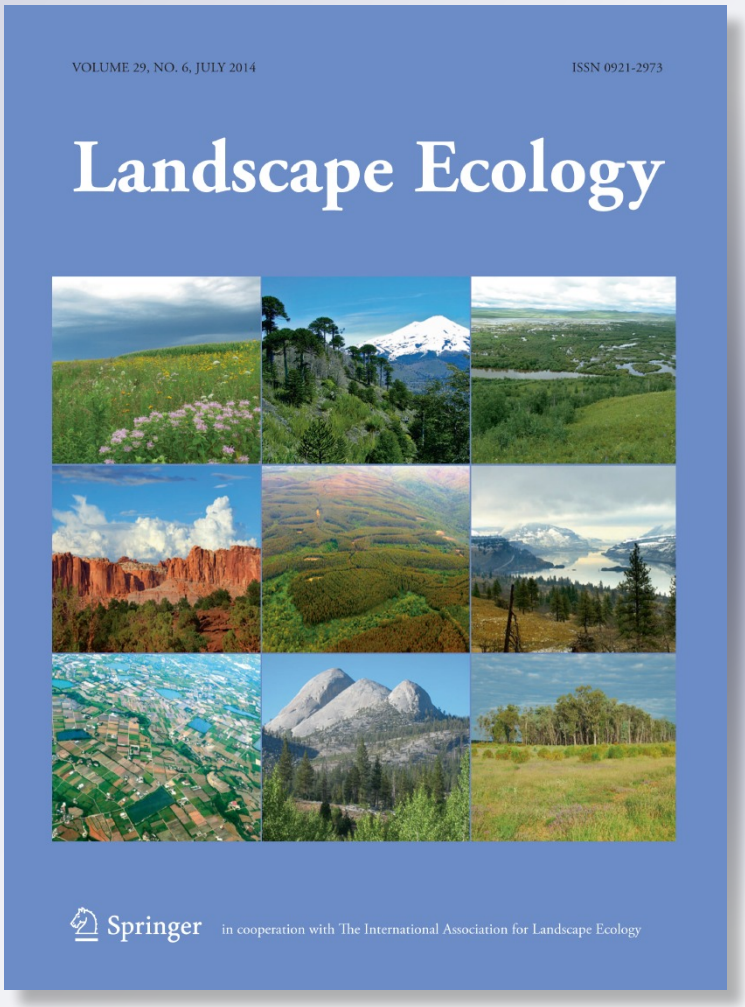
A model of the science–practice–policy interface in participatory land-use planning: lessons from Laos

Jean-Christophe Castella, Jeremy Bourgoin, Guillaume Lestrelin & Bounthanom Bouahom

Landscape Ecology

ISSN 0921-2973
Volume 29
Number 6

Landscape Ecol (2014) 29:1095-1107
DOI 10.1007/s10980-014-0043-x



Springer

Landscape Ecol (2014) 29:1095–1107
DOI 10.1007/s10980-014-0043-x

LANDSCAPE ECOLOGY IN PRACTICE

A model of the science–practice–policy interface in participatory land-use planning: lessons from Laos

Jean-Christophe Castella · Jeremy Bourgoin · Guillaume Lestrelin · Bounthanom Bouahom

Received: 23 February 2014 / Accepted: 8 May 2014 / Published online: 25 May 2014

Abstract An essential task of participatory action-research is to help close the policy implementation gap that leads to large discrepancies between policy frameworks and local practices. Too often, official regulations, laws and decrees fail to translate into concrete action on the ground. Loose institutional linkages between research, extension and local communities are often blamed as the main culprits for this gap. In turn, many stakeholders call for enhanced participation as a way to bring together scientists, development practitioners and local communities in negotiating competing claims for natural resources and designing realistic pathways towards sustainable development. Despite such general consensus about the value of participation, the latter cannot be decreed nor imposed. Participation is an emerging quality of collective-action and social-learning processes. In this paper, the experience of participatory land-use planning conducted in Laos serves to illustrate a model of the science–practice–policy interface that was developed to facilitate the interactions between three groups of stakeholders, i.e. scientists, planners and villagers, in designing future landscapes. Emphasis was put on developing an approach that is generic and adaptive enough to be applied nationally while engaging local communities in context-sensitive negotiations. The set of tools and methods developed through action-research contributed to enhanced communication and participation from initial consultation and cooperation stages towards collective decision-making and action. Both the activity of landscape design and the resulting patterns can be improved by incorporating landscape science in strategic multi-stakeholder negotiations.

Keywords Land-use planning · Participation · Boundary objects · Action-research · Landscape governance · Southeast Asia

J.-C. Castella (✉) · J. Bourgoin · G. Lestrelin
Institut de Recherche pour le Développement (IRD), PO Box 5992, Vientiane, Lao PDR
e-mail: j.castella@ird.fr

J.-C. Castella
Centre for International Forestry Research (CIFOR), Bogor, Indonesia

J.-C. Castella · J. Bourgoin · G. Lestrelin
Centre de Coopération Internationale en Recherche Agronomique pour le Développement (CIRAD), Montpellier, France

J. Bourgoin
School of Geography, Planning and Environmental Management, University of Queensland (UQ), Brisbane, QLD, Australia

B. Bouahom
National Agriculture and Forestry Research Institute (NAFRI), Agriculture and Forest Policy Research Centre, Vientiane, Lao PDR

Any discipline which is concerned with rational intervention in human affairs […] must both establish theory and engage in practice. Theory and practice will exhibit a groundless relationship, each generating the other, with neither being prime. This mutual development of theory and practice calls for action research in real situations, research in which the researcher has to allow the situation to take him/her where it will, research whose focus is the change process itself rather than some hypothesis under test. (Checkland 1985)

Introduction: the key role of action-research in land-use planning

Reconciling competing claims on natural resources

Since the Rio Conference on sustainable development in 1992, land-use planning (LUP) has been considered as a key policy instrument for engaging local communities in designing their future landscapes while decentralizing the governance of natural resources (Meadowcroft 1997). Under the banner of sustainable development, a large range of LUP approaches have been tested and many lessons have been drawn (Silberstein and Maser 2000; Sayer and Campbell 2004; Wollenberg et al. 2008). In the meantime, new issues have come to the fore of global policy agenda such as climate change, biodiversity depletion, land degradation and land-use intensification driven by international market trends. When touching the ground, policies negotiated at the global level (e.g. poverty alleviation, food security, biodiversity conservation, climate change mitigation through avoided deforestation) usually translate into some kind of LUP (Rudel and Meyfroidt 2014). In addition, powerful global corporations are involved in large-scale land acquisition, buying or leasing land that may or may not be cultivated and/or occupied. Very often, local communities are not consulted. "Resource grabbing" then happens when local people are deprived from the resources they used to get access to without proper compensation. There is a thin line, and often an overlap, between what would be considered as land grabbing or as lawful resources reallocation. Local community involvement in local LUP is therefore expected to reconcile competing claims on natural resources (Giller et al. 2008), while securing safeguards (e.g. land tenure rights of local population) so that policy instruments can be applied effectively on the ground. Consequently, the pathway towards sustainable landscape governance has to be negotiated by multiple groups of stakeholders involved in a complex network of social and spatial interactions distributed across scales (Ostrom 2012).

