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Sharpening the understanding of socio-ecological landscapes in Participatory Land Use Planning. A case study in Lao PDR.

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Abstract: In the two decades since the 1992 Rio Conference, Land-Use Planning (LUP) has become recognized as a key instrument in putting discourses on sustainable development into practice. In Lao PDR, despite the implementation problems, it is still seen as a lever for securing land tenure, rationalizing extension services provision, and more recently, for implementing ‘Reduced Emissions from Deforestation and Forest Degradation’ (REDD) schemes. Impact assessments of past LUP have revealed weaknesses of local institutions in the effective implementation of land policies. In order to avoid the blind trust placed in delusive LUP success stories, methods for monitoring community participation and understanding of LUP activities have been developed in order to assess the *quality of the process*. Expanding on this perspective, this article proposes a method to assess the *quality of LUP outputs* and to visualize the gap between planning objectives and their actual achievements. This method, based on a refined analysis of past and present land zoning practices in Lao PDR, gives full prominence to the complexity of landscape mosaics and the way local populations actually use the land. Furthermore, this approach, developed and tested under real planning conditions, can also be seen as a safeguard and support for inexperienced implementers in their land-use planning practices, as a diagnostic instrument for quality assessment, i.e. level of accuracy of a land-use plan, and may finally pave the way towards becoming a tool for land-use planning certification.

Keywords: Land-use planning, Participatory landscape simulations, Sustainable land management, Lao PDR

1. Introduction

The emergence of participatory approaches as a cornerstone of land management and development programs is linked to the wide recognition of the drawbacks in "intrusive land management strategies" (Agrawal and Gibson, 1999:630) and the utmost necessity of recognizing the value of local perception and knowledge (Chambers, 1983; Gadgil *et al.*, 1993; Agrawal, 1995; Hage *et al.*, 2010). Described by the United Nations Development Programme as the "central issue of our time" (Craig and Mayo, 1995:2), participation is also recognized as the main lever to support dialogue and promote the voice of the powerless under the practice of 'community development' (Craig *et al.* 1990). In addition, the integration of local complexity and priorities in the planning process is expected to facilitate further implementation through community capacity-building and the empowerment of local communities (Craig, 2007; Neef and Neubert, 2011). However, certain means need to be defined to avoid rhetoric-only approaches and what Arnstein defined as "empty ritual[s] of participation" (1969:216).

The methods of involving communities in the assessment of the socio-economic development needs of local populations either through Participatory Rural Appraisal (Chambers, 1994), involvement in Participatory Action Research (Selener, 1997; Reason, 1998) or more generally in Participatory Learning and Action (PLA) (Pretty *et al.*, 1995) are widely applied. The participatory component is usually intended to address local concerns while shifting the decision-making power from the researcher and practitioners to the communities. Promoting active participation beyond mere consultation of local communities, the tools developed under this paradigm encompass a range of village-based interviews and focus groups. Participatory mapping provides a bridging platform between scientists and local communities. This intuitive, adaptive and interactive tool facilitating discussions on local concerns, has been developed as an alternative to conventional mapping by involving local stakeholders in land management processes that influence their future well-being (Kalibo and Medley, 2007; Eksvard and Rydberg, 2010; McKinnon, 2010; McCall and Dunn, 2012). Nevertheless, for some long time, maps have been the exclusive "territory" of national elites who have used landscape representations to reformat, territorialize and assert control over nations' space (Cons, 2005). In the field of critical geography, many authors have highlighted the relationships between mapping and political motivations, and have defined a map as "an abstraction from concrete reality which was designed and motivated by practical (political and military) concerns" and as "a way of representing space which facilitate its domination and control" Lacoste (1973:1). This "democratization of cartography" is known as counter mapping (Peluso, 1995) and as such, challenges top-down planning with local and community maps (Crampton 2010:37). This approach proposes "maps of people's claims" (Peluso 2005:9) over resources which are often used as negotiation tools to clarify tenure rights and mediate land conflicts (Rocheleau, 1995; Chapin *et al.*, 2005; Peluso, 2005; Cronkleton *et al.*, 2010). Since the late 1990s, the spread of geo-visualization tools for participatory planning have enabled non-experts to manipulate and explore spatial data (McCall and Dunn, 2012). Participatory Geographic Information Systems (PGIS) are now used to involve local communities in addressing a whole range of natural resource management issues, i.e. tenure rights, land conflicts and integration of tacit knowledge in resource management (McCall, 2003; Chambers, 2006; Rambaldi *et al.*, 2006; Castella, 2009; Bernard *et al.*, 2011; MacCall and Dunn, 2012).

Participatory Land-Use Planning (PLUP), a form of PLA, is aimed at translating land policies and development discourses into sustainable resource management (Rydin, 1995; Wang *et al.*, 2008). PLUP is supposed to guarantee the involvement of local stakeholders in decision-making thanks to the use of efficient visual and negotiation-support tools. Unfortunately, field experiences are rarely published and it is difficult to assess the quality of methods, processes and outputs objectively (Marchamalo and Romero, 2007; Fox *et al.*, 2008; Hessel *et al.*, 2009).

The Government of Lao PDR (GoL) recently enacted PLUP as a national priority (MAF-NLMA, 2009). However, PLUP is still often considered as a mere upgrade of the former LUP-LA (Land-use planning and Land Allocation) using high-tech tools such as Global Positioning Systems (GPS), Geographic Information Systems (GIS), or high resolution satellite imagery. But, Lestrelin *et al.* (2012) have suggested that the district staff capacities for PLUP implementation together with the concurrent mandates of different implementing agencies present more problems than do the actual tools used in the field. The tight schedule imposed by the GoL to apply PLUP across the whole country by 2015 is also raising many questions regarding the value of the resulting land use plans particularly since quantity seems to be favored over quality of the process, especially in terms of community participation. Furthermore, this may confirm the opinion of certain detractors of Participatory GIS who disparage the inefficient use of information and communication technology in resource management (Abbott *et al.*, 1998; Chambers, 2006). In the absence of real, certified participation, this land zoning enterprise could well serve the interests of agri-businesses requiring free-space for concessions, in line with the government strategy to favor economic growth for the country to emerge from the ranks of the least developed countries by 2020, and *de facto* to legitimize ‘land grabbing’. With a myriad of projects involved in PLUP and no harmonized methods, the quality of the work performed on land-use planning is difficult to assess. When people claim that they produce real maps and/or engage in more participatory processes, objective measurement and monitoring tools are even more necessary to improve both process and outputs. In a recent publication, Lestrelin *et al.* (2011) highlighted the importance of defining objective criteria to gauge the participatory nature of a PLUP process rather than taking this for granted.

Along the same lines, this article proposes a methodological approach for an analysis of both the credibility and legitimacy of PLUP outputs. These terms, defined by Cash *et al.* (2003), refer to the adequacy of scientific knowledge (credibility) used throughout the participatory process, and the local relevance required to sustain a concrete plan (legitimacy). Throughout the article, the terms accuracy and realism will be used to determine how well a land-use plan fits with the local situation. An inaccurate plan is thus defined has one being beyond the range of possible local implementation. Two research questions are thus addressed:

i. How can the quality of a PLUP output be assessed and the gap between PLUP principles and practices visualized? and
ii. What can be done to fill the gap and progress from hazy to sharp land-use plans?

In the first section, the discrepancies between current planning applications and their intended principles are acknowledged, while the second section introduces a new approach to participatory land-use planning aimed at providing not only a certified output in terms of participation and rational planning, but also a tool for the assessment of the quality of a land management plan. Here, the quality of the PLUP output is also defined as truly representative of the quality of the process.

