Local knowledge and land degradation:
A participatory case study in the uplands of Laos

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Abstract: This paper presents the results of a study using participatory techniques to assess soil erosion in Ban Lak Sip, an upland village of northern Laos. Since 2000, soil erosion and related indicators have been measured in a 67-hectare watershed making up 15 percent of the village land. Measurements have included the survey of rill dynamics and the monitoring of sediment discharge in weirs. Due to the relative short time series (i.e. five years), these measurements provide only limited information on the long-term environmental change and the significance of the land degradation issue in the village. However, several group discussions and the results of a questionnaire survey indicate that a majority of farmers considers that, over the past fifteen years, there has been an important increase in soil erosion across the village land. Local knowledge related to land degradation processes and factors appears remarkably detailed. During group discussions, farmers identified several indicators of soil erosion and, on this basis, were able to reconstruct the history and predict the evolution of the village land, showing a continuous degradation trend that, without change in the current farming practices, would lead to the impossibility of cultivating upland annual crops in the next 10 to 40 years. Accordingly, this perception of land degradation has lead to a number of livelihood adaptations. Using such a 'hybrid research' approach integrating biophysical measurements and local perceptions of environmental change allow gaining a better understanding of local environmental issues and adaptive livelihood change. By extension, the approach provides valuable insights for identifying potential solutions to land degradation that are well adapted to the local socio-economic context.

Keywords: Land degradation; hybrid research; participatory approach; uplands; Laos

1. Introduction

According to the Global Assessment of the Status of Human-induced Land Degradation (GLASOD), 65 percent of the world's land resources are degraded to some extent (Oldeman *et al.*, 1991). The more recent sequel of GLASOD, the Assessment of the Status of Human-induced Land Degradation in South and Southeast Asia, states that in Southeast Asia virtually all land is degraded and more than 80 percent is at least moderately degraded. The same study specifies that erosion by water represents the most common case of land degradation with agriculture and deforestation as the two major causative factors (Van Lynden & Oldeman, 1997). Drawing upon these two studies, the UNEP states that "land degradation problems [in Southeast Asia] are directly related to land-use practices, particularly agricultural expansion and intensification" (2002: 75) and FAO considers that all the land resources of Laos are degraded with 84 percent of it at least moderately degraded (FAO, 2000).

Despite its authoritative sources, this information must be taken with caution. Many scholars argue that global assessments of land degradation lack the appropriate methodologies to deal with the complexity of the issue. Land degradation is indeed strongly scale-sensitive. That is, measurements made at a particular scale may be contradicted by other measurements at different scales (Gray, 1999). More generally, land degradation has multiple spatial and temporal dimensions depending on the biophysical, economic and cultural context in which it is defined (Fresco & Kroonenberg, 1992; Brookfield, 1999; Warren, 2002). As summarized by Johnson *et al.* (1997: 583), land degradation is "a term whose meaning reflects our perceptions, view points, timeframes, and value attachments". While for some actors (e.g. conservationists, tourism workers and foresters) the conversion of a forested area into agricultural land will often be seen as an indubitable degradation of the land, for others (e.g. farmers and cattle breeders), the change will be a rather positive one.

