area	0	100,000	1.5	0.25	1	1

### Environmental returns

The environmental quality of the simulated landscape is based on 2 simplified indices, namely biodiversity and carbon (Table 1). These indicators, which range from 1 to 4, score the level of biodiversity/carbon for the land use type considered per hectare. On the 100 1-ha-cell board, the biodiversity and carbon index for the whole landscape may thus vary from 100 to 400. This fuzzy system was preferred to the introduction of complex formulas and numbers derived from biodiversity and carbon assessment performed at the target site. The proposed environmental concepts would have been difficult for the participants to grasp with their primary school level of education. Plant and wildlife diversity was clearly understood because of the proximity of the national park and to awareness campaigns for biodiversity preservation. However, carbon storage and gas emissions remained very abstract concepts.

### Participatory simulation of land zoning

#### Understanding current land use

Participatory landscape simulation begins with the delineation of current land use systems on the board. First, players have to divide agricultural areas between rotational and permanent crops. Then, they classify the forestland into several types (ie production, protection, and conservation) in accordance with Lao Government forest policies (MAF-NLMA 2009). In practice, a transparent paper is overlaid on the board, and the players draw areas with different colors of chalk (Figure 4). Finally, they discuss livestock management and decide which land will be used for cattle grazing and whether the animals will be left roaming free or be enclosed. Livestock management is indicated on the board by placing tokens that represent the number of head of livestock in the different land zones. At the end of the delineation process, the economic and environmental returns on land are calculated. How different types of

information are combined to generate the simulation outputs is illustrated in Figure 5: land zones, environmental and economic returns, and labor requirements.

The facilitation team proceeds to compute all the values with the villagers. Booklets and calculators are provided to the participants to allow them to do their own calculations and compare them with others. Although the agriculture and NTFP return on land is a direct combination of the area and the return per hectare for each land use type, livestock return is calculated by multiplying the average income for an animal, the livestock capacity, and the area of each land use. As shown in Figure 5, the village income is the combination of livestock, agriculture, and NTFP return on land along with the off-farm income, which corresponds to 3.5% of the income generated by the village (value obtained from household surveys). Finally, the profit for each labor unit is obtained by dividing the village income by its total labor force.

The economic results pertain to the current land use. However, not all villagers benefit to the same extent. At this stage, the facilitators underline the inherent inequity among villagers in relation to land use and access to land. The way people use the land is related to their livelihood, and, when the landscape changes because of a modification of the land use plan, different farmer types will be affected differently. As a consequence, a household typology developed by Castella et al (2011) is used as a way to differentiate several land use strategies and to take into account heterogeneity in household types within villages. The contribution of each income-generating activity to the overall income of each type of farming system is represented in Table 2. To summarize, the 4 farm types from A to D represent a sequential shift of livelihood improvement and capital accumulation observed in many upland areas of northern Laos. The first type (A) includes subsistence farmers dependent on upland crops under shifting cultivation and gathering NTFP for their livelihood. The B type farmers are

FIGURE 4 Villagers involved in land zoning simulation. (Photos by Jeremy Bourgoin)



able to accumulate rice surpluses and invest in livestock. Type C has moved ahead with investments in tree plantations of teak or rubber, whereas type D is involved in off-farm activities (eg trading) and thus is less dependent on the forest and on agricultural land.

From what is written on the back of their farmer game card, the players discover at this stage which type they belong to and thus which strategy they will need to adopt in the next iteration of the simulation to fulfill their requirements. The first calculations are done by hand to spark the logic of associating different variables with land surfaces. Then, to avoid arduous calculations, the facilitators switch from paper and hand calculators to computer-assisted calculations by using an Excel spreadsheet. As a result, the players get the return on labor for each household type according to the relative contribution of each land use type to their income.