Moreover, this innovative approach is also original in its multi-scale perspective of the planning process. The land-use planning and land allocation (LUP-LA) agenda was performed only at the village level, while the PLUP field activities performed at the village cluster (*kumban*) level make it possible to overcome problems related to confused land use plans across scales (Lestrelin *et al.*, 2012).

2. Hazy context of LUP in the uplands

2.1 How haziness in village land use and land tenure system affects PLUP outcomes

The GOL's goal of sustainable development translates in terms of policy objectives in balancing the trade-off between (i) poverty alleviation and (ii) economic growth in order to lift the country from the list of Least Developed Countries (GoL, 2006) while protecting the environment and restoring the forest cover from the current 41% to 70% of the national territory by 2020 (GoL, 2005). In rural areas where 80% of the population lives, subsistence farming based on shifting cultivation is still common due to the limited availability of flat lands suitable for irrigated paddy rice cultivation or diversification to commercial crops, and to poor market accessibility. Shifting cultivation is described as an agricultural practice that is "primitive, unproductive and harmful to the environment" (Haberecht 2009:29), and as one which causes deforestation, soil degradation and erosion (Lestrelin, 2010). The GoL is deeply concerned about the social, economic and environmental impacts of deforestation. In fact, most of the rural population relies on the forests for timber, food, fuel, fiber, shelter, medicines, and spiritual protection (GoL, 2005). But at the same time, forests contribute to the Gross Domestic Product through timber exports to neighboring countries. Over the past few decades, successive land policies have aimed at settling, intensifying and modernizing upland agriculture with the underlying goal of eliminating swidden agriculture and moving from subsistence to commercial production so as to meet domestic needs and expand exports (GoL, 2006; Rigg, 2006).

Even though land is legally administrated by the state in Lao PDR, local management is commonly done through customary practices. In the early 1990s, land and forest allocation policies were designed to establish and clarify land use rights and to provide incentives to local communities for sustainable resource management (Heltberg, 2002). The legal tenure framework established in the mid-1990s includes the issue of renewable certificates allowing the temporary use right of agricultural land (LSFP, 1997). Although the plans seemed rather straightforward and simple, when dealing with the uplands cultivated under rotational 'slash-and-burn' practices, the process proved more complex due its dynamic nature. The legally permitted practice of swidden agriculture has informally been rendered unsustainable under LUP-LA by necessitating local shifting cultivators to reduce their fallow lengths to three years – also known as the 'three-plot policy' (Evrard, 2006). The reduction of the available productive areas has resulted in an artificial pressure on land access and thus the implementers of this policy have been forcing upland dwellers to change their cropping practices. These measures have affected local livelihoods as no convincing alternative cropping practices to cope with this drastic change were proposed (Sunderlin, 2006; Lestrelin and Giordano, 2007).

Through monitoring the impacts of land-use planning policies, many observers have acknowledged the gap existing between the theoretical benefits of land policies and their actual negative impacts on socio-economic development (Sunderlin, 2006; Lestrelin *et al.*, 2012). This gap between theory and practice can be partially explained by the lack of human and financial resources (i.e. lack of trained staff to implement land use policies and scarce amount of money to translate plans into action) together with the absence of follow-up activities (i.e. extension activities, monitoring) impeding the implementation and local adoption of land use policies (Alton and Rattanavong, 2004; Ducourtieux *et al.*, 2005; Lestrelin *et al.*, 2011; 2012). The direct consequence of these inappropriate measures was observed in the field where plans are either not used or simply lost, and where temporary land use certificates are yet to become formal land titles. These observations motivated a broader analysis of the gap between official tenure rules and their applications.

2.2 Measuring the gap

Four villages in Luang Prabang Province were selected as research sites to examine the past and present implementation of land-use planning (Figure 1). In Viengkham district, Paklao, Bouami and Phoukong have been selected so that they cut across a gradient of accessibility and integration to market economy. Similarly, these villages cut a gradient of distance to a prominent National Protected Area (Nam Et - Phu Loey). The villages of Paklao and Bouami underwent LUP-LA in 2006 in a development project which supported the district staff financially and technically. The planning process was a two-day zoning process with a few village leaders without any field visit (Lestrelin *et al.*, 2011). The lack of resources and capacity of the implementing side seems to have hindered a process of which the only visible output is a wooden board at the entrance of both villages displaying the location and areas of the different land uses within the village administrative boundaries (Figure 2 a, b). The villages of Phakok (Phonxay District) and Phoukong experienced a national pilot implementation of PLUP in 2009 and received abundant project support in the application of the national guidelines on land-use planning (MAF-NLMA, 2009). There, socio-economic assessments through village census and focus groups were coupled with field surveys assisted by GPS. Geographic Information Systems technology was further used to create digital land-use maps (Figure 2 c, d).

In these four villages, retrospective surveys were conducted to gather information on the local land use. The data collection focused on plot areas, numbers and locations as well as the labor force available to each household. The survey revealed that the average number of hectares of agricultural land per household is 4 ha in Paklao, 5.1 ha in Bouami, 4.4 ha in Phoukong and 3 ha in Phakok. Thus it would appear that the national strategy enforcing the reduction of shifting cultivation and fallow periods has been effectively implemented (Lestrelin *et al.*, 2011). However, a comparison of the numbers gathered from household surveys with those acquired from the outputs of the past zoning discloses evident discrepancies between the two sources of information (Figure 3). For Bouami and Paklao, satellite imagery analysis corroborates the existing gap. In a context of shifting cultivation, ground surveys and secondary information (e.g. old land use maps, forest cover maps, and digital elevation models) were used to support analyzing Landsat images for 2009 (Kongay *et al.*, 2010; Castella *et al.*, 2011). In addition, the 'landscape mosaics' approach helped creating generalized land-use types (Hett *et al*., 2011). This analysis shows that in Bouami and Paklao 1,370 ha and 1,908.7 ha respectively are classified as land under agriculture. This gives an average land area per household of 22.1 and 28.5 ha per household comparable to that found in the land use plans displayed on the wooden boards (Table 1). The existence of this discrepancy between the area declared as agricultural lands by the people and the area available is a recurrent issue that experts also raise at the national level: "land use plans [from LUP-LA] do not depict the reality and it seems that an incomprehensible gap exists between what people say they have and what they actually use as agricultural land" (personal communication, 2010).

2.3 Hypotheses on the origins of hazy land use plans

Two hypotheses can be advanced on the origins of this gap. Either there are flaws in the land zoning methodology and practices or villagers do not declare all their land, maybe as a strategy to avoid land taxes. Field observations show that it may well be a combination of both. Historically, implementers and villagers have learnt to be adaptive to successive land-use policies, and to human and financial resources limitations. In the 1990s, the district was asked to enforce the policy for the eradication of