Furthermore, local perceptions and related adaptations are frequently undervalued in favour of simplistic models. For instance, until relatively recently, often mislead by aggregate macro-scale data, much of the literature related to poverty-environment interactions posited a 'downward spiral' of poverty and environmental degradation (Scherr, 2000). In this neo-Malthusian model, population growth, limited access to land and lack of resources for conservation investments drive rural poor people to intensify their pressure on the environment, with the consequence that environmental degradation further limits natural resources availability and increases poverty. This model is increasingly challenged by a growing number of micro-scale and longitudinal studies which combine biophysical measurements and survey of local perceptions (e.g. Tiffen and Mortimore, 1994; Tiffen *et al.*, 1994; Forsyth, 1996; Templeton & Scherr, 1999; Mazzucato and Niemeijer, 2001; Ravnborg, 2003). As these studies have demonstrated in many different contexts, land degradation is not always as serious as presented by larger scale assessments, in part due to the fact that local populations adapt to land degradation by developing spontaneously effective land conservation measures. Yet, if the academic response to these studies has generally been positive, their impact on policy-making has often remained limited (Blaikie & Muldavin, 2004; Ives, 2004). In fact, the temptation to link poverty and environmental degradation is recurrent in a number of international organizations' approaches to the population-environment interactions (e.g. WCED, 1987; Durning, 1989; World Bank, 1992; UNEP, 1995; Dasgupta *et al.*, 2005; World Bank, 2006). As argued by many authors, without an approach integrating local perceptions and adaptations, the risk is that land degradation assessments may well represent more the narratives of particular actors than empirical realities (Fairhead & Leach, 1995; Leach & Mearns, 1996; Bassett & Zuéli, 2000; Adger *et al.*, 2001).

The present study is an attempt to integrate local perceptions with biophysical measurements of land degradation in Ban Lak Sip, an upland village of northern Laos. The approach builds on measurements of soil erosion and related factors in a small watershed (making up fifteen percent of the village land) and interviews of the villagers regarding environmental perceptions and livelihood change. The main objectives of the study are: (i) to highlight the points of convergence and divergence between scientific observations and local perceptions of land degradation, (ii) to assess the role played by land degradation in forcing local livelihood adaptations, and (iii) to discuss the possible contribution of local knowledge to understanding land degradation and developing potential solutions.

2. Overview of the research site

Ban Lak Sip is located at ten kilometres of Luang Prabang, along the national road No. 13 linking Vientiane to the northern provinces (Figure 1). The altitude of the village is approximately 430 meters, though parts of the village land rise above 700 meters. The village land is mountainous with an average slope gradient of 30 percent, ranging from 0 to more than 90 percent[1]. Luang Prabang province has a tropical, wet-dry monsoon climate with important temporal variation in rainfall. Of the 1,400 mm of average annual rainfall, more than 90 percent falls during the hot and humid April to October rainy season while the November to March dry season is cold and mostly dry. Runoff feeds several streams that run through the village territory. The main stream passing through the village is a tributary of the Num Dong River which combines with the Mekong south of Luang Prabang. A typical soil transect in the village land shows a soil thickness that generally decreases from over four meters to only a few decimetres as one moves from bottom land to summit areas. Following this soil distribution, soil structure evolves from a deep organic top horizon to a very thin organic topsoil.

Settlement began in the 1960s when some families originating from northern provinces settled on the current site of Ban Lak Sip. The village was formally created after 1975 and was then the recipient for the resettlement of five neighbouring communities in 1976, 1982 and 1996. By 2003, the village community had reached some 503 inhabitants, composed at more than 80 percent by members of the Khamu ethnic group. At the time of this study, despite the access to the road, the close proximity and potential attraction of the city of Luang Prabang, migration had not constituted a major pressure valve for the village residents.

In terms of livelihoods, Ban Lak Sip residents are currently involved in a variety of on-farm activities, though annual cropping – mainly upland rice for subsistence and Job's tear sold to export companies based in Luang Prabang – constitutes the single most important activity for almost all village households. Annual cropping takes place within a rotational shifting cultivation system and plots are now commonly cultivated for one or two successive years before a three year fallow period. In addition to annual cropping, vegetable production (e.g. chilli, beans, coriander and several grasses) based on a continuous cultivation system, collecting forest products (e.g. fuel wood, bamboo shoots, and grasses), hunting (mainly small rodents and birds), livestock farming (e.g. poultry, pig, cattle) and perennial tree production

1 Calculated from a 50-m resolution Digital Elevation Model (DEM) of the village land (Source: MRC).

(mainly teak and banana) also form important land-based livelihood activities. The location of these activities varies by slope and elevation as stylized in Figure 2. In general, annual cropping as well as collection of forest products and hunting are concentrated in the high elevation areas while livestock production is almost exclusively conducted within the village and on lower slopes. Vegetable cropping and tree plantations are found across the landscape. Of particular note in the spatial distribution of livelihood activities are the high elevations and steep slope zones where almost one third of all activities carried out by an average household are concentrated.