Bridging the gap between the rhetoric and the reality of participation

Landscape science addresses competing claims on natural resources and land management issues at multiple scales (Cash et al. 2006) by embracing the increasing complexity of the socio-ecological systems and governance mechanisms through interdisciplinary approaches integrating social and natural science perspectives (Moss 2000; Liu et al. 2007; Giller et al. 2008). Concepts such as adaptive co-management, social learning, multifunctionality, resilience or polycentricity provide theoretical frameworks to an emerging transdisciplinary landscape science that actively engages with diverse stakeholder groups, i.e. policy makers, lay citizens and other interest groups (Sayer and Campbell 2004; Reed et al. 2010; Ostrom 2012). Behind information and knowledge sharing, participation allows for the slow growth of relationships within which people take responsibility for their landscapes (Sancar 1993). Consequently, most of the policy instruments applied locally have gained a "P" for "participatory" in their acronym (e.g. PLUP for Participatory Land-Use Planning). Despite the strong engagement of scientists in action-research in providing cutting edge science to the production of relevant and locally specific scientific knowledge, there is often a missing link to local decision making (Faysse 2006; Wollenberg et al. 2008; Opdam et al. 2013). As a result, the contribution of landscape science to landscape governance is still limited with regard to the high level of expectation, especially in helping to solve the growing number of land-use conflicts and environmental problems in landscapes at local, regional, national and international levels (Tress et al. 2005; McAlpine et al. 2010; Opdam 2010; Conrad et al. 2011). Despite the scientific advances in landscape ecology and the emergence of new policy instruments in response to evolving development problems, the tools and methods applied on the ground by field practitioners and land-use planners to engage local stakeholders in problem-solving approaches have essentially remained the same (Sayer and

Campbell 2004). Innovative methods developed through pilot projects led by interdisciplinary research teams have often failed to translate theory into concrete changes in the everyday practice of development practitioners and decision makers (Nassauer and Opdam 2008). As a consequence, Beunen and Opdam (2011) urge the investigation of the role of scientific knowledge in local landscape planning.

Social learning and boundary objects

The "scientificity" of landscape planning is difficult to measure or attest using the criteria of positivist science. After Giller et al. (2008), we argue that the scientific credibility of a particular landscape design (i.e. one important step in the planning process) lies essentially in the quality of the negotiation that takes place during the design process itself. During negotiations, stakeholders engage in an iterative process of knowledge co-production through which they gradually change their understanding of the situation, build agreements and consequently adapt their practices (Steyaert et al. 2007). Social learning is about changing "understandings" and transforming individual worldviews through social interaction and border crossing between knowledge systems (Fazey et al. 2005; Reed et al. 2010). Boundary objects, or boundary spanning objects, are concrete artefacts (e.g. maps, 3D landscape models, role play games) that help people co-produce actionable knowledge from in situ recombination of indigenous and scientific knowledge during collective actions/simulations (Vinck 2009). Boundary objects have shown their relevance in facilitating the necessary translation of different forms of knowledge so that they can easily be mobilized, manipulated and reinterpreted by different stakeholders during negotiation processes (Carlile 2002; Cash et al. 2003). They can thus improve the coordination mechanisms across disciplines (Star and Griesemer 1989) and they facilitate the mediation process between multiple stakeholders (i.e. researchers, practitioners, policy makers, local authorities and communities) (Cash et al. 2003). In a PLUP context, a multi-stakeholder "negotiation platform" may be composed of (i) a negotiation arena allowing interactions between individuals, (ii) boundary objects that support mediation through facilitated communication, translation, visualization, etc., (iii) a group of people in charge of negotiating land-use plans on behalf of their respective stakeholder groups, and possibly (iv) a boundary organization in charge of facilitating stakeholder interactions within the negotiation arena (Clark et al. 2011). The latter organization may be a formal, dedicated institution or an *ad hoc* institution that emerges in response to a problem that needs to be tackled collectively.

The case study presented in this paper is grounded in the above theoretical framework. It builds on an experiment of participatory LUP conducted in Laos from 2008 to 2013. While a longer term perspective is necessary before actual impact on landscapes and livelihoods can be documented—Cash et al. (2003) suggest that a decade should be a reasonable time span to assess such impact—the emergence of a model of the science–practice–policy interface for PLUP is described here together with the adaptations of this initial model and associated boundary organization to a changing institutional environment. The "social life" of the model—i.e. how it evolved *in time* to fit the objectives and resources of different projects and *in space* to fit different socio-ecological contexts—is further reported. Finally, the value of the model is assessed, building on notions of legitimacy, salience and credibility proposed by Cash et al. (2003).

Promises and premises of PLUP in Laos

Pre-PLUP approaches: limited participation leading to poor local accountability and low impact

Since the early 1990s, a Land-use Planning and Land Allocation (LUP/LA) program has been implemented throughout Laos. By increasing land tenure security, LUP/LA was expected to encourage private investment, agricultural intensification and commoditization, and importantly, to stabilize slash-and-burn shifting cultivation and preserve the country's natural resources (Vandergeest 2003; Fujita and Phanvilay 2008; Lestrelin et al. 2012). Through these processes, the central government formally recognized customary rights to use natural resources and provided local institutions with important responsibilities (e.g. 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 foster more balanced and environmentally sound development trajectories (e.g. WCED 1987). However, according to various studies, the implementation of LUP/LA in Laos did not always encounter the success predicted by the Laotian authorities (Ducourtieux et al. 2005; Fujita and Phanvilay 2008; Lestrelin 2010; Lestrelin et al. 2011). Hasty implementation and the limited facilitation skills of implementers did not allow villagers to fully grasp the issues debated and get involved in the crucial stages of land zoning and drafting of village plans and regulations (GTZ 2004). In turn, limited participation resulted in confusion regarding land-allocation and -management decisions and provided little incentive for local populations to comply with land-use plans (Fujita and Phanvilay 2008). In many cases, locals were simply asked to comply with plans and regulations that they did not contribute to defining and did not fully comprehend, without being provided the necessary means to do so (Lestrelin et al. 2012). In 2007, a national review of past LUP experiences concluded that increased participation of local communities was necessary to achieve actual impact. The former LUP/LA was abandoned and a manual for PLUP was officially released in 2009 (MAF-NLMA 2009).