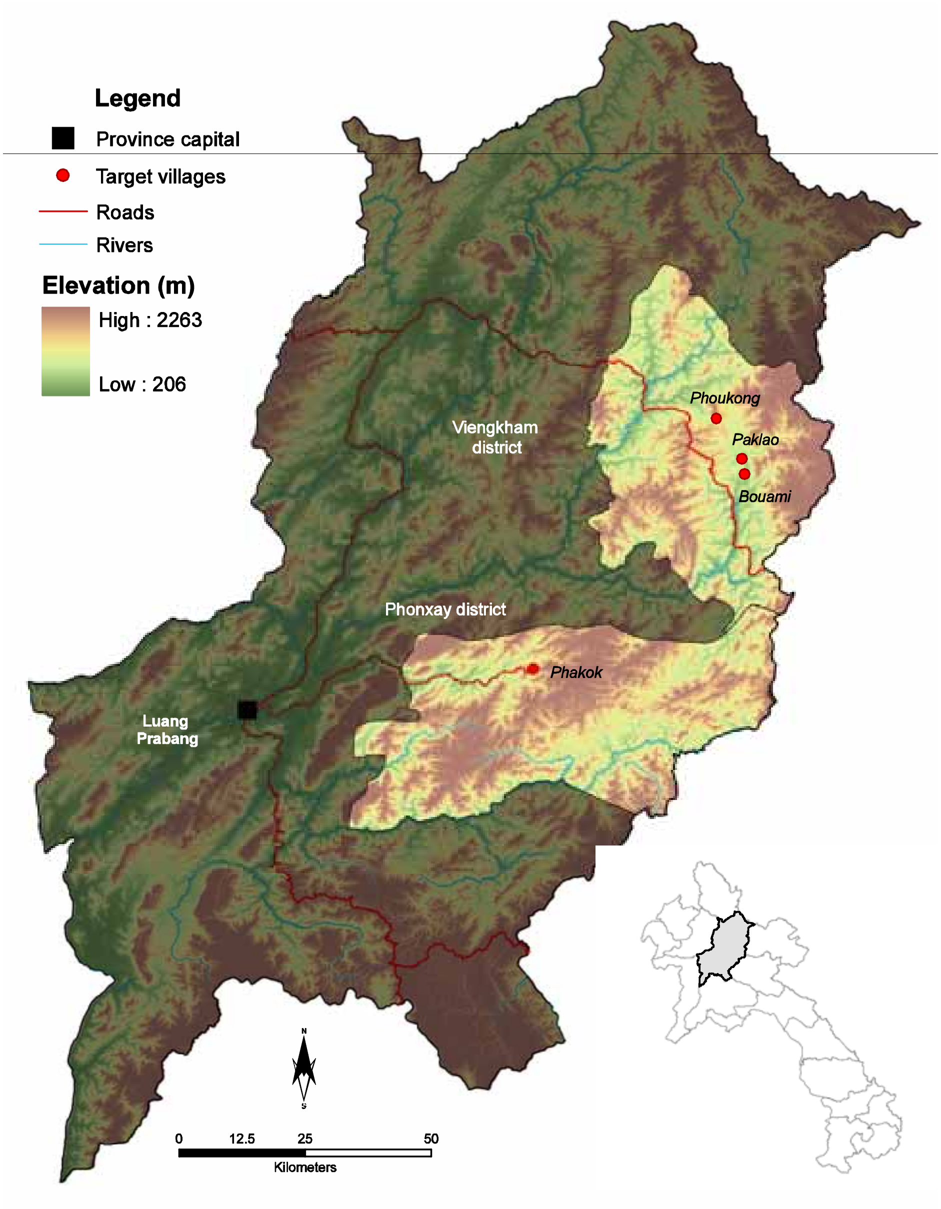


Figure 1. Location of the case study sites in Luang Prabang province.

shifting cultivation in order to increase forest cover and accelerate the development of rural areas. With no alternatives to upland rice being offered this experiment became a poverty trap. In order to escape from this trap, local communities responded by communicating false figures on land use, yields and labor force to please the district authority. In the 2000s, the process was given a 'participatory' label. While a certain variability exists in local policy interpretation, the implementers were in general more inclined to approve current land uses as future plans. As a result local communities received the land they asked for. This was in contrast to the previous period, when the three-plot policy was strictly applied, leaving local communities with a limited range of options to avoid the poverty trap (Lestrelin and Giordano, 2007. These options included changing their cropping practices (in particular through a shortening of the fallow period), moving to other locations in search of flat land for growing paddy, or resisting the policy changes by declaring resources to match to policy requirements and which did not reflect those on which they were really dependent. Neither of the two parties is fooled by the other's game but over time they have learnt how to manipulate the rules. Land-use planners are entangled in the local interpretation of national guidelines, and district staff do not delude themselves while confessing that "only 30% of the census data collected each year in the villages can be trusted" (Bounthan 2010, pers. comm.). A tacit agreement seems to exist between communities and implementers to merely satisfy the administrative directives and record the planning activities by setting up a board representing land zones at the entrance of the village. Both sides behave as passive resistant entities sustaining the haze on local land uses and overlooking the potential benefits of LUP outcomes.

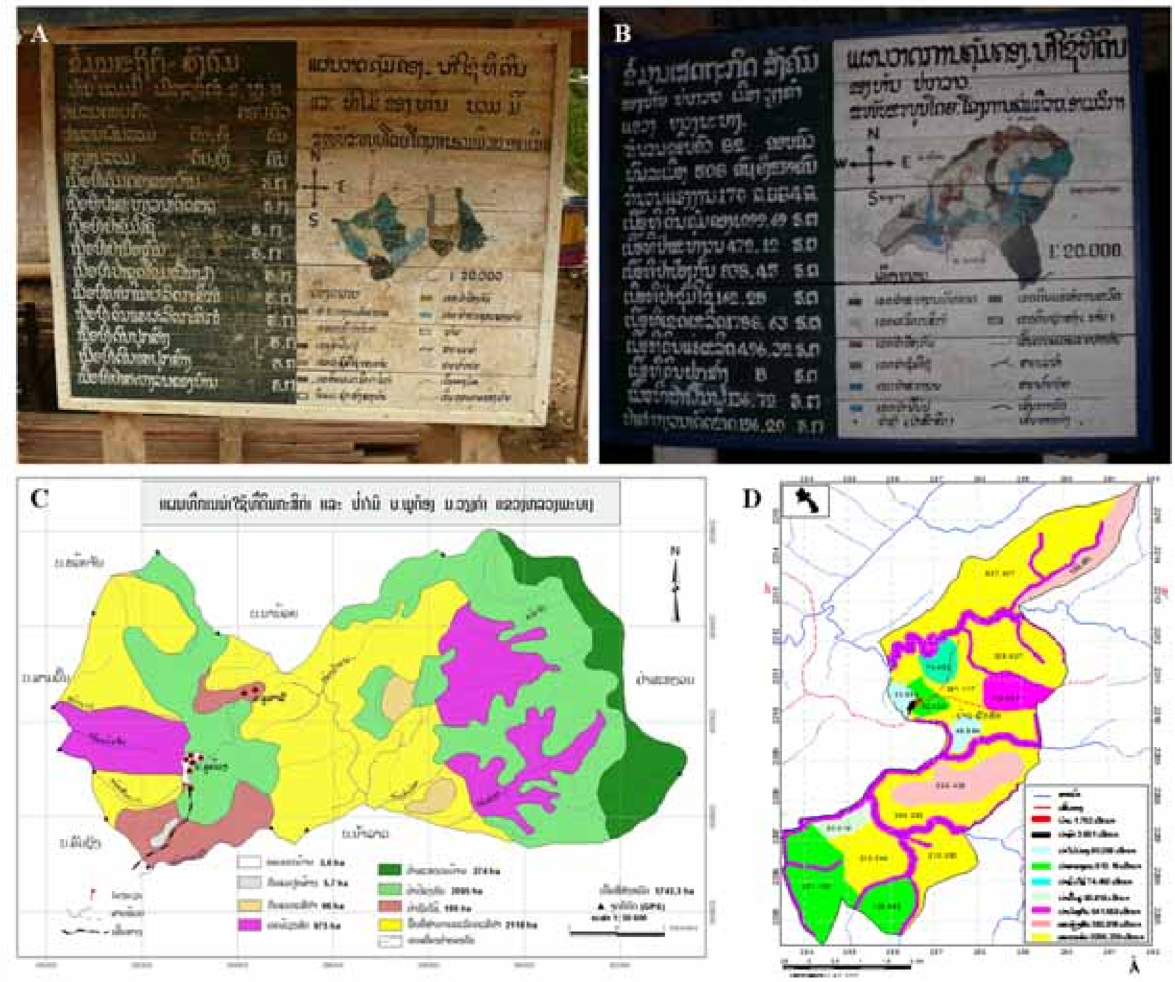
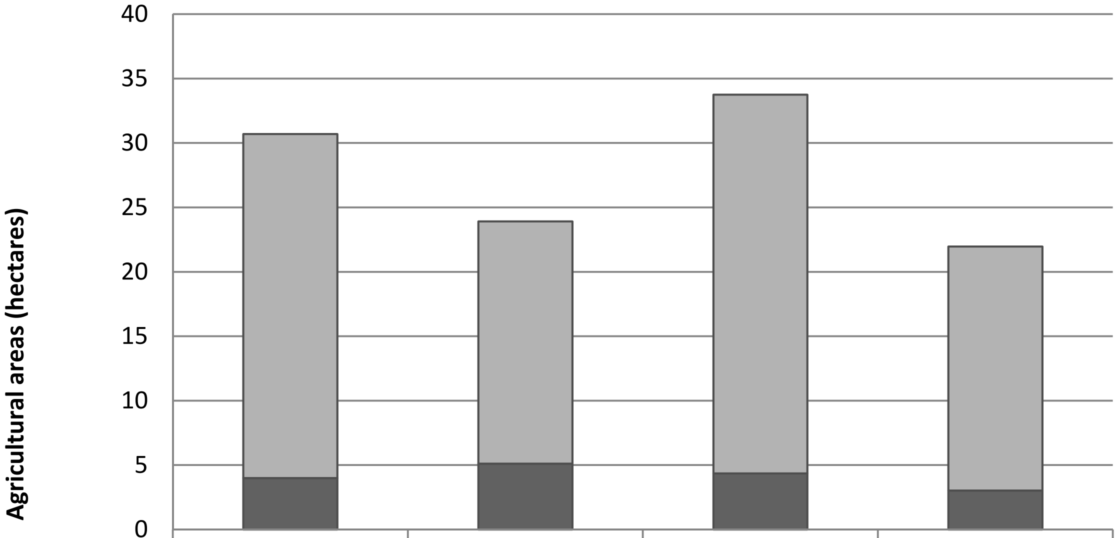


