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Toward a land zoning negotiation support platform: 'Tips and tricks' for participatory land use planning in Lao PDR

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Abstract

Managing complex landscape mosaics in areas dominated by poverty often requires addressing conflicting objectives and managing trade-offs, such as that between maintaining/enhancing ecological functions and improving livelihoods. Laos, like many other developing countries dependent on agriculture and natural resources for the subsistence of a mostly rural population, has used land use planning (LUP) as a core policy instrument to achieve sustainable development. However, previous reviews of LUP implementation showed large discrepancies between policies and practices and between the intended goals and actual outcomes. There is a need for increased participation, improved integration of scales, harmonization of superimposed plans, and enhanced coordination between implementing agencies and other stakeholders. Consequently, former normative approaches to LUP have been gradually replaced (at least on paper) by a new paradigm. Participatory land use planning (PLUP) has recently become a central element of donor-supported programs in developing countries. However, despite the good intentions of PLUP principles, implementation remains entangled with confused practical issues that compromise effective participation. As an alternative to complex, technologically sophisticated LUP models that local stakeholders cannot use or replicate, a communication platform supporting negotiations among multiple stakeholder groups was tested in a village cluster in Luang Prabang Province in northern Laos. This innovative approach, based on a combination of role-playing games, participatory 3D modeling, GIS, and socioeconomic and environmental impact assessment, allows stakeholders to collectively explore the consequences of land use decisions and choose between alternative future landscapes.

1. Introduction

During the past two decades, land use planning (LUP), described as an activity that envisages future land arrangements (FAO, 1993), has been recognized as a key instrument for achieving sustainable development and improving the livelihoods of forest-dwelling communities by ensuring sustainable land uses, prerequisite to poverty alleviation. LUP policies have evolved from an expert approach to land

suitability in the 1960s and 1970s to a more integrated approach involving planning experts, decision-makers, and ordinary citizens. Incorporated into sustainable development discourses, the blending of ecological, economic, and social aspects through hybrid lay–scientific initiatives is still relevant to ensuring locally appropriate and durable measures (Beierle, 2002; Grainger, 2010; Reed, 2008). Involving ordinary citizens in local management decisions and policy implementation was the core message of Agenda 21 signed at the Rio Earth Summit in 1992 and thus the mandate of participatory land use planning (PLUP) in achieving balance between development needs and the preservation of the rural environment (Maginnis et al., 2004; McShane and Wells, 2004; Sayer, 2009; Sayer and Campbell, 2004). The popularity of participation in natural resources management has not declined since then (Neef and Neubert, 2011). From an ethical angle, the aim of incorporating a participatory component in LUP is to avoid allowing a potential "top-down" imposition of pro-development interests to dominate planning decisions (Rydin, 1995). Thus, collaborative management, defined as a "joint decision-making by the state and communities about a set of resources" (Berkes, 2009, p. 1693), has been motivated by a desire to involve in policy making those citizens whom management decisions are likely to affect (Berkes, 2009; Wagle, 2000). From an instrumental perspective, enhanced participation in planning is expected to engender wider public support and facilitate the implementation of plans (Macnaghten and Jacobs, 1997). A large range of PLUP approaches, designed to encourage sustainable resource management by local communities, have been developed and tested in many countries.

Scientific articles and gray literature that discuss the theoretical appeal of the notion usually conclude by noting the difficulties of applying it in practice and hence of achieving its ambitious goals. For example, a challenge with community-based landscape planning in developing countries is that many of the people involved have low levels of literacy (Reid et al., 2006). It is also argued that the participation process can help reinforce the influence and interests of local elite over a silent and unheeded majority (Berkes, 2009; Wagle, 2000). Becu et al. (2008) wonder how to engage local stakeholders beyond passive participation where involvement usually does not go further than silent meetings and data collection. The difficulty in combining different perspectives into a collaborative management initiative is now assumed inherent in community-based planning (Wilson, 2006). Boundary-spanning activities have been promoted as an effective means of addressing transdisciplinary initiatives involving both experts and decision-makers through the development of tools that provide an interface between science and policy, and between knowledge and action (Liu et al., 2007). Such "boundary objects" are characterized by their propensity to translate scientific concepts into lay language (Grainger, 2010; Olsson et al., 2007). The success of efforts to engage local stakeholders in negotiations depends on the boundary objects' efficiency in facilitating communication and providing a "language" common to all stakeholders involved. Cash et al. (2003, p. 8089 have developed a framework "for understanding the effectiveness of systems that link knowledge to action for sustainability". The efficiency of the information generated through participatory activities depends on its capacity to be locally relevant (salience), to reflect local interests (legitimacy), and to demonstrate scientific adequacy (credibility). Nassauer and Opdam (2008, p. 635) introduced the concept of "design" in the paradigm of landscape science, which intends to provide a "common ground for technology transfer: where practitioners and scientists conceptualize landscape innovations". Addressing management issues in two developed countries, the authors demonstrate the importance of strengthening interactions between science and society through "knowledge innovation".