The first generation of PLUP: passive participation and unbalanced power relations

Yet, according to research conducted by Lestrelin et al. (2011) in Luang Prabang province (Fig. 1), the first PLUP experiments remained very similar to LUP/LA as practitioners were still lacking a clear operational framework (i.e. know-how, tools and methods). Despite support from international organizations, implementers of the PLUP approach had little experience in participatory approaches and the strict application of the tools and procedures listed in the PLUP manual tended to overlook the socio-economic context and the reactions of local people collected during the preparatory and planning phases. This had important consequences for the effectiveness of the process and its outcomes. Local participants' poor understanding of landscape planning in general and of the intentions of planning practitioners in particular led to very limited local inputs. In fact, land-use plans were prepared by district staff with technical support from national specialists. Under these conditions, only the use of digital maps and GPS points made PLUP different from former LUP/LA methods. Local actors remained simple observers of the process and participation could only be considered as their presence in the room.

The study by Lestrelin et al. (2011) further highlighted large discrepancies in the way national LUP guidelines were reinterpreted locally by implementing agencies. In Phonxay District (Fig. 1), for example, LUP was largely based on local claims and tended to reinforce existing land uses. In contrast, in Viengkham District, in the vicinity of the Nam Et-Phou Loey National Protected Area (NPA), large tracts of forest had been set aside by district officers for conservation. Thus, the ratio of agricultural land to total village land in the study villages of Phonxay District varied between 71 and 82 %, while in Viengkham District the same ratio varied between 44 and 66 %. These examples illustrate the way multiple interpretations of the same policy can engender a considerable diversity of local implementation procedures (Bourgoin 2012). Without proper training of the land-use planners and local stakeholders, the first land-use plan that was put forward by influential individuals tended to be adopted by the whole group through a passive and consensual process.

Designing a second generation of PLUP: participatory action-research without social learning

Early reports on pilot PLUP experiments pointed toward the need for innovative methods in order to actually apply the core principles of PLUP—i.e. enhanced participation and integration of scales and knowledge (Lestrelin et al. 2011; Pfund et al. 2011). Researchers from the National Agriculture and Forestry Research Institute (NAFRI) were called upon to mobilize scientific approaches in order to help reduce the gap between PLUP principles and practices. With the support of the Centre for International Forestry Research (CIFOR) and the Institute of Research for Development (IRD), a participatory action-research was launched in 2008 (Landscape Mosaics 2010; Colfer et al. 2011). The project was expected to provide knowledge about the functioning of the socio-ecological system and achieve a better integration of the conservation and livelihood aspects in LUP (Frost 2008). A large range of landscape assessment methods, e.g. participatory mapping, visioning exercises,