3. Biophysical measurements

In an effort to measure land degradation on Ban Lak Sip land, a survey of linear erosion in the village's sixty seven-hectare Houay Pano watershed was undertaken between 2001 and 2003. The survey consisted of rill and gully counts, measurement of their length and assessment of their volumetric evolution in the rainy season (Chaplot *et al.*, 2005). Fourteen rills and gullies were observed during the first year of survey, twenty-five during the second year and thirteen during the last year. Most of the rills appeared in annual cultivation fields during aggressive rainfall events and stretched from mid-slope to down-slope position. While a few expanded and deepened gradually over the three years to form gullies, most of them, filled in with branches and vegetable debris by farmers or let under fallow, disappeared after one year. For the entire watershed, linear erosion features were estimated to have resulted in annual soil losses of 2.4 tons per hectare in 2001, 1.5 tons per hectare in 2002 and only 0.1 ton per hectare in 2003 (Table 1). At the sub-catchment level, a significant correlation between linear erosion and spatial extent of annual cultivation was found during the first two years of survey. However, this correlation was contradicted by last year's measurements. Between 2002 and 2003, with similar annual and monthly rainfall amounts and comparable proportions of land covered by annual crops (not only for the watershed as a whole but also within its nine sub-catchments), linear erosion decreased rather substantially. As the authors of the study point out, these results illustrate the preponderant role played by rainfall intensity in triggering linear erosion. Thus, the positive correlation between annual crops' extent and rill formation exists only when rainfall events reach a particular intensity threshold and, in this regard, 2003 has experienced constant, low intensity rainfalls throughout the year.

Between 2001 and 2005, comparable erosion rates were found by the measurement of sediment yields – suspended sediment and bed load – in concrete weirs at the outlet of eight nested sub-catchments making up the Houay Pano watershed (Sengtaheuanghoung *et al.*, this issue). In the largest equipped sub-catchment, which represents 59.3 hectares or 90 percent of the total surface of the Houay Pano watershed, total eroded sediment yields per hectare ranged between 3.4 tons in 2001, 6.8 tons in 2002, 2 tons in 2003, 4.7 tons in 2004 and 0.7 tons in 2005 (Table 1). As in the case of linear erosion, rainfall amounts (annual or maximum monthly amounts) did not appear to have a significant influence on sediment yields. However, by contrast with linear erosion, statistical analysis of the five years of measurements shows a clear correlation between soil losses and land use. In particular, the total extent of annual crops within the watershed appears as a major driver for soil erosion.

These measured soil erosion rates may be discussed further and considered alternately low or high depending on the places of comparison and data collection methods (e.g. Pimentel and Kounang, 1998; Douglas, 1999; Gafur *et al.*, 2003). However, this would probably not add much to our understanding of the local significance of the soil erosion issue. Furthermore, due to their limited temporal extent, the biophysical measurements provide little information on the long-term environmental change in the village. Even if soil erosion appears positively correlated with annual cultivation, does this mean that the village land is undergoing significant degradation or are we simply observing a cycle whereby land is degraded during a period of extensive cultivation and later regenerated by a period of extensive fallow? The observations of local farmers can provide such information.

4. Local perceptions of land degradation

Several group discussions and the results of a questionnaire survey indicate that a majority of farmers believe that there has been an increase in soil erosion over the past fifteen years. For instance, in a questionnaire survey carried out among 16 of the 27 farmers working in the Houay Pano watershed, 87 percent answered that erosion had generally increased. More generally, out of 31 individuals interviewed in the village, 49 percent reported an increase in soil erosion across the entire village land (attributed mainly to agricultural pressure and increased frequency of intense rainfall events), 22 percent unchanged erosion rates, and 29 percent a decrease in soil erosion (attributed to a general decline in rainfall amounts).