#### Designing future plans

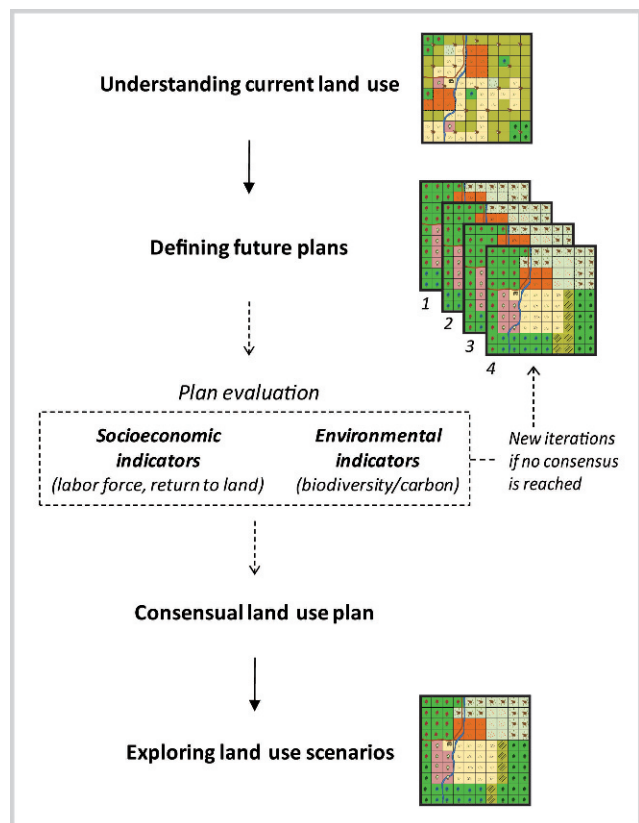
Once the participants have understood the simulation mechanisms for the current land use, they are asked to negotiate a future land use plan that would increase the economic and environmental value of the landscape. After

each round, the players choose among 3 different pins, which represent 3 levels of satisfaction regarding the current plan in comparison with the previous one and their expectations with respect to the role they play. If the new zoning improves their situation, they show a yellow smiley; if it remains the same, they show a green smiley; and if it is worse, they show a red smiley (Figure 2). The planning iterations continue until all players are satisfied (Figure 3).

In Muongmuay village, for example (Figure 1), the zoning simulation went through 4 stages of negotiation (Figure 6). The evolution of the output variables is shown in Table 3. The income values and the landscape changes are plotted in Figure 7A. Throughout the simulation, the players tuned the spatial arrangement of zones in the landscape to improve the income of the respective household type they represent. We noticed that the percentage of agricultural (rotation and permanent) and forest areas (conservation and protection) evolved throughout the successive iterations. In Muongmuay (Figure 7B), as in all other villages, the same trend was observed, that is, a gradual decrease in agricultural areas and an increase in forest areas until reaching the point at which shares of the 2 types of land cover were equal.



**FIGURE 5** Successive stages in the economic calculation. (Design by Jeremy Bourgoin and Jean-Christophe Castella)



**Exploring land use scenarios**

The second phase of the role play is introduced once the VLMC has reached an agreement on a virtual land use plan and learned how to negotiate conservation versus development trade-offs with different village and district stakeholders. A scenario exploration exercise was conceived as a way to sensitize participants to the fact that their land use plan is not a once-and-for-all plan carved in stone but one that should be revisited regularly. This activity stresses the way in which PLUP adapts to external and unexpected circumstances. Two scenarios were suggested to the participants as relevant to the specific context of LUP in the study region.

The first scenario is introduced by a facilitator playing the role of a foreign investor who plans to invest in the village. He requests a land concession of 20 ha (from the total 100 ha of the village) to develop a rubber plantation. The first land rent proposed was 100,000 kip/ha. Village participants were recommended to negotiate the price, the total area, and the spatial distribution of the concession in the landscape (one big block or fragmented plots) with the investor. Indeed, LUP is recognized as a way of preventing land grabbing by foreign companies. This is currently a burning issue in Lao PDR, where neighboring countries are negotiating land leases for tree plantations, mining, and hydropower investments (Dwyer 2007). Some conclusions

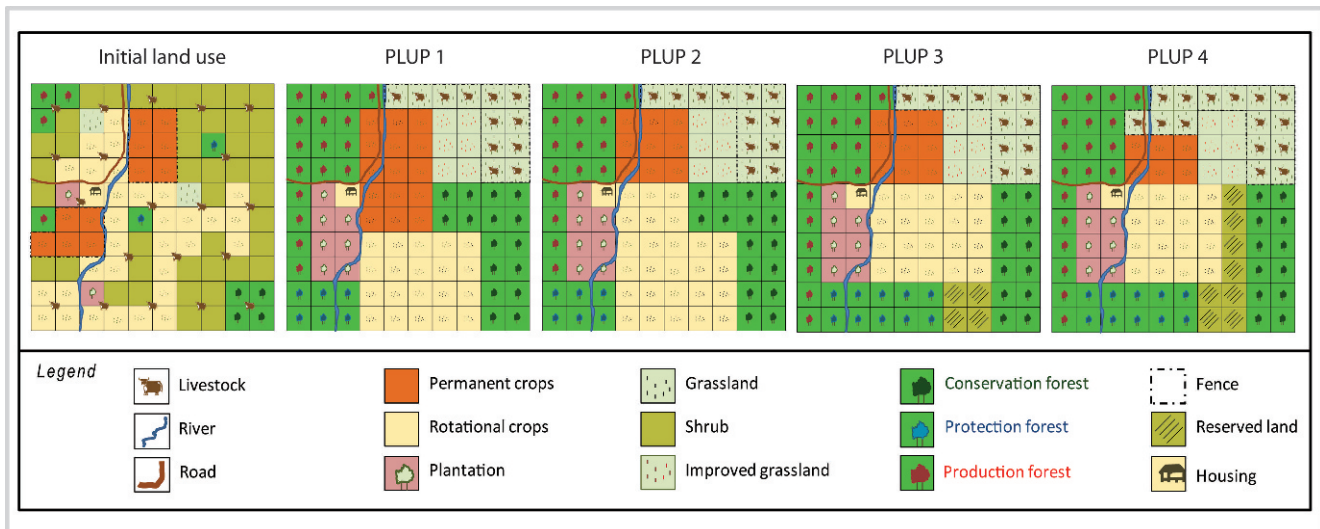
**TABLE 2** Relative importance of land uses for the different types of households.