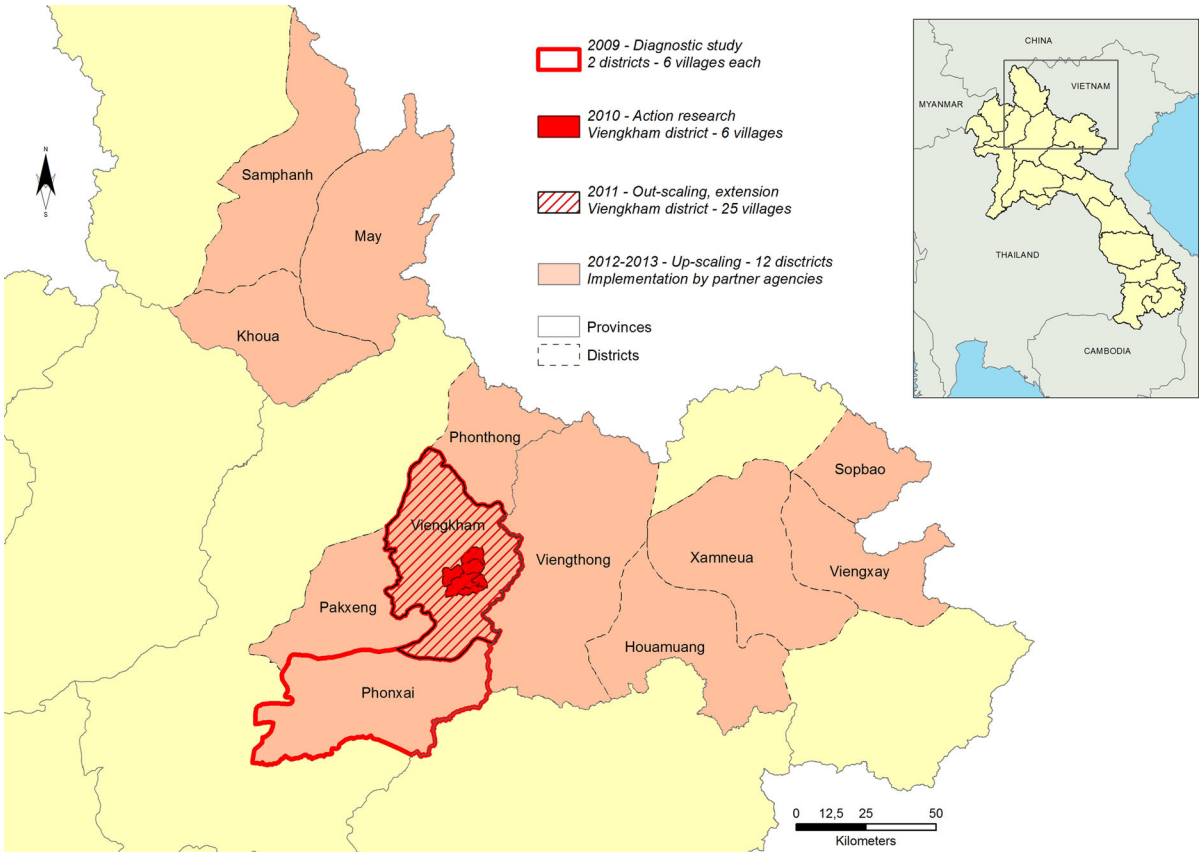


Fig. 1 Case study sites and chronology of PLUP action-research in Laos

multidisciplinary landscape assessment (Sheil et al. 2002) and participatory photography (Belcher and Roberts 2012), were deployed. They were selected and combined in successive workshops involving a large range of scientific disciplines so that a consensus could emerge about the interdisciplinary research orientations and implementation mechanisms (Frost 2008). Land-use changes and their likely implications were studied, as well as people's expectations, aspirations and concerns regarding LUP (Colfer and Pfund 2010). Data collection encompassed the perspectives of both scientists and local communities in characterizing local livelihoods and how they influence landscape changes (Belcher et al. 2013; Boissière et al. 2014). Participatory soil maps, data on spatial distribution and management of non-timber forest products (NTFPs), land-use change analysis based on chronological series of remote sensing data at the village and landscape scales were combined with household surveys, field measurements and participatory livelihood assessments (Castella et al. 2013b). But despite the clear objectives and collaborative focus between scientific disciplines, the boundary work between scientists and practitioners remained limited (Clark et al. 2011). The LUP process remained vague for all project participants during the initial 2 years (2008–2009) that were essentially dedicated to data collection and diagnostic studies (Colfer et al. 2011). While local perspectives on land management were recognized, the initial research design admittedly led to a "knowledge puzzle" composed of multiple layers of disconnected information. Beyond the rhetoric of participation, very little was known about how this knowledge would be mobilized during the course of the PLUP action-research.

A model of the science–practice–policy interface in PLUP

The framework proposed by Nassauer and Opdam (2008) was then used to conceptualize the role of science in PLUP and its potential impacts on landscapes (Fig. 2). Three stakeholder groups, i.e. a multidisciplinary research team, development practitioners from province and district line agencies, and village communities, were involved in a series of workshops aimed at reconciling local landscape design with national LUP guidelines. The sequence of actions that makes up the successive stages of the PLUP process was gradually co-constructed. A model of the science–practice–policy interface gradually emerged from boundary work, i.e. trial and error experiments where tools were tested, gradually refined and then validated collectively. This one-year adaptive learning process took place in 2010 in Viengkham district (Fig. 1).

Emergence of a PLUP model

Members of the land-management committees in the six villages of Muongmuay village cluster were involved in a series of learning and design activities. After elicitation of local knowledge related to landscapes and livelihoods, focus group discussions were used to generate the parameters of a role-play tool that simulated LUP. The role-play, called "PLUP Fiction", involved both the villagers and the district staff in a PLUP experiment based on a generic landscape (Bourgoin and Castella 2011). This "boundary object" is a learning tool for practitioners to understand the local context in which the LUP takes place while local communities are engaged in a negotiation process on current and future land-use plans. They discover PLUP and are introduced to the practical implications of LUP for livelihoods, landscape management and the socio-economic development of their village (Bourgoin and Castella 2011). By playing "PLUP Fiction", both groups of participants gradually became better negotiators in the land-zoning process (Bourgoin et al. 2012).

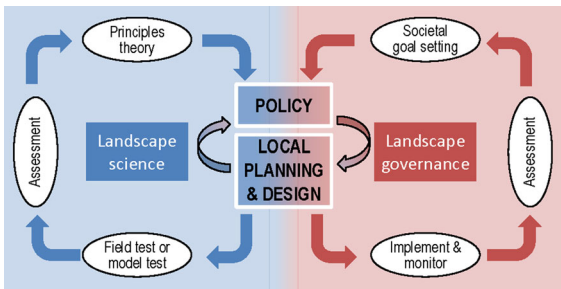


Fig. 2 Conceptual framework [adapted from Nassauer and Opdam (2008)]

Actual land zoning subsequently took place on a 3D model that provided a realistic representation of their village landscape. The 3D perspective enhanced local participation, helped participants to visualize alternative landscape scenarios and facilitated negotiation between stakeholder groups (Rambaldi 2010). Thus, most members of the village land-management committee, who were often left out of the discussions because of their limited capacity to comprehend landscape features on a topographic map or a satellite image, could be brought back into the negotiation by using a relief model of their village landscape as a boundary object. A geographic information system (GIS) was then coupled with a simple cost/benefit analysis model that was parameterized by the villagers themselves (Bourgoin et al. 2012; Castella et al. 2013a). Facilitators could capture real-time information on the land-use plan under discussion and present corresponding socio-economic and environmental returns. Providing feedback on the socio-economic and ecological implications of different land-use scenarios proved essential to make the stakes visible for stakeholders. Without feedback, the latter may remain in their respective positions with no idea of the potential long-term impacts on landscapes and livelihoods. Successive rounds of negotiation led the participants to a final pattern of land zoning that satisfied them all. In each of the six pilot villages, the whole LUP process took one week of constant interactions between the action-research team and the villagers (Bourgoin et al. 2012). Through iterative design, local stakeholders gradually refined their landscape plan and tested the introduction of innovative cropping and animal husbandry systems by changing the parameters of the simulation. The multi-stakeholder negotiation platform was finally made using a combination of participatory and spatially explicit tools that are described in detail in Bourgoin et al. (2012).

Producing actionable knowledge through PLUP

A key lesson from the initial landscape design experiments is that participants tend to retain only the information that is salient, from their perspective. Three types of knowledge were mobilized to gradually negotiate a balanced plan between two extreme scenarios: constraining forest conservation policy imposed by district staff versus granting local community whatever they request, i.e. usually maintaining the status quo on current land-use system.

- Conditions of the socio-ecological system, i.e. livelihood structure in terms of land, labour, capital, differentiated access to natural resources, local aspirations and options for development, population trends, etc.,
- Performance parameters of the different land uses, i.e. inputs in labour and capital per hectare, outputs in monetary value from agriculture, livestock and NTFPs collection,
- Spatial management of natural resources and landscape patterns corresponding to the successive scenarios negotiated on the 3D model and/or digitized with GIS software.

For each component of the PLUP knowledgebase, three levels of data precision can be achieved depending on the resources and time available for data collection. First, secondary data are compiled and mobilized to describe the main types of socio-ecological systems, land-use types and landscape patterns found in the target region. A typology can be established that helps implementing staff to associate the situation of the target village with known "village models". This background referential saves time as it avoids documenting the whole village situation before developing an understanding of the issues at hand and the potential development pathways. It also avoids possible mistakes by providing realistic values for all parameters, e.g. the existing cropping or livestock systems, and thus helps in discarding unrealistic responses to surveys or wrong measurements. Second, declarative surveys from local stakeholders generate locally specific data that are essential to co-construct a convincing village landscape for PLUP. Data collection through participatory methods helps to build trust between district staff and village communities, which is later reinvested in the PLUP negotiations (Bourgoin 2012). However, in some cases, the level of detail and accuracy of the responses provided by the informants may not meet the requirements necessary to plan concrete actions or provide sufficiently robust grounds to convince policy makers. More expensive and time-consuming direct measurements are then necessary, such as plot measurements to better estimate yields, collection of GPS points for detailed demarcation of land zones, etc.