During a series of group discussions, farmers identified, and sorted by order of importance: intense rainfall events, long history of agricultural rotations, cultivation on steep slopes and high elevation areas, and short fallow periods as the main factors for increased soil erosion rates in the village land. Decreasing yields – due to impoverished soils and land lost to gullies – and increasing workload – due to the appearance of hardier weeds and, to a lesser extent, the time spent for filling rills – were then identified by farmers as the main adverse impacts of soil erosion on their farming activities. As with erosion, 85 percent of the farmers working in the Houay Pano watershed reported that their yields had declined over the last fifteen years. In fact, reconstruction of upland rice yield and annual cultivation workload based on survey data shows a notable decline of the former since 1990 and a significant increase of the latter after 1995 (Figure 3).

According to the farmers interviewed, an 'ideal' upland field (i.e. where erosion risk is the most limited and fertility the highest) is chosen in accordance with the following criteria: gentle slope, covered by dense and green vegetation (old fallow or forest) and presenting moist and black soils. By contrast, they consider the red colour of the soil surface, the development of gullies, the presence of stones and particular weed species (e.g. *Imperata cylindrica, Mimosa invisa, Thysanoleana maxima*) as main indicators of degraded lands in the village. Based on these local indicators, farmers were able to describe five successive stages of environmental change: ranging from brown soils, dense-green crop cover and no noxious weeds to red-orangey soils, sparse-yellow crop cover, surfacing stones, and high densities of hardy weeds and gullies (Figure 4). Once this last stage is reached, the fields, unproductive, must be abandoned. Accordingly, the farmers reconstructed the history and predicted the evolution of the Houay Pano watershed, showing a continuous degradation trend that, *without change in the current farming practices*, would lead to the impossibility of cultivating upland annual crops in ten to forty years' time.

By and large, the totality of available evidence - physical measures and farmers' perceptions - indicates a troubling land degradation trajectory in the village. However, the picture should not mask the capability of local actors to adapt their livelihoods in order to control, or even avoid, soil erosion. Indeed, as the interviews also suggest, farmers are well aware of the potentially degrading impacts of erosion on their farming activities and their knowledge of the factors and processes involved is very detailed.

5. Livelihood adaptations

In general, since 1990, the village households have shifted from relatively specialized production to diversification. While in 1990, an average household was engaged in two or three livelihood activities (generally, annual cultivation of glutinous rice, collecting-hunting and poultry farming), in 2003, with a strong development of tree plantation (essentially teak and banana), vegetable cultivation (mainly cash crops sold at the Luang Prabang markets) and non-farm employment (e.g. small trading by the roadside, construction or factory worker, etc.), the same household had four or five different sources of subsistence. At the same time that they have diversified their activities, farmers have increased the cultivated area (Table 2) and the amount of time spent on livelihood activities (Table 3). In terms of area, the largest increase has been in tree plantations, which nearly quadrupled in extent and now occupy nearly as much area as the area of annual crop production. Vegetable cropping has also shown a very significant percentage increase. Most of the increased labour usage has been devoted to vegetable cropping, non-farm activities and livestock farming (with the recent development of pig, goat and fish farming). As introduced earlier, the annual cropping workload also increased during the period both in terms of the number of workers and average workload (see Figure 3). In fact, the average household workload has sharply increased over the entire survey period, going from 156 to 244 days of activity per year. Finally, there has also been a relative reorientation in the location of livelihood activities. Annual cropping and vegetable cropping have expanded mainly in the flattest parts of the landscape, while plantation agriculture has expanded across all elevations (Table 4).

Clearly, there is no single explanation for such wide-ranging changes in local livelihoods. As shown by another study, the economic liberalization of the country and the national land reform have played major roles in shaping the development trajectory of Ban Lak Sip (Lestrelin and Giordano, in press). However, land degradation has also had a significant role. To some extent, many of the strategies adopted by the villagers have contributed to avoid soil erosion being a major constraint for their livelihood. Some farmers, by devoting additional labour to annual cultivation and cultivating larger areas, have simply attempted to stabilize agricultural yields and maintain agricultural production at an acceptable level (see Figure 3). Yet, the soil erosion issue has remained intact for these villagers. Engaging more radical changes, others have adopted full-time non-farm occupations and successfully untied their livelihoods of land-related constraints. Generally, by diversifying their activities, adopting non-farm occupations and spending more time on alternatives to annual cropping such as livestock farming, tree plantation or vegetable cultivation, a majority of villagers have indirectly reduced the limiting effects of soil erosion on local livelihoods.