Despite the development of rationales to link landscape science and citizen involvement, reported cases of PLUP are characterized by deficient methodological standards that hinder the practical implementation of sustainability principles (Fox et al., 2008; Kaswamila and Songorwa, 2009; MAF–NLMA, 2009). Internationally, on-the-ground activities are usually conducted under the implementers' own interpretation, creating a diversity of implementation pathways under the same overarching concept. Hessel et al. (2009), for example, show in a case study from Burkina Faso that the link between spatially explicit mapping and socioeconomic data was bypassed and that, although their outputs could trigger

useful discussions, the level of accuracy attained could not guarantee further use by local communities. Fox et al. (2008) describe PLUP experiences in Cambodia where planning was limited to a participatory mapping exercise with local communities. The exercise addressed land and tenure issues at a village scale, but intervillage conflicts could not be visualized. Much other PLUP-related research developed nonspatial and theoretical scenarios that were not actually intended for implementation (Hoang Fagerstrom et al., 2003; Marchamalo and Romero, 2007).

In Laos, weaknesses in providing landscape innovations through co-management are exemplified by successive LUP policies (Lestrelin et al., 2011b). Since the early 1990s, a Land Use Planning and Land Allocation (LUP/LA) program has been implemented throughout the country. By increasing land tenure security, LUP/LA was expected to encourage agricultural intensification, favor private investments and the development of commercial on-farm productions, and, importantly, stabilize shifting cultivation and preserve the country's forest, soil, biodiversity, and water resources (Fujita and Phanvilay, 2008; Lestrelin, 2010; Vandergeest, 2003). Through these processes, the central government formally recognized customary rights to use natural resources and provided local institutions with important responsibilities, such as land distribution, registration and tax collection, monitoring, and conflict resolution. Hence, in line with the sustainable development paradigm, greater consideration for local claims, knowledge, and institutions was expected to bring about more balanced and environmentally sound development trajectories (UNCED, 1992; WCED, 1987). However, various studies indicate that the implementation of LUP/LA in Laos did not always achieve the success predicted by the Lao authorities (Ducourtieux et al., 2005; Fujita and Phanvilay, 2008; Lestrelin and Giordano, 2007). One of the reasons for the poor outcomes is the gradual complexification of Laos' LUP system, which resulted from two concurrent processes: a multiplication of the actors involved in LUP—each with its own mandates, priorities, and approaches to planning—and a sustained, yet not necessarily coordinated, effort to improve on previous policy (Lestrelin et al., 2011b).

A more positive trait has been that the flourishing of new LUP instruments partly reflects a sustained effort by the government of Laos and its international development partners to improve planning approaches and, importantly, adapt them in response to reported deficiencies, emerging issues, and changing concerns. This is illustrated by the evolution of village-level LUP, where each new instrument is presented as an improvement on previous ones (Lestrelin et al., 2011a). Since the mid-1990s, the LUP/LA mandate has gradually expanded by including individual land allocation procedures and monitoring (LSFP, 1997, 2001). More recently, PLUP has emerged to replace LUP/LA in order to provide a more participatory and integrated planning process at the village cluster level (MAF–NLMA, 2009). However, the premise of PLUP in Laos, as scrutinized by Lestrelin et al. (2011a), appears to repeat the mistakes of the past with inappropriate on-the-ground practices undermining thoughtful (inter)national guidelines. The authors concluded that solely highlighting the need for more participation could neither increase local participation nor affect local land uses in pilot initiatives of PLUP. In practice, limited facilitation skills and implementation capacities of land use planners, together with the absence of constructive feedback loops, imposed considerable limits on local communities' participation and inclusion of local perspectives.

Based on a review of past LUP experiences in Lao PDR (Lestrelin et al., 2011a), this paper proposes a boundary-spanning framework for implementing PLUP in accordance with the main principles defined by the national agencies in charge of the implementation, that is, the Ministry of Agriculture and Forestry (MAF) and the National Land Management Authority (NLMA). The method is then illustrated by a case study from Viengkham District in Luang Prabang Province. Finally, lessons are drawn from this experience and the conditions for generalizing this innovative approach to the national level are discussed.

2. Revisiting the principles of PLUP: Participation and integration

The two Lao government agencies in charge of land management (MAF and NLMA) prepared a manual on "Participatory Agriculture and Forest Land Use Planning at Village and Village Cluster Level" to coordinate their efforts into a standardized approach to PLUP that their respective line agencies at the province and district levels could apply consistently. Building on the knowledge generated through disappointing past attempts (i.e., LUP/LA), the guidelines intend to provide appropriate adjustments in a context of strong governmental ambition to participate in globalized trade and investment through the engagement of rural areas in a market-based economy. The improved PLUP approach has been built on participation and integration principles to ensure consistent field application, as elaborated upon below.