A pragmatic approach to data collection consists in gradually increasing the quality of the information and precision of data along the successive stages of the PLUP process. Coarse data are first collected during the diagnostic phase before more detailed information from declarative surveys is used during the planning negotiation. Negotiators do not usually need precise data to engage in the discussion. Broad assessment of the impact of land-use changes on household economics, on village biodiversity and carbon sequestration turned out to be sufficient to engage members of the village land-management committees in discussing future landscapes (Bourgoin et al. 2012, 2013). Higher levels of precision are only necessary at the implementation phase, i.e. the translation of the land-use plan in concrete extension activities specific to the different land-use types. Too many village plans stop at the end of the planning phase and never translate into concrete activities, therefore wasting all the efforts and resources invested in collecting highly precise data that are never used (Castella et al. 2013a).

Institutionalizing multi-stakeholder negotiation

The model of the science–practice–policy interface that emerged from the PLUP experiments was gradually formalized so that it could be better disseminated and institutionalized. Figure 3 shows the major changes from (a) a linear, normative application of the PLUP principles as prescribed in the 2009 PLUP manual (Lestrelin et al. 2011) to (b) a strategic negotiation involving multiple stakeholder groups into an iterative planning process and scenario analysis (Bourgoin et al. 2012). As described above, diverse actionable knowledge is used in the process to collectively describe the landscape, build LUP capacity and explore scenarios (Fig. 3). The combined use of boundary objects in the negotiation platform supports the iterative process of scenario development, assessment, rejection and finally adoption, once all parties agree with the output of the negotiation

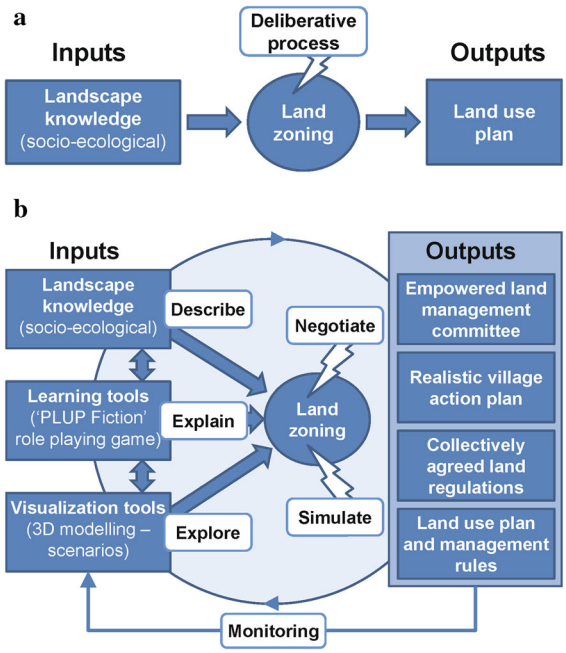


Fig. 3 **a** The original linear model of land-use planning **b** The proposed platform for strategic negotiation in land-use planning

(Bourgoin et al. 2012). As a result, the negotiation that takes place during LUP is systematized and rationalized, i.e. facilitators guide participants through a series of deliberative processes and provide necessary—and sufficient—information to feed decision making. The facilitation process does not go without challenges, especially in the case of tensions or frustrations between stakeholders with contradictory views or objectives. But a negotiation platform is in place and deliberative mechanisms are collectively agreed to address these issues openly and transparently so that some kind of agreement can be reached. It is in sharp contrast to previous negotiation practices (Fig. 3a) where participants tended to blindly agree to everything as they did not really understand the stakes at hand in LUP nor the tools and methods used (Lestrelin et al. 2011). The proposed model turned participation from mere meeting attendance into strategic negotiation involving participants with unequal capacities with opportunities to intervene, mobilize resources and influence outcomes (Neef and Neubert 2011).

In line with the model of the science–practice–policy interface proposed by Giller et al. (2008) for natural resources management (Fig. 4), the negotiation can be described as a generative dance between knowledge and knowing (Teulier and Hubert 2004). Through participatory simulations, indigenous and scientific knowledge is shared, combined, contested among participants through a learning process leading to knowing. The activities of designing, describing, explaining and exploring are combined in such a way (see arrows in Fig. 4, after Giller et al. 2008) as to inform collective decisions that engage the future of the village community. The final stage of the planning process consists in engaging local stakeholders (i.e. district planners and local communities) in long-term monitoring (Fig. 3b) which is deemed necessary to revisit their plans regularly. The actual impacts of PLUP on local landscapes and livelihoods depend to a large extent on how the actionable knowledge generated during the planning process is carried over by members of the village land-management committee to other villagers who did not take part in the PLUP negotiations and other stakeholders, such as private investors. Through the PLUP process, the participants gain legitimacy vis-à-vis other people in negotiating land issues. They are empowered as land-use planners. Members of the village land-management committee are then expected to manage land conflicts, report and sanction deviant behaviours, and guarantee compliance to the plan vis-à-vis third parties. This emerging local institution supported by the relevant knowledge networks is key to the success of PLUP (Bourgoin et al. 2012).

Generalization pathways: towards a unified model of the science–practice–policy interface

Beyond the initial pilot testing that ended in December 2010, researchers together with development practitioners continued strengthening the science–practice–policy interface model to facilitate implementation at a larger scale. Three complementary generalization pathways were explored in a subsequent phase of the project that started in early 2011. They are analysed here through the analytical lenses of credibility, legitimacy and salience proposed by Cash et al. (2003).