At the same time, a number of farmers have started to cultivate annual and vegetable crops in flatter parts of the landscape which, as observed by Forsyth (1996) in northern Thailand, can be seen as an adaptive change related to local perceptions of higher erosion risk on steep slopes. By cultivating on the few flat areas of the village land, farmers take advantage of the sediments eroded from the slopes. Finally, the major expansion of teak plantations may also be seen as a combined effort for both developing alternatives to annual cultivation and controlling soil erosion by maintaining land cover on the slopes. However, while many farmers confirmed the first explanation, teak plantation was never described as a way to control erosion. Actually, and this somewhat illustrates the wisdom of the villagers, some scholars argue that soil erosion may be increased under teak plantation due to the absence of undergrowth, the concentration of raindrops on the large leaves and their amplified 'splash effect' when they reach the soil (e.g. Bruijnzeel, 2004). In fact, the plantation of teak in upland fields is often the main option chosen by the farmers when the land is too degraded and annual cropping has become unprofitable.

When interviewed on potential solutions to the current situation of land degradation in the village, farmers identified three main points of interest and their related issues:

- *Development of pig and goat farming:* According to the interviewees, the major issue faced by those who are engaging in this direction lies in a lack of access to credit, training and veterinary services. The initial financial investment is often too high for the local households. Furthermore, livestock farming is not a traditional activity for the villagers of Ban Lak Sip. Their lack of technical knowledge and the frequent animal diseases jeopardize the local attempts to develop livestock farming. In addition, according to some villagers, if the activity is to develop, land-related conflicts could appear between goat breeders and cultivators (e.g. insufficient pasture areas, credit for fencing and/or labour to manage grazing leading to animals wandering in cropping areas, etc.).

- *Development of intensive vegetable cultivation:* If widely adopted, this would require a better access to wetlands and humid areas in the village. Yet, according to the villagers, with the Land Use Planning and Land Allocation program, a major part of the areas suitable to vegetable cultivation (i.e. gently sloping land in riparian areas and dense forests) have generally been classified in protected areas banned of agricultural activities. In fact, a number of households that have recently engaged in intensive vegetable cultivation are doing so illegally, under the protected forests' cover. It has to be noted however that, even if the Land Use Planning was to be re-evaluated, few land is actually suitable to vegetable cultivation in the village. Calculations based on DEMs indicate that the proportion of land with gentle slopes (i.e. less than 8%) represents only 4 percent of the Houay Pano watershed and 8 percent of the total village land[2].
- *Development of non-farm activities:* This is perhaps the most critical area where significant external intervention would be needed. According to the villagers interviewed, without external support, the shift to non-farm activities is generally made at the expense of the land resources. Because of a lack of financial capital, many households have chosen the option of over-cultivating their upland fields with the aim of raising funds before abandoning farming activities. Recently, a large number of households have sold part or totality of their land. Some have done so in order to finance the studies of their children or to acquire transportation means. A few others have used the money of the sale to emigrate towards supposedly better contexts, often in urban areas. In all these case, the ultimate objective was to provide the household with better access to non-farm employment opportunities. The risk is that, without a better access to credit, increased farming pressure (and ensuing land degradation), loss of land resources (for an already marginal population) and uncontrolled migration might be the only ways for the villagers to reach their objective.

6. Discussion and Conclusions

2 These calculations have been based on a 10-m resolution DEM of the Houay Pano watershed and a 50-m resolution DEM of the Ban Lak Sip village territory (Sources: MSEC and MRC datasets).