2.1. Participation

The manual highlights the need to improve the participatory nature of LUP and advocates that the elaboration of land use plans should be directly derived from villagers' views. Land management activities should also be adaptive and allow for different ethnic groups to voice their needs with an equal representation of women and men at each stage of decision-making. Prior to the zoning process, village rights to exploit natural resources and modify their landscape through LUP have to be clarified for the entire village community. In fact, the main promise when involving local communities in LUP is to prevent deviant uses by local elite and influential individuals or corporations, which might seek to exert control over natural resources; for example, cases of land grabbing have been reported in conjunction with LUP implemented with the support of foreign investors (Baird, 2009). Besides, the aim is for the process to be driven by the people who will be the most affected by the outcome and who can provide knowledge that will fit into the local frame (Ericson, 2006). Participation is also essential because it provides local-scale information and intends to "encourage the construction of a common vision for sustainable regional development" (Valencia-Sandoval et al., 2010, p. 65. Furthermore, by improving villagers' capacity to influence local processes, local participants gain the ability to negotiate with government representatives, an aspect that redesigns the power balance. Within the communities, it also gives visibility to the whole range of stakeholders and contributes to balance gender, social and economic status, and ethnicity.

2.2. Integration

Coping with scales, knowledge, and multiple stakeholders' perspectives is in the mandate of land use planners; however, although integration is recognized as an important principle, in practice, it often remains at the recommendation stage (Gunarso et al., 2007; Lal et al., 2001). PLUP has therefore reaffirmed the ambition to efficiently translate integrative concepts into local land management plans. The subdistrict perspective of PLUP is assumed to mitigate intervillage conflicts and support collaborative management between villages of the same village cluster (*kumban*). Border conflicts between villages are often the result of past relocation policies clustering villages along the road or merging small villages into larger ones. In addition, tacit agreements over land use exist between neighboring villages, which justifies integrating LUP at multiple scales from village to village cluster and district.

The participatory nature of the process entails the integration of different types of knowledge. Indigenous knowledge, widely praised for its local relevance and the salience it provides to the whole initiative, should lean on scientific expertise in terms of global processes affecting land uses. The use of advanced geographic technology through Global Positioning Systems (GPS) and satellite imagery is also promoted to avoid mapping irregularities (MAF–NLMA, 2009). Knowledge integration has the potential to better inform negotiation and facilitate multi-actor landscape planning (Opdam et al., 2006). However,

combining hard scientific data with local expertise can be challenging, as local stakeholders might not understand the consequences of their decisions and could be manipulated by those who better understand the issues at stake, that is, land use planners and local leaders (Kitchin and Dodge, 2007; Nassauer and Opdam, 2008). Rather than using "outsourced" data likely to be locally distrusted and/or rejected, the knowledge used to make informed decisions should be generated through social interaction involving layman stakeholders. Facilitators of such collective processes have then to frame the knowledge into meaningful "boundary objects", which become the main supports for multi-stakeholder negotiations in search of land management compromises (Jasanoff, 2007; Treu et al., 2000; Von Haaren, 2002). These simple—but not simplistic—media have to be carefully designed so that they can manage the trade-offs between scientific/academic relevance (credibility) and the understanding/interest of local communities (legitimacy and salience) (Cash et al., 2003; Pullin et al., 2004).

3. Case study site

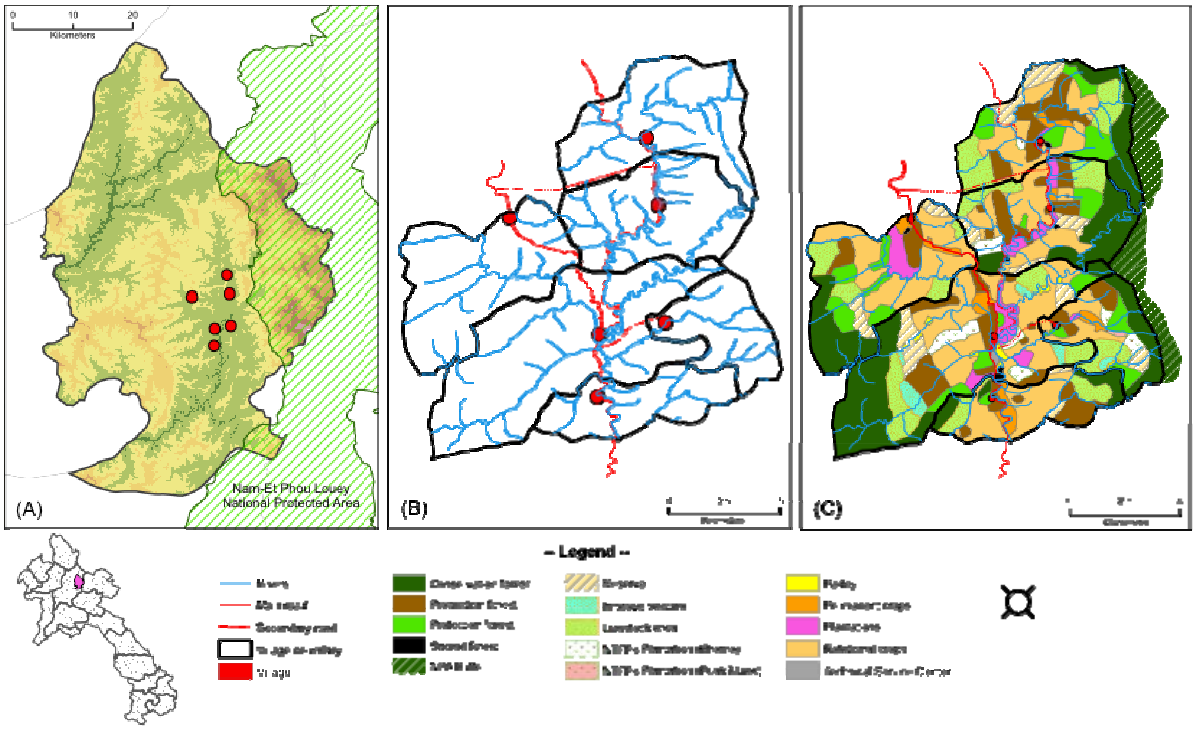
In the uplands of Laos, as in many other developing countries, agriculture and natural resources represent livelihood mainstays for the rural population. Subsistence farming by shifting cultivation is predominant because of low accessibility to roads and markets, although the government has denounced slash and burn practices as "primitive, unproductive and harmful to the environment" (Haberecht, 2009, p. 29). In Viengkham District, as in many other remote upland areas, PLUP is considered a key policy instrument of the government to accelerate the ongoing transition from subsistence to commercial agriculture. Ranked among Laos' poorest districts, Viengkham District borders the nation's second largest protected area (Nam-Et Phou Louey National Protected Area), which prides itself on harboring one of the few remaining breeding populations of tigers in the country. LUP is considered a key policy instrument for helping to reconcile conservation and development objectives and prevent loss of ecosystem services (i.e., biodiversity, soil fertility, carbon) in the complex landscape mosaics found in Lao PDR (MAF–NLMA, 2009). Muongmuay *kumban* encompasses six villages: Donkeo, Paklao, Bouami, Muangmuay, Huaykon, and Vangkham (Fig. 1A). This village cluster was selected based on its typical characteristics of upland agriculture and relative remoteness from the main markets, hindering the diversification of agricultural activities. Most villagers subsist on local produce, traditional slash and burn agriculture prevails, and most of the cash income is generated from the sale of non-timber forest products (NTFPs) and livestock.