Credibility for the scientific community

Generating scientifically sound knowledge from pilot experiments requires a comparison of the contextual,

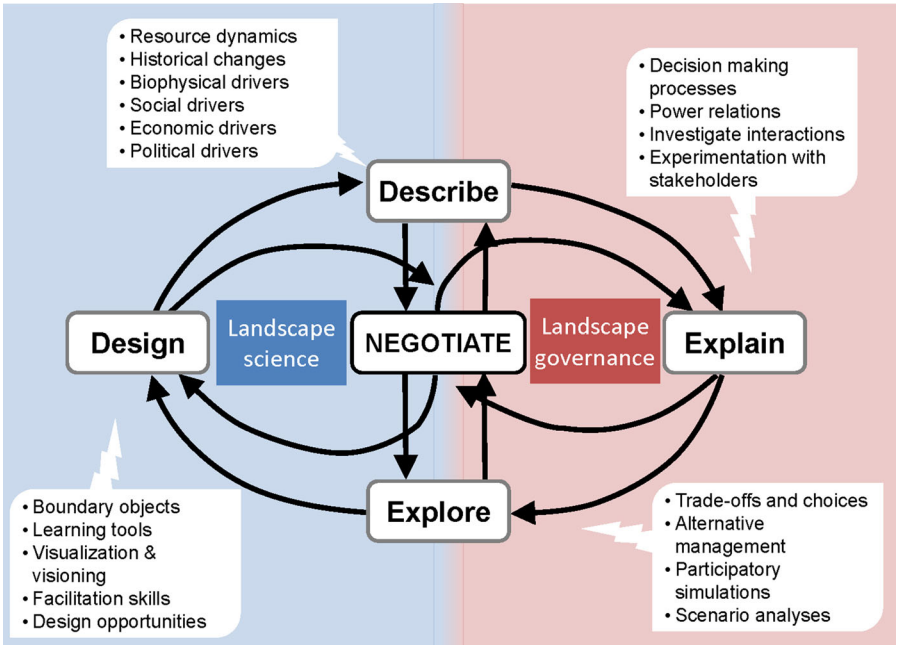


Fig. 4 The generative dance between knowledge and knowing in landscape design [adapted from Giller et al. (2008)]

empirical results to a theoretical framework. In the case of action-research, theory and practice are co-constructed in an interactive process of contextualization and de-contextualization, i.e. generalization (Checkland 1985). The 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 and monitoring, impeding the implementation and local adoption of land-use policies (Ducourtieux et al. 2005; Lestrelin et al. 2011). In the case of PLUP, the quality of the output is directly linked to the quality of the participatory process that gave rise to it. Consequently, the scientific credibility of the proposed model emerges from the adaptive co-learning process between theory and practice (Fig. 3b). Two categories of knowledge need to be scientifically validated in this context: realism of the designed landscape, i.e. agroecological and socio-economic performances of the land-use plan, and quality of the land-use negotiation, i.e. participatory process that led to the plan. Cash et al. Bourgoin (2012) addressed the former category and suggested criteria for data quality check. Lestrelin et al. (2011) developed an approach to measure the level of community participation in LUP. Indicators were proposed to assess the quality of the community engagement in LUP and to compare different methodological approaches and/or implementation protocols. Indeed, with the many projects involved in PLUP, in the absence of harmonized methods and procedures, the quality of the work performed on the ground is difficult to assess. Methods for assessing the gap between planning objectives and their actual achievements are essential to maintaining the quality of the PLUP process when implemented country-wide. Put together, the monitoring approaches proposed by Lestrelin et al. (2011) and Bourgoin (2012) provide safeguards for both sides, i.e. inexperienced planners and community members, and support in designing future landscapes (Fig. 3b). In addition, they can also be used as an instrument to assess the credibility of land-use plans produced by other methods, improve their accuracy and ultimately pave the way to LUP "certification".

Legitimacy for practitioners

Researchers teamed-up with a development NGO (Agrisud International) to replicate the innovative PLUP model in a larger number of villages (n = 25)

(Fig. 1). The method had to be adapted to a smaller team of implementers: four district staff as compared to the ten individuals (including national and international researchers and provincial staff) who were involved in fieldwork in the previous period. Researchers were involved in the adaptation of the approach through co-learning in real implementation situations with village communities. They were involved in capacity building of their district partners so as to give them larger autonomy in the implementation process. Facilitation methods for focus group discussions were improved so that local staff felt more confident in their interactions with villagers. They also learnt technical skills such as constructing 3D models of village landscapes with villagers, zoning land use, computing parameters in Excel files and using GIS software (Quantum GIS). Beyond the technical skills they gained through practice, district staff were empowered vis-à-vis village communities by the agricultural extension activities they could propose on behalf of the development project for each land-use zone collectively defined. They generated actionable knowledge that could lead to real outcomes beyond the landscape planning exercise. They proved that the job was reproducible by others and they could gradually assert their legitimacy as stakeholders. Last but not least, they contributed to the development of a handbook and toolbox on PLUP field implementation (Castella et al. 2013a). The latter served as a training support for practitioners who engaged in large-scale implementation in other districts and at the national level. Two projects have contributed so far to upscaling the approach: an integrated development project undertaking LUP in three provinces (Luang Prabang, Huaphan and Phongsaly) is using the model in 300 villages, while another project has tested and adapted the model to the strengthening of bamboo value chains in Huaphan Province. The main lesson from this extension process is that the flexibility provided by the method is well adapted to the diversity of local environments and to the specific objectives of each project. The method has been modified but the overall principles were maintained. A community of practice should gradually emerge through enhanced legitimacy gained from the experience of multiple projects in facilitating PLUP negotiations.

Salience for policy makers

The rapid dissemination of the method demonstrated the salience of the proposed negotiation platform in responding to the challenges of PLUP implementation as presented above and in Bourgoin et al. (2012). The contextual relevance of the method was guaranteed by its very process of bottom-up emergence through action-research. Upscaling required drawing and sharing lessons that would help in generalizing and institutionalizing the approach beyond a single district, up to the national level. The researchers thus engaged in a policy dialogue at the national level that involved a large number of projects coordinated by bilateral and multilateral cooperation agencies and NGOs working with the same line agencies from the Ministry of Agriculture and Forestry and the Ministry of National Resources and Environment. The objective of such dialogue was to get feedback from diverse PLUP implementation initiatives that followed the publication of the PLUP manual so that experiences could be shared and methods could be harmonized. A limited number of working groups were set up on key topics of interest: e.g. reconciling land-use plans developed at multiple scales, improving local participation in LUP, harmonizing land-use zoning techniques and methods, land registration and titling, knowledge management, land-use-plan implementation and monitoring.

The knowledge networks that emerged at multiple scales through the landscape design process are boundary organizations that become visible in their capacity to harmonize methods across institutions and sectors, i.e. ministries and line agencies, and across scales, i.e. from village to district, province and national levels. A real challenge is to nurture and sustain such boundary organizations despite staff turnover and institutional changes (Colfer et al. 2011). Too often new forms of participation are applied with limited consideration of the context in which they operate. There is a tendency to focus on the participatory procedure itself, at the expense of ignoring contextual factors, such as the role of local bureaucracies, which can influence the effectiveness of the process and its outcomes. Local administrations should be better integrated into the boundary organization that supports social learning in landscape design.