Going back and forth between empirical measurements and local perceptions raises some interesting questions regarding land degradation processes and the methods used to assess them in the present study. According to farmers' perception, the village land would be on a continuous degradation trajectory characterized by two dynamics: the upland fields are progressively rendered unproductive and soil erosion rates have increased significantly over the past fifteen years. The first perceived trend cannot be directly confronted with scientific experimentation since the measurements available provide no clear indications on the impacts of soil erosion on land fertility. However, considering the sediment yields recorded over the past five years, it is clear that an important transfer of fertility has occurred from the watershed to downstream areas and that the soil losses have hardly been compensated by the very short fallow periods currently practised by the farmers.

With regard to the second trend perceived by the villagers, the results of the biophysical measurements do not exactly confirm a general increase in soil erosion rates. Indeed, both linear erosion rates and sediment yields appear to vary importantly from one year to another without veritable trend over the five years of survey. This mismatch should definitely not be considered as discrediting local knowledge. Indeed, what the local perception may translate is the importance of the soil transfer which occurs within the watershed, from the cultivated slopes to sedimentation areas located downslope. With manual tillage in particular, the quantity of soil that is displaced by gravity from the upper part to the bottom of the slopes can be very significant, yet with a minor impact on sediment yields at the outlet of the watershed (Dupin *et al.*, 2002).

However, conflicting perceptions suggests that local knowledge should not be used uncritically. Rainfall is described by the population of Ban Lak Sip as a major driving force for variations in soil erosion rates. While for a majority of villagers, an increased frequency of intense rainfalls has lead to the general increase in soil erosion mentioned above, for a minor - yet significant - part of the population, a recent decline in rainfall amounts has lead to lower soil erosion rates. The first group of villagers proposes a description of environmental change in the village which concurs with the results of the biophysical study. What their perception suggests is that, rather than annual or monthly amounts, the role of rainfall intensity during particular meteorological events is a main driving force for soil erosion generation.

Regarding the description given by the second group of villagers, biophysical measurements and statistical analysis appear to contradict the idea of a cause-and-effect linkage between declining rainfall amounts and decreasing erosion. At first view, long-term records of annual rainfall in Luang Prabang do not seem to show either increasing or declining amounts (Figure 5). And a similar observation can be made when looking at monthly records over the past five years in the Houay Pano watershed. From one year to another, there are definitely variations in monthly rainfall amounts but no clear trends of decrease can be identified (Figure 6)[3]. In addition, for the two biophysical studies undertaken in the Houay Pano watershed, annual and monthly rainfall amounts are not significantly correlated to soil erosion rates. Whatever the explanations for the perceived association between declining rainfall amounts and decreasing soil erosion may be, the contradictions between perception and experimentation should caution us from assuming that local knowledge is always on the mark (Gray and Morant, 2003; Oudwater and Martin, 2003).

In terms of local socio-economic trajectory, as shown by the livelihood approach, the villagers of Ban Lak Sip appear to have employed considerable energy and resources for modifying their farming practices, reworking their livelihoods and, ultimately, controlling or even avoiding land-related constraints. Accordingly, when asked about potential solutions to the land degradation issue, very few interviewees mentioned technical solutions that would allow them to continue annual cultivation (e.g. improved cropping systems, soil conservation techniques). Incidentally, despite some bypassing of the regulations, a large majority of the villagers seems to agree with the Land Use Planning and Land Allocation program. Partly aimed at rendering upland shifting cultivation impracticable (Ducourtieux *et al.*, 2004; Evrard, 2004), this program was implemented in the village in 1995 and has lead to the protection of a major part of the village land (i.e. some 290 hectares, or two third of the village territory, have been banned of agricultural activities). What could have been a major cause of conflict being the traditional nature of shifting cultivation in the area is in fact well accepted by the Ban Lak Sip residents who find their own justifications in forest conservation

3 Looking at long-term climate change the region, it has to be noted that such a 'quick and rough' analysis should certainly be deepened. Indeed, according to some scholars, “rainfall in the whole of Thailand shows a remarkable decreasing trend since the 1950s during the month of September” (Bruijnzeel, 2004: 189).

measures (e.g. regeneration of forest resources for collecting and hunting, preservation of traditional forested landscapes, climatic regulation).