Landscape change analysis based on remote sensing data showed a gradual segregation between agricultural and forest lands, the former being concentrated along the road and the latter being in less accessible or protected areas (Castella et al., 2011). Historically, the landscape used to display a more complex mosaic, typical of swidden systems, but successive land policies have resulted in a gradual segregation of land uses. Since the 1990s, pressure on the agricultural land has been created by relocating villages closer to roads in an attempt to increase villagers' access to market, education, water, and electricity infrastructure, among others. Land scarcity was also exacerbated by decreases in the fallow period with the three-plots policy; this policy, during individual land allocation, restricted each household to three plots for rotational crops, de facto limiting the fallow period to a maximum of three years. During the same period, the boundaries of the national park were expanded, and so villages in the vicinity were relocated.

Recent changes in land use are gradually leading to a segregated landscape structure with, on the one hand, regeneration of forest resources in strictly protected areas and, on the other hand, degraded landscapes dominated by intensive agricultural activities in the most accessible areas. Conservation and development areas have been spatially dissociated. While forest regeneration has obvious positive implications for biodiversity in protected areas, the reduction in complex landscape mosaics that used to retain a large share of the original forest biodiversity is detrimental to the poor upland communities that relied on NTFPs as a safety net in periods of shortage. Opportunities to diversify agricultural activities

exist; however, in the absence of a coherent land management plan, pilot projects tend to propose improved fallow systems supposed to promote ecological intensification of agriculture and avoid encroachment over forest land, an aspect that reduces the chances of adoption by individuals. Collective decision-making—key to adoption (Hendriks et al., 2007)—is often bypassed and the lack of negotiation rarely allows for a village consensus.

Fig. 1. Location of Viengkham District (A) and the target villages where land use planning was conducted from boundary delineation (B) to land use zoning (C).



4. Action-research in PLUP implementation

In 2010, an innovative approach to PLUP was designed to apply the principles of enhanced participation and integration described in Section 2 and tested in real conditions in the six villages of Muongmuay village cluster, in Viengkham District (Fig. 1A). The action-research involved scientists from international (e.g., University of Queensland, Center for International Forestry Research , Institut de Recherche pour le Développement) and national (e.g., National Agriculture and Forestry Research Institute) research institutions, practitioners (e.g., development projects and extension agents from the District Agriculture and Forestry Office; DAFO), local authorities (e.g., land management officers and district governor's office), and village communities. A dozen people took part in the implementation of PLUP over successive field missions. The end goal was to train a team of national experts capable of applying the method by themselves. The overall approach presented below was developed through an adaptive process that was constantly refined during implementation in villages.

4.1. Village boundary delineation

Generally, a combination of topographic maps and high-resolution satellite imagery was used to define boundaries in one village at a time. Given the objective of addressing boundary issues for a cluster of villages, the challenge was to define a way to bring together knowledgeable representatives from all the villages concerned and delineate initial boundaries in one day. For that purpose, a participatory 3D model (P3DM) was constructed for the whole village cluster (Fig. 2C). Each block was built in one day by a team of four people using paperboard cut around the contour lines and superimposed (Rambaldi, 2010). With Geographic Information System (GIS) software and only the village-points layer available, a frame encompassing all the target villages was created and clipped with a digital elevation model (DEM) of the area. Participatory maps of the villages were used to appreciate the potential extent of villages that did not possess definite administrative boundaries.