	Household type			
	A	B	C	D
Permanent crops, %	47	34	7	12
Rotational crops, %	58	27	8	7
Plantations, %	11	11	55	23
Livestock, %	7	48	15	30
NTFPs, %	58	33	9	0
Off-farm, %	21	2	17	60

could be drawn from testing this scenario on 6 VLMCs. The participants always looked dubious when the scenario was presented. Two villages refused to adapt their land use plan and protested against the low income received per hectare for the lease in comparison with the agricultural income they themselves could generate from this land. Explaining that the land belonged to their children, some players were concerned that reducing the village area by giving out a large share of their land to foreign companies would be detrimental to future generations. Furthermore, villagers argued that, by paying land taxes to the government, they should have the right to turn away investors, even those with district support. They realized that, in the absence of formal village land use plans and land registration, their land was still at the mercy of foreign and domestic investors. In other villages, the players accepted the project because it was backed by the district authority and they thought that they could not resist. Nevertheless, they were determined to provide only the minimum number of hectares from their plans and to carefully negotiate the price per hectare by always comparing with the lowest income generated by their agricultural practices (opportunity cost). The participants also emphasized that negotiations for land lease should remain an individual matter between the company and the villagers willing to give away their lands.

The second scenario involved a payment for environmental services, that is, carbon credits through the REDD scheme. This time, village participants were rewarded for their forest area at the rate of 1 million kip/ha per year. In every village, the concept was approved while sometimes being questioned with respect to durability. Although not being reluctant to increase their forest area, the players negotiated which land should be converted. It was clear that community land mainly should be targeted for forest expansion under a REDD scheme. Land tenure issues and payment redistribution mechanisms were discussed and agreed upon by all members of the community. As a result, they mainly converted production forests (or village use forest) where they can access wood, wildlife, and NTFPs, and that are officially classified as village land, whereas protection and

FIGURE 6 Successive land use maps as defined by participants through negotiation. (Design by Jeremy Bourgoin and Jean-Christophe Castella)



conservation forests are considered as state land under the Land Law.

### Key lessons

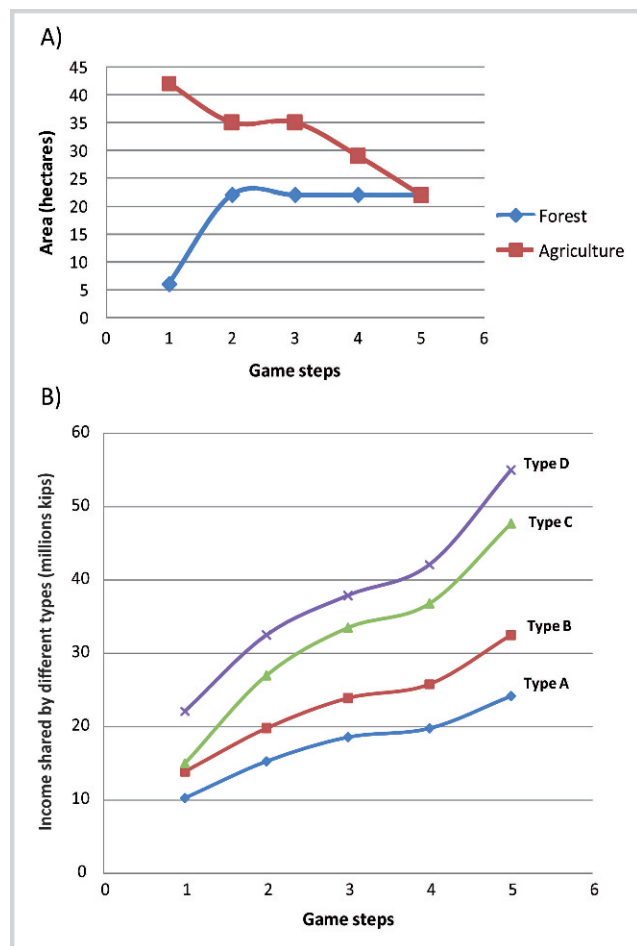
In all 6 villages of Viengkham District where PLUP Fiction was tested in 2010, the participants showed a great deal of interest in the role play. A 2-stage validation of the learning approach was conducted. Debriefing sessions after the role play were organized with the village participants and village and/or district observers to collect their first impressions. Then, a few months later, a survey was conducted with a gender-balanced sample of villagers selected randomly and with the 12 members of the land management committee who had been involved in the PLUP Fiction role play.