Figure 2. Land-Use Maps for Bouami (a), Paklao (b), Phoukong (c), and Phakok (d).

3. From hazy to sharp

In 2010, new methods articulated around clear principles were developed to enhance PLUP quality, particularly in terms of community engagement in land zoning (Bourgoin *et al.* 2011). Participatory Learning and Action approaches were promoted to establish legitimate sets of plans and a zoning method was used to engage local stakeholders in land zoning negotiations. Presented in detail in this section, the PLUP diagnostic methodology, called the 'Fitness Assessment Tool', was invaluable in improving the quality of this participatory process and also, in enhancing the relevance of planning outputs. In addition, it can also be used as a measurement instrument to assess the credibility of land use plans conceived by other methods.



	Paklao (LUPLA 2006)	Bouami (LUPLA 2006)	Phoukong (PLUP 2009)	Phakok (PLUP 2009)
Available land	26.7	18.8	29.4	18.94
Declared land	4	5.12	4.36	3.03

Figure 3. Comparison of Agricultural Areas from Surveys and Land-Use Maps.

3.1 Assessing the credibility of PLUP outputs

The National Agriculture and Forestry Research Institute (NAFRI, Lao PDR) participated in an action-research project proposing a reflective process supporting the local implementation of land-use planning with the support of international research partners and in partnership with Provincial (Provincial Agriculture and Forestry Offices - PAFO) and District (District Agriculture and Forestry Offices and Land Management Authority – DAFO and DLMA) line agencies. Field activities took place in the six villages of the Muongmuay cluster in the district of Viengkham (Luang Prabang Province) and were aimed at developing alternative methods for implementing land-use planning. The rationale was to provide a better way to deal with community participation, knowledge integration and multi-stakeholder negotiation (Bourgoin *et al.*, 2011). A negotiation platform was developed around key action-research activities to tackle land-use gaps explicitly and assist village zoning activities in combining both socio-economic and geographic information (Selener, 1997). The first activity was the delineation of the village boundaries. A combination of three-dimensional models of the landscape and global positioning technology was used. Then socio-economic data was collected through associated learning activities by means of a role-playing game in order to involve villagers in a land zoning simulation (Bourgoin and Castella, 2011).

3.1.1 Socio-economic data

A stratified random sampling of 30 households was conducted in all six villages. By including all classes of poverty (low, medium, high), the survey aimed at capturing the composition of villagers' annual income and an understanding of their linkages with the land-use. The socio-economic data collection was further used to build a specific village typology where four household types share financial and spatial resources differently and therefore have a distinctive impact on land uses (Castella *et al.*, 2011). Household types were defined according to their degree of dependence on a particular sector of activity and specific components of their village landscape, i.e. upland crops under shifting cultivation, livestock, tree plantations and off-farm activities. Important while discussing future village land-use, information on population trends was also recorded during focus groups with the members of the village authority (Bourgoin *et al.*, 2011).

	Paklao	**Bouami**	**Phoukhong**	**Pakhok**
Land-use planning	LUPLA 2006	LUPLA 2006	PLUP 2009	PLUP 2009
Agricultural area from village survey (ha)	268	317.8	314	273.2
Agricultural area from village map (ha)	1,788.6	1,166.6	2,118	1,709.4
Agricultural area from satellite analysis (ha)	1,908.7	1,370	No data	No data
Number of households	67	62	72	90

Table 1. Land-Use Planning Data for Target Villages

3.1.2 Geographic information

As mental representations of rural landscapes allow subjective views dependent on perceptions and cultural contexts, a boundary object was needed in order to provide a common visual interface for people with different backgrounds and experience to learn and negotiate (Rambaldi, 2010). Topographic maps are often used to support participatory mapping exercises, however despite the depiction of obvious landscape features, people face difficulties positioning themselves with a two-dimensional support, often misinterpreting geographical features (Rambaldi *et al.*, 2002). In order to facilitate a broad comprehension during zoning activities, a three-dimensional physical model (3D model) was used for the delineation of zones. Using pins and yarn of different colors, village members proceeded to delineate zones on this model, debating the location and size of each land-use area in 5 to 10 years. Once a plan covering the whole village area is achieved, the data is captured and entered in a geographic information system (GIS). As the landscape is not a flat surface, radial displacement is deflected by taking a series of perpendicular photos above the 3D model in order to minimize data loss and errors associated with geo-referencing (Rambaldi and Callosa-Tarr, 2002). The images are stored in computers and imported in geographic software (open-source Quantum GIS and commercial ArcGIS). The different land uses are captured by on-screen digitizing and converted into vector layers. GIS scripts operate the calculation in hectares of each zone within the village boundary and store the information in the layer's attribute table. During the development of this method, a sensitivity analysis was conducted to assess if the region's topography had a significant influence on the area calculation. Three-dimensional analysis was undertaken using the '3D Analyst' feature of ArcGIS, combining a Digital Elevation Model (DEM) and the land-use polygons (n=159). A statistical analysis using R compared the areas generated from 2D on-screen digitizing and 3D surfaces. Using a non-parametric test (Mann-Whitney-Wilcoxon), it was concluded that no significant difference existed between the two methods (p-value of 0.69) and conveniently, on-screen digitizing was used for the rest of the experiment.