Representatives of the six villages of the *kumban* met around the blank relief model along with delegates of the National Protected Area and people from villages neighboring the target *kumban*. People started to familiarize the 3D model by adding names of places, rivers, and mountains in their own language (Lao or Khmu). Then they started discussing with their neighbors the location of the boundary between their respective villages. The delineation was marked using color pins and threads and facilitated by staff from the team who speak both languages. The delineation of the six villages' boundaries finished after three hours of intense discussions and negotiations. The polygons representing the village limits were georeferenced and digitized in ArcGIS, and then projected onto a wall to make hardcopy versions for each village.

The boundary delineation meeting involved only a couple of village representatives for each village. Consequently, to validate the boundaries, the maps were presented in each village to a broader assembly. The two representatives explained the collective process they had gone through and the boundary delineation was collectively refined and approved after discussions. The villagers and the implementing team also discussed the location of required GPS readings to finalize sections of the village boundary that did not match any physical features (e.g., rivers, mountain ridges).

Finally, during a meeting with the village cluster representatives, the boundaries of all villages were reviewed and finalized using maps. Fig. 1B displays the result of the delineation process validated by the local authority. After ensuring that no potential territorial conflicts were left pending, inter-village boundary agreements forms were issued to all villages and approved by the district administration.

Fig. 2. Boundary objects support interactions between people and landscapes. (A) Virtual landscape used to simulate land use planning. (B) 3D modeling facilitates villagers' comprehension and participation. (C) The resulting land use zoning in Muongmuay *kumban* (see also Fig. 1C).

4.2. Data collection and processing

Socioeconomic surveys were undertaken at different scales in each village. At the village level, a census provided general information about the village households on social aspects (e.g., ethnicity, position in the village, social status), financial assets, and sources of income (e.g., capital, number of parcels, livestock, and plantations). The village census was complemented by an assessment of past population trends that helped identify potential village land requirements in future years. Focus groups for men and women were organized separately to identify agricultural and forest land-related problems and opportunities that could be addressed by land management plans and village extension programs. Finally, basic information on village wildlife, as well as the location, relative abundance, and collection patterns of wood and NTFPs, was used to assist the land zoning activity.

At the household level, interviews were conducted with 30 randomly selected families in the village to characterize the household economies and create categories according to a regional typology (Castella et al., 2011). In the questionnaire, cropping and livestock systems were investigated, as was collection of NTFPs. Although of marginal importance to most households in the study area, plantations of valuable industrial trees, such as teak, rubber, and agar wood, and income from off-farm activities were also assessed, as they usually indicate a high level of socioeconomic differentiation within the village. More systematic landscape-level information was also gathered on the number, area, and location of both cropped and fallowed agricultural plots in the village. The household and land use data generated from different sources were subsequently cross-checked with villagers. This adaptive stepwise survey was used to gradually refine the PLUP knowledge base available at the village level.

Further, an *analysis framework* was required to fully appreciate the value of all the information collected. In general, most LUP teams collect a large range of data because it is a compulsory requirement in national guidelines, but then use only a limited subset of the available information. This does not suggest that implementers do not have at their disposal relevant methods to conduct LUP, but that they often rely on their own field experience and empirically built mental models to facilitate the participatory planning activities. This person-specific approach, highly dependent on individual skills and personal facilitation qualities, tends to impede the ability to replicate and to ensure consistency of planning methods across sites. As a result, the LUP processes become highly dependent on the experience of individual implementers and projects. The extent to which socioeconomic data collected during the PLUP are actually used for land zoning and LUP becomes highly variable at the subnational and national levels.

In the proposed analysis framework, the first step consisted of categorizing the households into several classes. Data on income generation were compiled, with each household being classified into different types of livelihood strategies depending on the share of their total income generated from cropping activities, livestock raising, tree plantation, NTFP collection, or off-farm activities. Dependency matrices linked household types and income-generating activities. The expert-based household typology was completed according to classification criteria generated from intensive livelihoods surveys in the northern uplands of Lao PDR (Table 1).

Table 1. Characteristics of household types

Type	**Main income source**	**Criteria (*main* / secondary)**
A	Shifting cultivation	- *No major income from plantations* - *Receive less than 10–15 million kips/year from livestock (cattle + buffalos)* - Involved in off-farm work activities: waged worker, handicrafts
B	Livestock	- *No major income from plantations* - *Receive more than 10–15 million kips/year from livestock (cattle + buffalos)* - Involved in off-farm work activities: waged worker, handicrafts
C	Plantations	- *Involved in plantations: teak, rubber, agar wood, etc.* - Involved in livestock raising
D	Off-farm	- *Involved in off-farm activities: trader, shopkeeper* - Involved in livestock raising - Involved in plantations

4.3. Land use zoning

4.3.1. Setting up village land management committees

In general, the important decisions made in the village are devolved to the village authority, which is composed of the village head and two (or three) deputies, heads of the elder committee, youth and women's unions, and secretary of the communist party. However, as indicated in the PLUP manual, a better balance of power within the group involved in LUP should be promoted to improve broader village community participation. To address this concern, a village land management committee (VLMC) was set up with members selected according to individual criteria: high motivation, ability to communicate, and knowledge of village land uses. Furthermore, the selection procedure aimed at achieving among VLMC members a balance of gender, ethnicity, and socioeconomic status. Achieving gender balance often involved tough negotiations with local authorities as they were almost always reluctant to provide enough women's names, arguing that women do not usually make decisions at village level, are too busy with domestic tasks and field activities, and are not knowledgeable enough on land issues. Despite long discussions, in most cases, the initial gender balance requirement ended up as a man:woman ratio of 2:1. A committee membership of 10 to 15 participants was found ideal to ensure real interactions could take place within the group and that all individuals could voice their concerns (Neef and Neubert, 2011).