Thus, at present, the villagers are experimenting spontaneously many different strategies but, through all the local alternatives, there seem to be a common cause which is that upland annual cultivation should be replaced, or at least complemented, by less labour-consuming and/or more profitable activities. According to a majority of interviewees, development won't pass by an improvement of the annual cultivation system. Rather, livestock farming, vegetable cultivation and non-farm employment seem to represent the most promising options for local livelihoods. However, as the interviews also suggest, for an already marginalised population, external support to specific domains (i.e. credit, training and reassessment of the land allocation scheme) is required if one does not want to see a situation of vulnerability turned into negative consequences.

As pointed out by some scholars, in many instances, neither scientists nor local populations' views of land degradation are complete (e.g. Ericksen and Ardon, 2003). As this study demonstrates, an approach integrating both views can provide a comprehensive understanding of the processes and factors underlying local land degradation dynamics and local land use strategies. However, the study also suggests that farmers' perceptions of land degradation should not be integrated uncritically. Local knowledge is socially-constructed and, as such, it often reflects values and concerns that are not directly related to the observation of environmental dynamics (Gray and Morant, 2003). Therefore, an important challenge lies in the development of research methodologies that allow a more informed and critical integration of local knowledge in land degradation studies.

The present work has remained limited to the definition of a local land degradation issue and the identification of potential solutions. However, the approach adopted may also proves valuable for more practical objectives. Indeed, if both local and scientific views are taken into account and integrated into a common framework, the communication between development agents and local populations is likely to be greatly facilitated. And so are development interventions (Niemejer and Mazzucato, 2003). For instance, regarding their approach to water erosion in the uplands of Tanzania, Vigiak *et al*. (2005: 309) argued that “the use of farmers' concepts in the description and recognition of erosion phenomena may create a common 'language' among extension workers and farmers that could strengthen farmers' participation in SWC [Soil and Water Conservation] planning intervention”. For the same authors, integrating local knowledge can also represent an efficient way to reduce the high costs in capital and human resources that a biophysical approach to land degradation usually incurs. In the end, integrating local perceptions and representations appears as an indispensable stage of any approach to land degradation. From the assessment of land degradation to the identification of its potential solutions, local knowledge provides a wide range of valuable information to both researchers and practitioners and, hence, may greatly facilitate development interventions.

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Tables and illustrations

Table 1: Annual rainfall, linear erosion and annual crops distribution in the Houay Pano watershed, sediment yields in the Houay Pano sub-catchment No. 4, 2001-2005 (Source: Chaplot *et al.*, 2005; Sengtaheuanghoung *et al.*, this issue)

Year	AR (mm)	Linear erosion (tons/hectare/year)	Sediment yields (tons/hectare/year)			Annual crops (% of the total surface)
			Total	BL	SL	
2001	1774	2.3	3.36	1.46	1.89	9.6 %
2002	1221	1.4	6.83	1.88	4.95	40.4 %
2003	1308	0.1	2.03	0.19	1.83	31.5 %
2004	1383	n/a	4.67	0.87	3.80	32.1 %
2005	1377	n/a	0.74	0.08	0.66	14.7 %

Note: Annual rainfall (AR); Bed load (BL); Suspended load (SL).