Conclusion

In this paper, we argue that science can contribute to bridging the gap between policies and practices if it focuses on participation, negotiation and co-learning processes rather than simply extracting data and collating comprehensive databases in the belief that scientific knowledge will be useful at a later stage. A key element for bridging the gap is to "operationalize" landscape science through a dedicated model of the science–practice–policy interface. Using the conceptual framework of Nassauer and Opdam (2008), landscape design was conceived as a combination of processes and products that bring about intentional landscape change. Through landscape design, different groups of stakeholders, i.e. scientists, practitioners and community members are negotiating the spatial organization of landscapes. Together, they bring scientific knowledge into decision making by negotiating trade-offs between different claims, needs and land uses. When research and policy actors intensively engage with "ordinary" citizens, their ideas about public participation can shift in a more inclusive direction. Beyond scientific knowledge, scientific posture is essential to support local planning and inclusive decision making in landscape design. In this regard, landscape visualization and learning tools designed through action-research have proved useful to: (i) enhance participation, i.e. from mere meeting attendance to strategic negotiation, (ii) empower all stakeholders groups through the emergence of an *ad-hoc* knowledge network, and (iii) increase local legitimacy and policy salience through scenario exploration.

Acknowledgments This research was conducted by the National Agriculture and Forestry Research Institute (NAFRI, Laos) within the framework of the Catch-Up Program (Comprehensive Analysis of the Trajectories of Changes) supported by the Institut de Recherche pour le Développement (IRD, France) and the Center for International Forestry Research (CIFOR, Indonesia) and the Landscape Mosaics Project implemented in partnership with CIFOR and funded by the Swiss Agency for Development and Cooperation (SDC). The study was also supported by The Agrobiodiversity Initiative (TABI) funded by SDC, in Phonxay District and by the Upland Research and Capacity Development Program (URDP) funded by the Swedish International Development Cooperation Agency (SIDA) in Viengkham District of Luang Prabang Province. Extension activities in Viengkham District were developed in partnership with the project on "Food security for Women and Rural Poor in Viengkham District, Luang Prabang Province" coordinated by Agrisud International and funded by the European Commission (EuropeAid/127415/L/ACT/LA). PLUP implementation at larger scale was supported by the GIZ-funded Northern Uplands Integrated Rural Development Programme (NU-IRDP) and the EU-AFD funded GRET-SNV Bamboo Sector project. The authors thank all villagers, researchers and practitioners from government agencies who were involved in this collective venture. Positive comments and constructive by two anonymous reviewers were highly appreciated.

References

Belcher BM, Roberts M (2012) Assessing participatory photography as a method to understand local perspectives on environment and development in northern Lao PDR. For Trees Livelihoods 21(3):145–157

Belcher B, Bastide F, Castella JC, Boissière M (2013) Development of a village-level livelihood monitoring tool: A case-study in Viengkham District, Lao PDR. Int For Rev 15(1):48–59

Beunen R, Opdam P (2011) When landscape planning becomes landscape governance, what happens to the science? Landsc Urban Plan 100:324–326

Boissière M, Bastide F, Basuki I, Pfund JL, Boucard A (2014) Can we make participatory NTFP monitoring work? Lessons learnt from the development of a multistakeholder system in Northern Laos. Biodivers Conserv 23:149–170

Bourgoin J (2012) Sharpening the understanding of socio-ecological landscapes in participatory land use planning: a case study in Lao PDR. Appl Geog 34:99–110

Bourgoin J, Castella JC (2011) "PLUP fiction": landscape simulation for participatory land use planning in Northern Laos. Mt Res Dev 31(2):78–88

Bourgoin J, Castella JC, Pullar D, Lestrelin G, Bouahom B (2012) Toward a land zoning negotiation support platform: "tips and tricks" for participatory land use planning in Laos. Landsc Urban Plan 104:270–278

Bourgoin J, Castella JC, Hett C, Lestrelin G, Heinimann A (2013) Engaging local communities in low emissions land use planning: a case study in Laos. Ecol Soc 18(2):9

Carlile P (2002) A pragmatic view of knowledge and boundaries: boundary objects in new product development. Org Sci 13:442–455

Cash DW, Clark WC, Alcock F, Dickson NM, Eckley N, Guston DH et al (2003) Knowledge systems for sustainable development. Proc Natl Acad Sci USA 100:8086–8091

Cash DW, Adger WN, Berkes F, Garden P, Lebel L, Olsson P, Pritchard L, Young O (2006) Scale and cross-scale dynamics: governance and information in a multilevel world. Ecol Soc 11(2):8

Castella JC, Bourgoin J, Cottet L, Drouillat M, Nanthavong K, Phatsalin S, Lestrelin G, Bouahom B, Thepphavanh M (2013a) Handbook on participatory land use planning. Methods and tools developed and tested in Viengkham District, Luang Prabang Province. NAFRI–IRD–CIFOR, Vientiane

Castella JC, Lestrelin G, Hett C, Bourgoin J, Fitriana YR, Heinimann A, Pfund JL (2013b) Effects of landscape segregation on livelihood vulnerability: moving from extensive