4.3.2. Participatory landscape simulation

A role-playing game developed by Bourgoin and Castella (2011) and called "PLUP Fiction" was used to train VLMC members in negotiating land zoning on a stylized landscape. Within a relatively short time (one and a half days), a group of villagers learned about the implications of land zoning for their

livelihoods. This group-building exercise was the cornerstone of an empowerment process, as it put VLMC members in the role of land use planners. During the zoning simulation, people drew areas of different land uses on a board made of 100 one-hectare cells. After delineating all the zones, players counted the number of cells of each land use type to get the corresponding number of hectares. The values on economic and environmental returns to the land use types were then multiplied by the number of cells associated with each land use to compute the economic and environmental values of the whole simulated landscape. Environmental value pertains to biodiversity and carbon indexes associated with the different land use types. Incomes derived from livestock raising and NTFP collection in the simulated landscape were included in the calculations along with agricultural income. The "landscape values" resulting from successive land zoning simulations helped participants to explore different options without consequences in reality. They could negotiate land uses and adjust and readapt the plans until consensus was reached among the different stakeholder groups they represent (i.e., villagers, district authorities, conservationists). This exercise constituted a sort of rehearsal for the actual land zoning negotiations taking place the next day.

4.3.2. Village zoning

The land zoning process involved the VLMC delineating zones on a 3D model of their village instead of the simulation board of the "PLUP Fiction" role-play. First, the participants familiarized the blank terrain landscape by writing the names of places they recognized (e.g., mountain summits, rivers) in their own language. Then, data collected during the focus group discussions (e.g., location of NTFPs, wood, and wildlife) were displayed on the 3D model with stickers. When all features of the landscape had been encompassed, the participants used pins and threads to delineate land zones within their village boundary (Rambaldi, 2010). This interactive method triggered lively discussions about the location and type of land use (Fig. 2). When the whole landscape had been dealt with, and the zones named and described in relation to physical features of the terrain, the zoning stopped. Pictures were taken from above to encompass the whole village landscape. Then, the landscape pictures were georeferenced with the help of recognizable terrain features such as mountains, roads, and rivers, to capture the land use plan into GIS software (ArcGIS). When the image fit an appropriate scale, the different land use types were subsequently digitized as polygons. A script was run to calculate the exact area of each polygon.

4.4. Iterative planning

4.4.1. Time

The parameters used to provide environmental and economic feedback from the land use plan were the same as those elicited by the VLMC members during the "PLUP Fiction" zoning simulation. They were complemented by socioeconomic data from detailed household surveys to estimate the proportion of each household type in the target village and their relative dependence on each land use type. Based on the GIS-computed area for each land use type, a cost–benefit assessment of the land use plan was generated from an Excel spreadsheet and presented to the VLMC. First, an overall environmental value for the landscape was provided as a combination of biodiversity and carbon indexes. Then, the total village income was computed based on returns to land from livestock, agriculture, and NTFPs.

The economic outputs of a given landscape arrangement could thus be compared with the livelihood needs of the different household types and discussed by the VLMC. Depending on the feedback received, committee members negotiated which kind of land use should be added, removed, or modified. They thus entered into a new round of planning, that is, delineation/capture/analysis. Time wise, the process was not costly. Photographs were taken after each round of LUP and analyzed in the GIS. Then, given the

dynamic structure capabilities, the model instantly generated outputs after computing land use areas. On average, this activity took one day. As with the zoning simulation, the process stopped when a satisfactory compromise was reached.

4.4.2. Scale

The government of Laos has stated that LUP activities should take place at the scale of the newly created subdistrict units (i.e., village clusters or *kumban*). Once the village boundaries had been agreed upon at the village cluster level, LUP was conducted in each of the six villages in the Muongmuay village cluster. Fig. 1C represents the final land use map of the cluster as an aggregation of single village land use plans. At the end of the process, a planning meeting was organized at the *kumban* level, gathering two key members of each VLMC, one man and one woman, who were selected by their peers to represent their village. The overall objective of the meeting, chaired by the head of the *kumban*, was to visualize the results of the LUP conducted for each village and propose to negotiate any changes that planners wished to make on the 3D model at the higher level of integration (i.e., village cluster). For example, discussions took place on livestock areas that cut across village boundaries and that therefore lead to livestock circulating in neighboring villages. Some villages decided to build fences around their livestock areas while others reached agreements on intervillage livestock management (e.g., communal livestock zones). Corridors were also created for wildlife circulation by creating continuous tracts of conservation forest between contiguous villages. After the meeting, the various village and intervillage agreements were checked collectively and a village cluster agreement was prepared for signing by the district governor.