3.1.3 Knowledge integration in a negotiation support model

The combination of geographic and socio-economic data is achieved through the use of a simple spreadsheet model that can be easily manipulated by non-experts. The program is compatible with Microsoft Excel or Open Office (open source) and displays a clear user interface. Initially developed as a research tool, the model has been gradually adapted for routine use by district staff and distributed in its final version in Lao language to field implementers (i.e. national researchers and/or district/province government staff).

The Fitness Assessment Tool (FAT) simulates household land requirements in relation to a proposed village land-use plan. Technological and physical conditions are defined by the village community. The tool has been designed in such a way so as not to impinge on participation or discussions between actors. Proposing ballpark figures, the FAT can be easily understood, manipulated and thus, eases discussions. The notion of planning credibility is introduced to gauge the feasibility of a land-use plan or in other words, appraise the gap between land-use plans and current socio-economic situations.

In practice, all the information gathered during interviews is formatted in spreadsheets and several tables are created to crosscheck information obtained from different sources (e.g. random household surveys, exhaustive village census, focus group discussions, participatory mapping). The percentage of each household type is combined with their corresponding share of income from agricultural activities, livestock and non-timber forest products. The entry point for the integration of village data and geographic information is the area of each land use as villagers are involved in many land related activities. In each village, the data analysis provides information on the extent to which the different household types depend on each sector of activity for income generation. With the hectares of each land use gathered from the land-use plan, the model links geographic data with the level of reliance and the expected income per hectare for each household type in a particular village.

	Village census	**In-depth survey of 30 households**	**Update during PLUP**
Average area of upland rice per household (hectares)	5 ha	3 ha	7.3 ha
Village labor force (number of people)	112	136 (by extrapolation)	192

Table 2. Agricultural Information for Bouami Village from Various Sources

These multiple parameters are integrated with the spatial arrangements of the landscape by using several equations:

(1) $$\mathrm{I_x} = \sum_{i=1}^{n}\sum_{j=1}^{m}\left(S_{xi} \cdot A_j \cdot R_i\right)$$

where, $\mathrm{I_x}$ is the income attributed to the household group *x*, having *i* activities on *j* land uses. S_{xi} is the share of activity, *i* is the total income of the household type *x*. A_j is the area of land use *j* and R_i is the return on activity *i*.

The *n* activities include rotational and permanent agriculture, collection of Non-Timber Forest Products (NTFPs) and livestock. The return value associated with these activities is expressed in kip/hectare (with US$1 = 8030 kip in June 2011). As livestock cannot be represented spatially, the return estimate, $\mathrm{R_{livestock}}$ is described in equation 2.

(2) $$\mathrm{R_{livestock}} = \frac{K_j \cdot p}{f}$$

where, K_j is the livestock carrying capacity of each land use (maximum head of cattle/ha), *p* is the average price of one head of cattle and *f* is the livestock selling frequency (in years).

The total income corresponding to a single activity *i* is thus:

(3) $$\mathrm{I_i} = \sum_{x=1}^{y} I_{xi}$$

The off-farm income cannot be assessed spatially but it depends on the village status and wealth. In order to have an adaptive value for this activity, *k* is defined as a constant share[1] of the income generated by the agricultural activities (4).

(4) $$\mathrm{I_{off\text{-}farm}} = k \cdot \sum_{i=1}^{n} I_i$$

In an extensive agricultural system like the uplands of Lao PDR, the limiting factor of economic development is not land scarcity but labor availability. The credibility of a plan is evaluated by the ratio between the labor force predicted by the model and the labor force actually available in the village. The estimated labor force needed to implement the proposed land-use plan can be calculated as shown in equation 5:

(5) $$\mathrm{LF_{plan}} = \sum_{j=1}^{m} (A_j \cdot LR_j)$$

where, the labor force (LF) is directly related to the labor requirement (LR) per hectare.

The future village labor force can be extrapolated from population growth information. Assuming that the proportion of labor force in the total population remains constant over the planning period, the population growth factor can also be used as a labor force growth factor ($\mathrm{LF_{real}}$).

The accuracy or realism of a land use plan is defined as a measure of fitness comparing the projected labor force in 10 years with the labor requirement related to the plan (6).

(6) $$\mathrm{Realism} = \left(\frac{LF_{real}}{LF_{plan}} \right) \times 100$$

The model also estimates environmental values of the land-use with biodiversity and carbon indexes. A scoring system allows local communities to assign an environmental value to the land use type in their village landscape as displayed in Table 3. The scoring system is introduced to the village community during the ‘PLUP Fiction’ zoning simulation (Bourgoin and Castella 2011).

By its very nature, this model can also be used as a diagnostic tool to analyze the quality of former land-use plans through a retrospective analysis. For example, the land zoning conducted by the district agriculture and forestry officers in 2006 in the village of Bouami can be examined. The model was used to integrate the areas of each land use defined on the wooden board (Figure 2a) together with village socio-economic data. The resulting estimate (from equation 6) revealed that the current labor force would have been able to use only 29% of the delineated agricultural land zones of the landscape. This unrealistic figure illustrates poor local consultation and reflects the poor integration of village socio-economic information in the design of the land use plan.

[1] This *k* value has been estimated from field surveys in six target villages of the district of Viengkham. More generally, it has seemed to be relevant for the whole of the northern uplands of Lao PDR.

LAND USE	Agricultural income (kip/ha)	NTFPs return (kip/ha)	Livestock capacity (head/ha)	Labour requirement (man/ha)	Biodiversity index	Carbon index
Conservation forest	0	0	0.5	0	4	4
Grassland	0	100,000	1.5	0.1	1	1
Permanent crops	2,500,000	200,000	0.5	1	1	1
Shrub	0	0	0.5	0	2	2
Production forest	2,500,000	5,000,000	0.5	0	3	3
Protection forest	0	2,500,000	0.5	0	4	4
Rotational crops	1,000,000	1,500,000	1	0.25	1	1
Plantations	4,000,000	100,000	0	0.1	1	2
Livestock area	0	100,000	1.5	0.25	1	1
NTFP plantations	0	3,000,000	0	0.1	1	1

(1USD = 8.030 kip in June 2011)

Table 3. Model Parameters for Bouami

3.2 Rationalizing the process for improved outputs and outcomes

3.2.1 Insuring data quality

The provision of feedback on the realism of their plans to members of the village land management committee during land zoning allows villagers to finally realize the importance of providing correct information at the onset of the planning process. This article uses the example of Bouami village to illustrate the participatory process conducted in all six villages of the target *kumban* and which yielded similar results. The village population is decreasing at an annual rate of 1.5% on average. The labor force evaluated at 112 people in 2010 was set to become 96 people in 2020. This first zoning iteration computed by the model gave an estimated total labor force of 461 people needed to implement the plan. Under similar technological inputs (e.g. no fertilizers, no tractors), the accuracy of the plan is evaluated (equation 6) at 23% meaning that only this percentage of agricultural land could be exploited given the limitations of the future village labor force.

How is it possible to explain such a large discrepancy at the early stage of the zoning negotiation? First, the villagers tended to over-estimate the extent of agricultural areas because they were afraid they would not have sufficient land to crop or that some areas (steep or stony) may not be suitable for cultivation. Second, the data provided during village and household surveys may have been inaccurate because of the reasons previously described (i.e. shifting levels of compliance/resistance to land policies depending on how strict the district staffs are in the local implementation of national regulations).