The feedback received from the members of the VLMCs who were involved in the experiment was very positive. Villagers usually had been confined to the role of observers, whereas, in this exercise, they were fully involved in all stages of the LUP process and became actors in the design of their village land use plan. Through an inexpensive learning phase that takes only a few days, the key elements of PLUP were introduced to and manipulated by simple villagers, who reported that they had progressively understood the zoning issues at stake and put themselves in the shoes of members of their VLMC, thanks to the role play. They felt empowered by the landscape simulations and scenario explorations they went through. The participants felt confident with the results of the simulations because they had generated the parameters for their own village; they understood the

TABLE 3 Output variables of land zoning simulation in Muongmuay village.

	Initial land use	Land use planning iterations			
		PLUP1	PLUP2	PLUP3	PLUP4
Overall annual income (million kip)	240.0	422.0	407.0	402.0	380.0
Average annual income per labor unit (million kip)	12.6	19.0	23.0	24.8	31.0
Share A type households (million kip)	10.3	15.3	18.6	19.8	24.2
Share B type households (million kip)	13.9	19.8	23.9	25.8	32.5
Share C type households (million kip)	15.0	27.0	33.5	36.8	47.7
Share D type households (million kip)	22.1	32.5	37.9	42.1	55.0
Biodiversity value	169.0	200.0	200.0	200.0	196.0
Carbon value	171.0	207.0	207.0	207.0	203.0
Number of livestock	29.5	36.0	36.0	36.0	40.5
Labor force needed	18.95	22.2	17.7	16.3	12.2

**FIGURE 7** (A) Evolution of agriculture and forest areas throughout the simulation; (B) evolution of income for different household types. (Design by Jeremy Bourgoin and Jean-Christophe Castella)



sequence of actions and did the calculations themselves. They learned that a plan has to be negotiated, and they somehow felt like better negotiators.

While players were working on an artificial landscape, they often referred to existing areas of their real village and used local names to describe places on the board. Having their village situation in mind, the way participants defined land use arrangements was far from trivial. The knowledge gained from the zoning simulation was then of great value when the same people got involved in the actual delineation of zones for their own village the next day. Beyond the empowerment of the participants as members of the newly created VLMC, the

usefulness of the method for the actual zoning, the subsequent day provided a second stage of validation.

From a researcher's point of view, the exercise was successful in that it increased awareness of the impacts of land zoning on local livelihoods and the environment. The method has also proven capable of integrating biophysical and socioeconomic data at the landscape level in a simple yet knowledge-intensive learning tool. In fact, the results of more traditional interdisciplinary research conducted from 2008 to 2010 in the northern uplands region were encapsulated in the role play in such a way that the main findings could be delivered efficiently to the local population through a learning-discovery process. Land use change analysis from satellite imagery, biodiversity studies, household surveys, and geographic information systems was successfully combined to create this unique learning experience relevant to PLUP implementation in mountainous areas. This preparatory work combined with the researchers' experience helped in designing the learning approach that would best fit the local context.

The validity of the approach is then limited to the areas that share the same characteristics as the study site, that is, the uplands of Laos or 75% of the country's territory. The long preparation phase guarantees the validity of the approach in the target landscapes and then allows villager engagement in a learning pathway relevant to their local situation in only one day, with a trained team of several facilitators.

The land zoning simulation also should be evaluated for its capacity to improve genuine participation and to increase participants' ownership of the results (Lestrelin et al 2011a). This sense of ownership of local communities has been described as a key element of success in PLUP (Meadowcroft 1997). Usually, training in LUP is only provided to the implementers. The feedback provided by the district staff members who acted as facilitators or observers also pointed out the importance of villagers' empowerment (ie by providing the knowledge that will help them understand all the aspects at stake in PLUP) to the quality of local participation. Land use planners should not consider PLUP Fiction as an optimization tool aiming at finding the best land use plan nor as a decision support system that helps them ground their decisions in empirical evidence but as a negotiation support tool by which multiple stakeholder groups negotiate their own pathway toward sustainable landscape management.

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