5. Discussion: How does the proposed approach fit with PLUP principles?

The approach presented in this paper combines a number of individual tools and methods that address the challenges of PLUP implementation in Lao PDR (Fujita and Phanvilay, 2008; MAF–NLMA, 2009; Lestrelin et al. 2011a, 2011b). Both the whole framework and its individual components were designed through a participatory learning and action process, and gradually refined to overcome practical problems encountered during implementation. This learning process enabled the identification of lessons for out-scaling (i.e., replication in other places) and up-scaling, reported below in relation to the two principles of PLUP introduced in Section 2.

5.1. Participation: From meeting attendance to consultation and negotiation

As pointed out by Lestrelin et al. (2011a), too often, land use planners consider participation as a question of who is present in the room during the LUP process. Who should participate and how should be key issues in the process of multi-scale co-management (Wagle, 2000). Similarly, the extent to which people understand what is going on and the influence they could have on the process by voicing their ideas remain largely overlooked. In many cases, improving participation has been interpreted as balancing genders and ethnic groups in the assembly or addressed by increasing the number of community members attending meetings. Consequently, the qualitative dimension of participation (i.e., people's engagement, commitment, and empowerment) has been neglected by land use planners, who have focused more on the quantitative dimension of participation. A commonly reported reason for suboptimal implementation is that time constraints prevent local communities from fully understanding the complex issues involved in LUP and consequently from actively engaging in multi-stakeholder negotiations with district land use planners. As we learned from the innovative PLUP experience reported in this paper, other important obstacles to genuine consultation of local communities are: (i) the absence of visualization and learning tools that would increase local communities' understanding of the land issues at stake and promote effective participation; (ii) land use planners' limited facilitation skills for engaging local people in an

open negotiation process; and (iii) the absence of a simple method to measure and monitor the quality of participation, as this lack means that land use planners are not motivated to perform better in terms of participation quality (i.e., engagement of local people), and therefore continue to monitor performance based on a simple indicator such as the number of people attending meetings.

In the approach reported in this paper, landscape visualization and learning tools were developed to support LUP activities and help local people elaborate their own views based on a simple representation of the landscape. First, a terrain model of the target village cluster was built based on a DEM. The 3D representation of the landscape facilitated the interventions of the villagers who were not able to locate themselves on a simple 2D topographic map. The main advantage of P3DM is that it allows participants to project their own mental model of village land use on a scaled physical landscape (Rambaldi and Callosa-Tarr, 2002). After the preliminary discovery phase, during which participants build a common representation of their environment by naming the important benchmarks of their village landscape (i.e., streams and rivers, valleys, and mountains are labeled and named in the local language), they can exchange views and negotiate meaningfully based on this boundary object they have co-constructed with the land use planners (Brunckhorst et al., 2006; Maginnis et al., 2004; Sayer and Campbell, 2004).

Second, a partial representation of the landscape reality was proposed during the "PLUP Fiction" role-play to focus the participants' attention on learning the rules of the game (i.e., socioeconomic implications of decisions made in relation to the location and area of different land use types), rather than allowing them to be distracted by land issues in their real landscape, which would have been made visible by more realistic boundary objects such as high-resolution satellite imagery. The landscape simulation board used to train participants in land zoning is therefore an abstract representation of the land cover/use of a hypothetical village. It triggered lively discussions about the general implications of spatial arrangements made during land zoning independently of the real situation of the village. This social learning experience also involved villagers in assessing different scenarios through which they could understand the virtual implications of alternative futures (Blackstock et al., 2007). Learning-by-doing with boundary objects turned out to empower local participants, who could employ the lessons learned during the simulation and demonstrate local appropriation and adoption of the process to engage more actively in the planning process for their real village (Becu et al., 2008; Berkes, 2009).

Engaging a group of villagers, often illiterate or with only elementary school education, in balanced negotiations with land use planners is a real challenge. The "PLUP Fiction" tool provided a unique experience for villagers to learn the tips and tricks of LUP and enhanced local capacity for problem solving through scenario planning (Berkes, 2009; Bourgoin and Castella, 2011). It helped elucidate the seemingly complex planning approach by explaining how the environmental and socioeconomic value of different landscape patterns can be assessed based on local knowledge of land use systems. This boundary activity motivates knowledge co-production by providing clear linkages between village socioeconomic information and the spatial arrangement of the land. As noted by Castella et al. (2005), individual farmers often have a limited understanding of the village land use as a whole, and so a simulation involving playing different roles can increase awareness of how various local strategies in land management are related to households' dependence on the land for subsistence and income generation. Field observations showed that in the absence of training of new land management committee members, past land use plans mainly resulted from the inputs of government implementers and/or a couple of knowledgeable representatives of village authorities (Lestrelin et al., 2011a). Through the training in land use negotiations, villagers from a range of social positions were transformed from marginalized observers to the main actors in the process.