After acknowledging the results of the first zoning iteration, the villagers decided that the plan was not optimal and took the initiative to look at the raw survey data used in the model. After going through the socio-economic census, the villagers conceded that the data was inaccurate and decided to update the values for the labor force, agricultural areas and fallow length. Table 2 shows that the census data underestimated shifting-cultivation areas as villagers had provided numbers intended to satisfy government regulations. The villagers admitted that they usually give wrong figures to avoid paying taxes that are calculated on the basis of the labor force and the area under shifting cultivation. This can be observed in Table 2 where data from the village census appear to be more accurate than the information gathered through individual questionnaires.

In a second step, the participants proceeded to make another refinement by recognizing that the landscape could not be fully exploited. Based on the physical terrain represented on the 3D model, the group made a rough estimation of the percentage of the land area that could be used effectively for agricultural purposes. Satisfied and confident about the new figures, the villagers engaged in the second round of land zoning.

	Plan 1	**Plan 2**	**Plan 3**	**Plan 4**
Land use efficiency (%)	23	51	85	89
Land uses (hectares)				
Conservation/Protection forests	1,242.26	1,185.67	1,185.67	1,185.67
Grassland	272.8	373	373	373
Permanent crops	194.23	57.43	30.7	30.7
Plantation NTFPs	0	87	87	87
Production forest	307.2	414.75	414.75	414.75
Rotational crops	1,145.9	921.77	875.5	847
Plantation trees	107.1	156.97	183.7	183.7
Reserve land	77.46	150.34	196.6	225

Table 4. Land Use Evolution Through Successive PLUP Iterations in Bouami Village

3.2.2 Insuring quality of the zoning process

At the end of the day, the group in Bouami village made four significant zoning iterations that were necessary in order to reach an agreement. Table 3 displays the gradual refinement of land-use plans and shows a steady diminution in rotational crops together with an increase in the diversification of agricultural activities throughout the process. At first, the villagers tended to over-estimate their capacity to cultivate large areas through swidden agriculture or permanent crops. In another technological context, the demand for an excessive labor force would be compensated for by increased mechanization and/or the use of chemical inputs in the intensification of land use. The shift from traditional agriculture was followed by the establishment of tree plantations representing long-term investments with low labor force requirements. Village production forests from which villagers could collect more NTFPs were expanded as a result of the conversion of old fallows. Through plans 3 and 4, clarifications were made by acknowledging that all the agricultural land could not be utilized by the village because of labor force limitations, and that certain areas had to be classified as reserve land and put on hold for the next generations or migrants. Working in such a forward-looking manner allowed the villagers to design credible land-use plans based on a refined knowledge of the current village situation. This is illustrated in Table 4 which highlights the continuous increase in accuracy resulting in a plan with an 89% fit to the local situation.

A final scenario envisaged by the village land management committee consisted of increasing the fallow-length in the model from 3 to 6 years in order to get closer to the current village land management. The model produced an estimate of 99% accuracy. Despite its good representation of the local reality, this figure based on the fallow length deviated widely from that in the national regulations and thus proved difficult to publicize in a PLUP. It was agreed to keep plan 4 as the final one.

The results of the model were summarized using key indicators derived from the equations in section 3.1 and could therefore be incorporated in a comparative framework (Table 5). *Landscape Income* relates to the level of income generated by the whole range of land-use types in the village while *Grass-root Income* refers to the financial returns for households mostly dependent on shifting cultivation and NTFP collection. Displayed as percentages, their value is related to the maximum income value generated by a landscape exploited with optimal efficiency (by the whole village for the first indicator and by Type A households for the second). The third indicator measures the plan's e*nvironmental value* which combines those biodiversity and carbon indexes as defined earlier (Table 3). The fourth indicator, referred to as *stabilized swidden*, relates to the share of non-forest land not used under rotational agriculture (GoL, 2005). The last indicator measures the *realism* of the land-use plans (equation 6).

Indicators formula	Remarks
$\text{Landscape Income} = \left(\frac{\sum_{i=1}^{n} I_i}{\sum_{i=1}^{n} I_{i\_optimal}} \right) \times 100$	'Optimal' refers to a 100% realistic plan
$\text{Grass-root Income} = \left(\frac{I_A}{I_{A\_optimal}} \right) \times 100$	'Optimal' refers to a 100% realistic plan
$\text{Environmental Value} = \left(\frac{\sum_{j=1}^{m} (A_j \cdot S_j)}{0.7 \cdot 4 \cdot A_{village}} \right) \times 100$	S_j is the score of land use *j*. The maximum value is represented by 70% of the village area under conservation or protection (score=4)
$\text{Stabilized Swidden} = \left(\frac{1 - A_{swidden}}{A_{village}} \right) \times 100$	$A_{village}$ is the total village agricultural area (in hectares) $A_{swidden}$ is the area under swidden agriculture (in hectares)
$\text{Realism} = \left(\frac{LF_{real}}{LF_{plan}} \right) \times 100$	LF_{real} is the labor force estimated in the village in 5 years' time

Table 5. Assessment Indicators for the Quality of a Land Use Plan

Notwithstanding the increase in credibility through the successive planning iterations, the process is also characterized by improved values for all of the other parameters as illustrated by Figure 4. Indicators related to the landscape structure such as *environmental value* and *stabilized swidden* display no drastic changes due to the ten-year time-frame scenario planning. However, under short-term perspectives, the economic values of the landscape and the *grass-root income* experience obvious improvements. A comparison of the evolution of LUP in Bouami reveals that the values obtained from the 2006 LUPLA plan were similar to those from the first iteration of PLUP in 2010 (Figure 4). The expected improvement is therefore encapsulated in the successive zoning iterations providing room for the villagers for negotiation in the design of a consensual plan that is more relevant to their own situation. Additionally, the method helps to visualize the impact of the two land-use planning approaches on the different household types within the village. Figure 5 displays the income levels of the four household types in the successive land-use plans. Characterized by efforts towards local participation, PLUP outcomes, in addition to being realistic at 89%, provide on average 64% more income than does the inaccurate LUPLA.

Similar results have been obtained at the level of each of the five other villages in the village cluster and also at the village cluster level through combining all six of the individual village land-use plans. The accuracy of first plans in the six villages is only 40.3% on average in contrast to that of an average of 87.5% in the final plan. Figure 6 shows that the successive planning iterations induced a systematic shift from a landscape dominated by swidden agriculture to a more heterogeneous mosaic of land uses. For instance, the *kumban* final plan (Figure 6) displays a higher diversity of land use types including tree plantations, NTFP domestication, cash crops and improved pasture areas.

4. Discussion

By providing feedback on the strengths and weaknesses of their successive land zoning to PLUP implementers, and village communities and district staff, all stakeholders are empowered in negotiating land-use plans. Field experience has demonstrated that local communities are quite suspicious when outsiders (foreigners and/or Lao governmental staff) come to survey their village and they seem reluctant to deliver accurate information about land management. An iterative zoning process is proposed here as a gradual way of making the villagers feel comfortable with the aims and objectives of PLUP and to clarify the link between spatial land-use patterns and village socio-economic context. Social learning and trust building through participatory activities seems to provide better quality inputs that will fundamentally “lead to higher quality decisions” (Reed 2008:2420).

This article not only develops a relevant methodology to PLUP, but also goes further by presenting a way of rationalizing the PLUP process itself. As demonstrated in Bouami village, the framework of combining socio-economic and spatial information in a GIS could be used as part of a PLUP certification scheme. The methodology developed in the uplands of Lao PDR, is relevant to places in relative isolation from markets and technical innovations while the rationale and GIS tools developed could be also be used in other land-use planning contexts.