shifting cultivation to rotational agriculture and natural forests in northern Laos. Hum Ecol 41(1):63–76
Checkland P (1985) Achieving "desirable and feasible" change: an application of soft systems methodology. J Oper Res Soc 36:821–831
Clark WC, Tomich TP, van Noordwijk M, Guston D, Catacutan D, Dickson NM, McNie E (2011) Boundary work for sustainable development: natural resource management at the consultative group on international agricultural research (CGIAR). Proc Natl Acad Sci USA. doi:10.1073/pnas.0900231108
Colfer CJP, Pfund JL (eds) (2010) Collaborative governance of tropical landscapes. Earthscan, London
Colfer CJP, Andriamampandry E, Asaha S, Lyimo E, Martini E, Pfund JL, Watts J (2011) Participatory action research for catalyzing adaptive management: Analysis of a "fits and starts" process. J Environ Sci Eng 5:28–43
Conrad E, Christie M, Fazey I (2011) Is research keeping up with changes in landscape policy? A review of the literature. J Environ Manag 92:2097–2108
Ducourtieux O, Laffort JR, Sacklokham S (2005) Land policy and farming practices in Laos. Dev Change 36(3):499–526
Faysse N (2006) Troubles on the way: an analysis of the challenges faced by multi-stakeholder platforms. Nat Res Forum 30:219–229
Fazey I, Fazey JA, Fazey DMA (2005) Learning more effectively from experience. Ecol Soc 10(2):4
Frost PGH (2008) Action research in landscape mosaics: approaches and methods. A report of and reflections on a workshop held in Lombok, Indonesia, 3–6 December 2007. CIFOR, Bogor. www.biodiversityplatform.cgiar.org. Accessed Feb 2014
Fujita Y, Phanvilay K (2008) Land and forest allocation in Lao People's Democratic Republic: comparison of case studies from community-based natural resource management research. Soc Nat Res 21:120–133
Giller K, Leeuwis C, Andersson JA, Andriesse W, Brouwer A, Frost P, Hebinck P, Heitkönig I, van Ittersum MK, Koning N, Ruben R, Slingerland M, Udo H, Veldkamp T, van de Vijver C, van Wijk MT, Windmeijer P (2008) Competing claims on natural resources: what role for science? Ecol Soc 13(2):34
GTZ (2004) Study on land allocation to individual households in rural areas of Lao PDR. Deutsche Gesellschaftfür Technische Zusammenarbeit, Vientiane
Landscape Mosaics Project (2010) Building sustainable landscape management in the Lao PDR Biodiversity Platform Policy Brief, CIFOR, Bogor. www.biodiversityplatform.cgiar.org. Accessed Feb 2014
Lestrelin G (2010) Land degradation in the Lao PDR: discourses and policy. Land Use Policy 27:424–439
Lestrelin G, Bourgoin J, Bouahom B, Castella JC (2011) Measuring participation: case studies on village land use planning in northern Lao PDR. Appl Geog 31:950–958
Lestrelin G, Castella JC, Bourgoin J (2012) Territorializing sustainable development: the politics of land-use planning in the Lao PDR. J Contemp Asia 42(4):581–602
Liu J, Dietz T, Carpenter SR, Alberti M, Folke C, Moran E, Pell AN, Deadman P, Kratz T, Lubchenco J, Ostrom E, Ouyang Z, Provencher W, Redman CL, Schneider SH, Taylor WW (2007) Complexity of coupled human and natural systems. Science 317:1513–1516
MAF-NLMA (2009) Manual on participatory agriculture and forest land use planning at village and village cluster levels. Ministry of Agriculture and Forestry and National Land Management Authority, Vientiane
McAlpine CA, Seabrook LM, Rhodes JR, Maron M, Smith C, Bowen ME, Butler SA, Powell O, Ryan JG, Fyfe CT, Adams-Hosking C, Smith A, Robertson O, Howes A, Cattarino L (2010) Can a problem-solving approach strengthen landscape ecology's contribution to sustainable landscape planning? Landscape Ecol 25:1155–1168
Meadowcroft J (1997) Planning, democracy and the challenge of sustainable development. Int Polit Sci Rev 18(2):167–189
Moss MR (2000) Interdisciplinarity, landscape ecology and the "transformation of agricultural landscapes". Landsc Ecol 15:303–311
Nassauer JI, Opdam P (2008) Design in science: extending the landscape ecology paradigm. Landscape Ecol 23:633–644
Neef A, Neubert D (2011) Stakeholder participation in agricultural research project: a conceptual framework for reflection and decision-making. Agric Hum Val 28(2):179–194
Opdam P (2010) Learning science from practice. Landscape Ecol 25:821–823
Opdam P, Nassauer JI, Wang Z, Albert C, Bentrup G, Castella JC, McAlpine C, Liu J, Sheppard S, Swaffield S (2013) Science for action at the local landscape scale. Landscape Ecol 28(8):1439–1445
Ostrom E (2012) Nested externalities and polycentric institutions: must we wait for global solutions to climate change before taking actions at other scales? Econ Theor 49(2):353–369
Pfund J-L, Watts J, Boissière M, Boucard A, Bullock R, Ekadinata A, Dewi S, Feintrenie L, Levang P, Rantala S, Sheil D, Sunderland T, Urech ZL (2011) Understanding and integrating local perceptions of trees and forests into incentives for sustainable landscape management. Environ Manag 48(2):334–349
Rambaldi G (2010) Participatory three-dimensional modelling: guiding principles and applications, 2010th edn. CTA, Wageningen
Reed MS, Evely AC, Cundill G, Fazey I, Glass J, Laing A, Newig J, Parrish B, Prell C, Raymond C, Stringer LC (2010) What is social learning? Ecol Soc 15(4):r1
Rudel TK, Meyfroidt P (2014) Organizing anarchy: the food security–biodiversity–climate crisis and the genesis of rural land use planning in the developing world. Land Use Pol 36:239–247
Sancar FH (1993) An integrative approach to public participation and knowledge generation in design. Landsc Urban Plan 26:67–88
Sayer J, Campbell B (2004) The science of sustainable development: local livelihoods and the global environment. Cambridge University Press, Cambridge
Sheil D et al (2002) Exploring biological diversity, environment and local people's perspectives in forest landscapes. Methods for a multidisciplinary landscape assessment. Center for International Forestry Research, Bogor
Silberstein J, Maser C (2000) Land-use planning for sustainable development. CRC Press, Boca Raton

Star S, Griesemer J (1989) Institutional ecology "translations" and boundary objects: amateurs and professionals in Berkeley's museum of vertebrate zoology, 1907–1939. Soc Stud Sci 19:387–420

Steyaert P, Barzman M, Billaud JP, Brives H, Hubert B, Ollivier G, Roche B (2007) The role of knowledge and research in facilitating social learning among stakeholders in natural resources management in the French Atlantic coastal wetlands. Environ Sci Pol 10(6):537–550

Teulier R, Hubert B (2004) The notion of "intermediary concepts" contributes to a better understanding of the generative dance between knowledge and knowing. In: 20th EGOS Conference, Lubljana, Slovenia, June 30–July 3

Tress B, Tress G, Fry G (2005) Integrative studies on rural landscapes: policy expectations and research practice. Landsc Urban Plan 70:177–191

Vandergeest P (2003) Land to some tillers: development-induced displacement in Laos. Int Soc Sci 55(175):47–56

Vinck D (2009) De l'objet intermédiaire à l'objet frontière. Revue d'Anthropologie des Connaissances 3:51–72

WCED (1987) Our common future. Oxford University Press, Oxford

Wollenberg E, Campbell B, Dounias E, Gunarso P, Moeliono M, Sheil D (2008) Interactive landuse planning in Indonesian rain-forest landscapes: reconnecting plans to practice. Ecol Soc 14(1):35