5.2. Integrating landscape planning and management

Managing the trade-off between local relevance and scientific credibility is a key challenge in landscape design (Cash et al., 2003; Nassauer and Opdam, 2008; Opdam, 2010; Pullin et al., 2004). For instance, a more complex method was tried in a pilot study using GIS scripts and scenario modeling to compute all the values and deliver the outputs (Pullar and Lamb, 2008). Although this approach has more credibility for an academic audience, it would have required advanced GIS training for local government staff. The complexity of the scripts and algorithms would have prevented them from adapting the method to their own circumstances and/or reusing it in other villages. Other evidence-based approaches relying exclusively on high-definition satellite imagery are constrained by the time and skills required for planners to ensure that local actors can actually understand and use these high-tech devices. In a context of co-management, the negotiation support tools developed in this study were designed to bridge socioeconomic data and spatial information in simple media that (i) retained the most important information for decision-making and (ii) packaged the relevant knowledge in a format that made it understandable by all stakeholders involved. To ensure a legitimate process, time and resources were dedicated to provide proper training to empower members of the VLMC. Otherwise, there is a risk that participants become passive spectators, leaving the district planners to pilot the planning process. These experiences are reported here to stress the importance of adapting materials and methods to local contexts and to the capacity of the people who will be further implementing the land use plan.

One key aspect when starting PLUP activities in a new village is the need to build trust between the stakeholders that will interact during the few days of the planning process, that is, the district planners (with the support of the action research team in our case) and the village community. At the debriefing session at the end of the collective process, villagers usually admitted that they were reluctant to provide real, precise information to the team collecting socioeconomic data as they suspected that the information would be used for tax collection or to impose the three-plots policy. As a result, when asking villagers about their number of plots, land use planners received the politically correct answer: three plots; these responses were then later contradicted once the team gained better insight into the village land use system. The learning process increased the participants' confidence, as they realized that using correct information about land use and livelihood systems would improve the quality of the final product—the land use plan—and therefore would facilitate its implementation.

After the initial "participatory simulation–discovery phase", which helped stimulate the dialogue, a trust-building process gradually permeated the boundary between experts and community members (Cash et al., 2003). The first round of planning on the village terrain model always ended with a tense moment of doubt and then of revelation about the importance of local people's contribution to the quality of the PLUP output. The experience repeated in the six target villages showed that villagers systematically overrepresented their current land use on the 3D model while they underestimated their field numbers and areas when surveyed individually. The result was far from realistic in terms of the labor force required to implement such a plan. Facilitators drew on this discrepancy between the individually declared areas and the mapped areas for the same land use type to illustrate to villagers the importance of reliable data. The limited labor force available in the village would have made it impossible, under the current cropping practices, to exploit the large area delineated as agricultural land. Members of the VLMC then acknowledged that the number of plots declared by each household had been underestimated to avoid taxes, that the plots were larger than the one-hectare plots usually declared, and that the fallow period was longer than the "official" three years. They then agreed to revise the initial household data to get figures closer to the reality, which allowed the group to engage in a more realistic second round of zoning. As a result, the plan gradually became more realistic in terms of labor force requirements and the size of the village livestock herd that the land use plan could accommodate.

Once trust had been built between the planners and community members, the manipulation of the boundary objects allowed villagers to refine and adapt their plans to make them more realistic. Being realistic is a necessary condition for a plan’s actual implementation. In villages investigated by Lestrelin et al. (2011a) where LUP/LA had been implemented most recently, a response to the negative impacts of the three-plots policies had been to allocate to the villagers whatever land they would request for agriculture, resulting in unrealistic plans similar to those obtained during the first round of PLUP. In these villages, the land use plan was never translated into action, mainly because people had not cared about producing a realistic plan at the outset. The iterative learning approach allowed simple farmers to gradually become amateur landscape planners but, most importantly, it increased trust in the district staff who came to facilitate the planning process, engaging them in a long-lasting partnership toward sustainable landscape management (Reed, 2008).

6. Conclusions

This paper shows how visualization and learning boundary tools can help translate participatory principles into reality by empowering locals in designing future land use plans and by acting as catalysts of negotiation (Folke et al., 2005). Our action-research approach attempts to move beyond the “dos and don’ts” or “PLUP recipes” to propose an integrative communication platform combining local and scientific knowledge. It exemplifies “how [science] can improve the quality of the decision making process, as well as that of its outcome” (Beunen and Opdam, 2011, p. 325). The concept of “design” in landscape science, introduced by Nassauer and Opdam (2008), has been used in the context of PLUP through the development of legitimate, credible, and salient “landscape boundary objects”. The proposed boundary objects empowered the VLMCs by improving effective participation. Often relegated to the role of mere observers of a planning process piloted by district authorities, local villagers could voice their views and have some influence in the final land use decisions. Hence, by negotiating land use plans and development scenarios, participants seemed to have been able to reach an agreement on a spatially explicit landscape management plan with a high degree of ownership.

The legitimacy of PLUP outputs should be considered at both local and national scales. A successful bridging approach needs to be pertinent at the national level while being supported by local authorities. Therefore, boundary work should be anchored in a national governmental strategy to engage communities in decentralized governance of the farm/forest interface and thus build long-lasting mechanisms of co-management.

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