Lestrelin *et al.* (2011) advocated that an assessment of participation is necessary for the objective monitoring of the level of village community engagement in a planning process that is still often termed “participatory” since that was its stated intention. However the assessment of the practice of real participation requires additional safeguards and control measures. Once the work is completed with no monitoring system embedded in the process, i.e. in the negotiation framework described here, there is little possibility of any control over the quality of the process. But a real physical output, such as a land-use map, can still be evaluated in terms of its feasibility given the current landscape features and local resources (i.e. technological level, capital, labor force available).

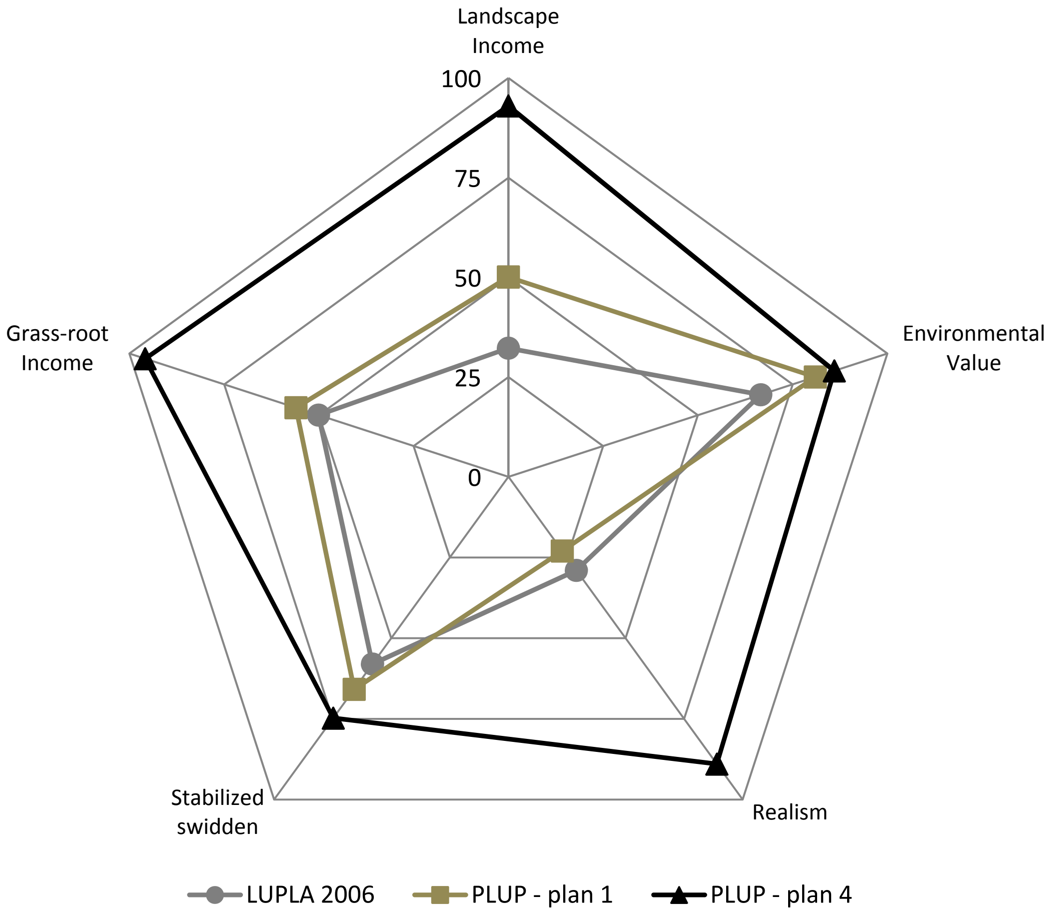


Figure 4. Comparison PLUP and LUPLA in Bouami Village.

The admission of failure of past land-use planning approaches relates to the constant search for suitable plans through a process of optimization. Most planning exercises have taken place at the national or regional level, grasping the biophysical heterogeneity of the landscape but overlooking the complexity of social situations. Such top-down plans designed and applied without any integration of local priorities, are unlikely to be implemented voluntarily, and often meet with passive resistance from local communities. In contrast, the bottom-up approach presented here demonstrates that a consensus can be found through an iterative and participatory exercise. This compromise exists between the bounds of the current land-use plan proposed by the villagers and the government land-use policy applied by the district. Essentially, it also presents a trade-off between scientific credibility and legitimacy vis-à-vis local communities (Bourgoin *et al.*, 2011).

Although the solution to land-use planning may be sub-optimal from a bio-physical point of view, its main advantage is that not only is it endorsed by the authorities, but also by the local communities. Local relevance and understanding are factors necessary to anchor the land-use planning process and outputs in a long-term perspective (Reed, 2008). Nonetheless, there are implicit unavoidable shortcomings and simplifications. The process deliberately overlooked large scale climatic, political and economic drivers with an important impact on land-use change (Lambin *et al.*, 2001; Lambin and Geist, 2006) since such difficult concepts are hard for local stakeholders to grasp and manipulate.

Nonetheless, the simple nature of the approach makes the tool flexible and adaptive to a range of situations in rural developing countries.

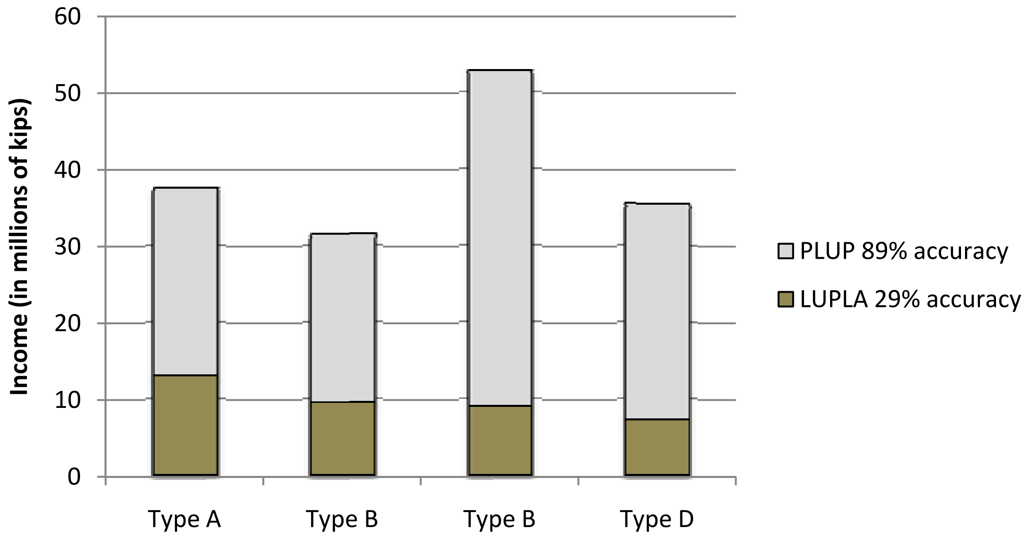


Figure 5. Income Differences between Various Household Types Resulting from Different Land-Use Planning Practices. The accuracy value comes from the Fitness Assessment Tool which also provides income estimates for the different household types.

Within the context of rural planning, models should be assessed on their operational value. For instance, the robustness of highly accurate and integrative holistic simulations is constrained by a few unreliable parameters such as the local census data. It is preferable that models facilitating a process such as PLUP need the capacity to be able to engage in wise decision-making instead of relying on intrinsic scientific qualities that leave local stakeholders out of the scenario.

From an analytical perspective, the Fitness Assessment Tool could prove efficient in discriminating between legitimate and sterile representations of land-use plans. If 'all models are wrong but some are useful' (Box, 1976), the facilitative approach undertaken with local communities helps in the creation of land-use plans that reach a high level of practical feasibility within the allocated time frame, and the skills and resources available. The involvement of the villagers in this iterative activity increases the ownership of outputs and readiness for compliance. Under the current national planning measures, assessment seems to be crucial in order to ensure that the planning activity can make it possible for the plans to be logically applied for the sake of improving local livelihoods. In fact, many concerns are emerging from the research community in Lao PDR regarding the forthcoming elaboration of PLUP at the village level to the national scale.

Under strong political pressure, the National Land Management Authority (NLMA), under the Office of the Prime Minister has the mandate to perform PLUP in the 47 poorest districts of Lao PDR by 2011 and throughout the entire country by 2015. With limited time allocated per village and non-updated training, it is likely that the same drawbacks observed in past and current pilot projects will be repeated. This article advocates that an ex-post analysis of a LUP is possible while providing support to government staff to use such a method as a PLUP routine. Currently, staff members from the District Land Management Authority and Department of Forestry and Agriculture are being trained to use this method on a routine basis in the district of Viengkham.

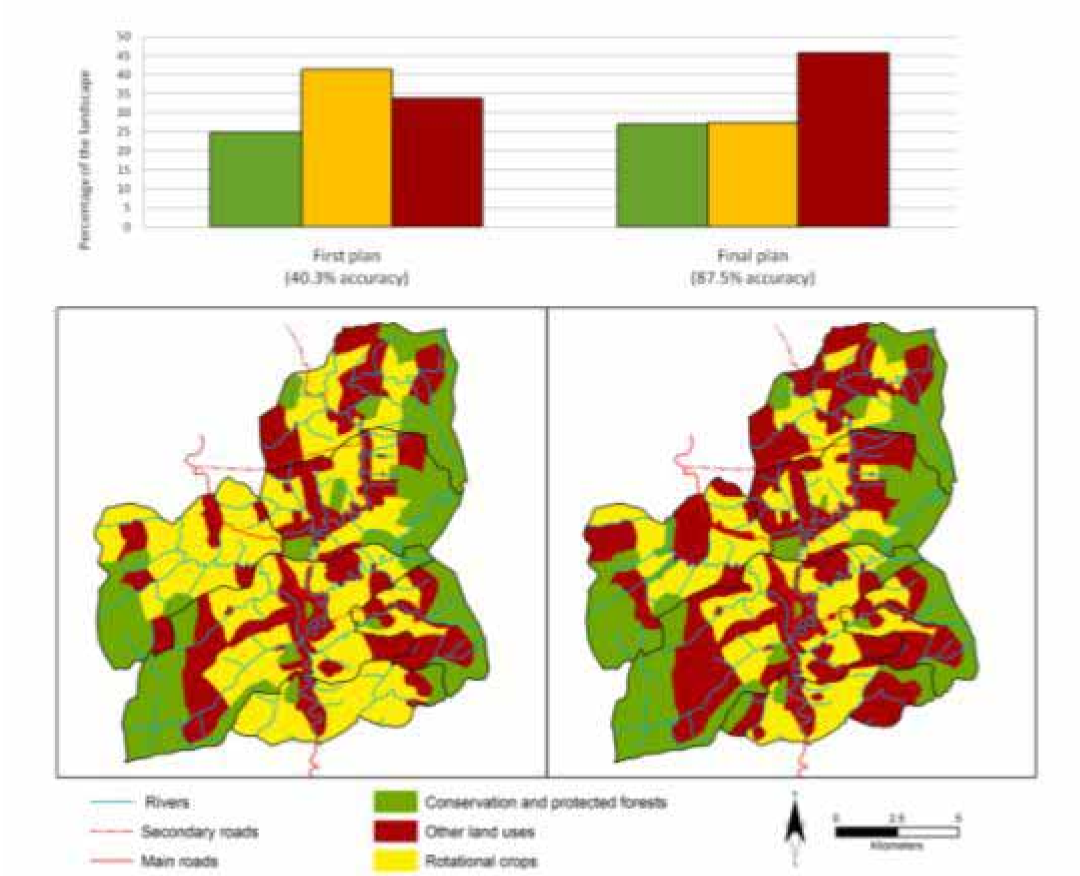


Figure 6. Landscape Evolution through the PLUP Iterative Process

Just as for the measurement of participation (Lestrelin *et al.*, 2011), so should the assessment of the accuracy of a land-use plan become a standard procedure because the development of ‘sharp’ plans increase the usefulness of land-use planning projects, and the likelihood of implementation and follow-up activities beyond the bounds of traditionally delusive success stories.

The development of future land use alternatives is motivated by a local desire to improve living conditions and livelihoods for a diversity of households in the village. In the past, the lack of monitoring and follow-up activities were identified as major constraints to sustainable landscape management and described as hindering the success of land-use plans (Lestrelin *et al.*, 2012). In addition, one can wonder if the problem of local ownership of plans does not lay higher up with the creation of land suitability maps that have been proven to be disconnected from the local reality, and of no use for extension services. The methodology proposed in this article can assist in clarifying undisclosed land tenure systems and in providing knowledge of the local views and needs envisaged within a ten-year time frame. Beyond the collective mapping and definition of land management rules attached to each land-use type, extension activities have to be developed to translate spatial agreements and good intentions into concrete action. Having realistic plans will facilitate the work of government institutions like the National Agriculture and Forestry Extension Services (NAFES) and international organizations (iNGOs) to implement development and agricultural extension projects in a clear setting, using land use plans that have emerged from the local demand and context.

On another level, Reduced Emissions from Deforestation and Forest Degradation (REDD) has been flourishing in Lao PDR and elsewhere as a payment for carbon efficient land management practices.

But entangled in international paradigms, the implantation phase is struggling with questions related to the demarcation of boundaries, community lands and resource rights as well as the anticipation of disputes between the state and communities without land titles (Phelps *et al.*, 2010; Dooley *et al.*, 2011). Moreover, local consultation remains, in general, mainly procedural and the legal frameworks supporting national strategies and sub-national implementation are overlooked. To overcome these constraints and succeed in affiliating a global scheme with local objectives, REDD must depend on existing national land policies to develop sub-national approaches. In this regard, PLUP is currently perceived as a key instrument for REDD implementation at the local level, providing guidance over rights to land, territories and resources. REDD could also provide first and foremost the long-term incentives prerequisite for compliance with land-use plans and lengthening of monitoring activities. A potential synergy is thus anticipated between the two mechanisms (Chokkalingam, 2010). However, only credible and participative plans will have a chance to really address local livelihoods.

5. Conclusion

The approach reported in this article aims at developing an efficient means to measure the output and outcome of a PLUP process as key components of an impact pathway. Allowing adaptive refinements of the land-use plans by the village land management committee through negotiation facilitated by district staff improved practical management of trade-offs between conservation and development objectives that previously were out of reach of village communities. At the rural village-wide scale, the method described in this article can help rationalize agricultural land development initiatives by creating land-use plans that are realistic with regard to local capabilities (both human and technological). Indeed, field experiences have shown that participation should not be romanticized. Safeguards are required from both sides (i.e. planners and communities) for a genuine engagement in formalizing and sharing their common vision of their future landscapes and designing innovative resource management strategies to implement their land-use plans together.

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