Table 2: Average area cultivated (hectares) per household, by crop, 1990-2003

	1990	1995	2003
Annual crops	0.83	0.91	0.93
Tree plantations	0.23	0.29	0.82
Vegetables	0.07	0.06	0.19

Table 3: Average household time allocation (days/year), by livelihood activity, 1990-2003

	1990	1995	2003
Annual crops	46	55	55
Tree plantations	3	4	11
Vegetables	21	26	53
Collecting & Hunting	22	26	22
Livestock	8	11	18
Non-farm	55	73	86
Total	**156**	**195**	**244**

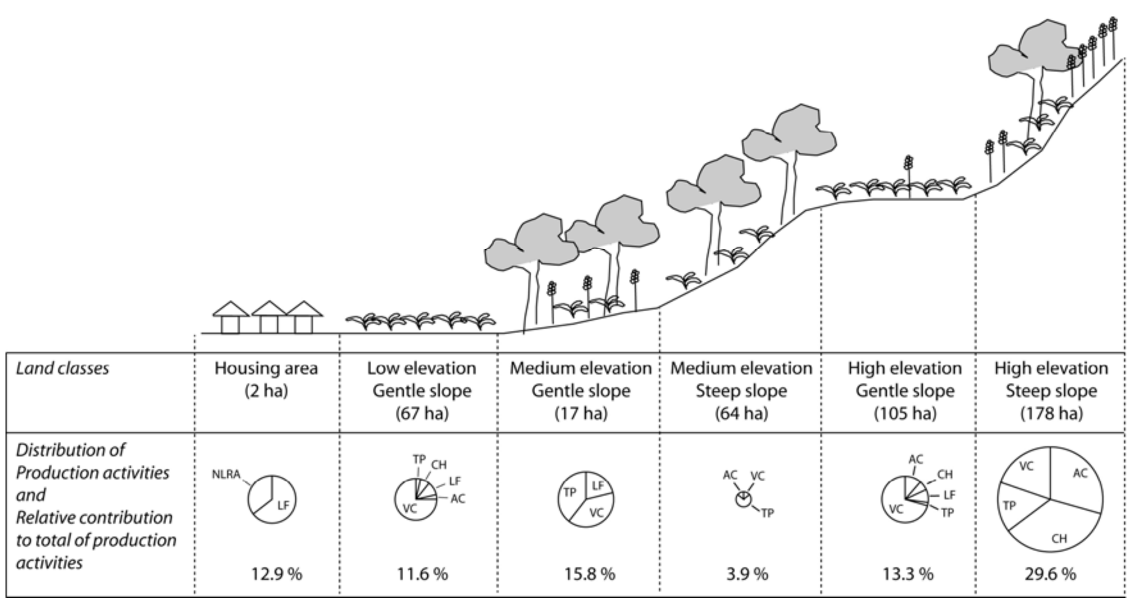
Table 4: Crop and plantation area and relative distribution by altitude and slope characteristics, 1990-2003

		1990	1995	2003
Annual crops	Total surface (ha)	14.3	14.4	17.9
	LE, gentle	-	-	-
	ME, gentle	-	-	-
	ME, steep	-	-	-
	HE, gentle	*21.4%*	*24.6%*	*29.6%*
	HE, steep	*78.5%*	*75.4%*	*70.4%*
Plantations	Total surface (ha)	4.3	5.2	16.4
	LE, gentle	-	-	*0.8%*
	ME, gentle	*4.8%*	*19.8%*	*22.1%*
	ME, steep	*4.6%*	*3.9%*	*19.5%*
	HE, gentle	-	-	*12.2%*
	HE, steep	*90.6%*	*76.3%*	*45.4%*
Vegetables	Total surface (ha)	0.3	0.2	2.7
	LE, gentle	*1.5%*	*3.9%*	*14.5%*
	ME, gentle	*4.8%*	*10.0%*	*11.2%*
	ME, steep	-	-	*0.2%*
	HE, gentle	*85.2%*	*74.4%*	*68.0%*
	HE, steep	*7.4%*	*11.1%*	*5.9%*

Note: Low Elevation (LE); Medium Elevation (ME); High Elevation (HE); Slope less than 15% (gentle); Slope greater than 15% (steep).

Figure 1: Location of Ban Lak Sip in Laos

Figure 2: Distribution of livelihood activities, by altitude and slope characteristics, 2003



Note: the pie charts represent the distribution of livelihood activities within an elevation/slope class. Their sizes are proportional to the contributions of a particular elevation/slope class to the total of livelihood activities. AC: Annual cropping; CH: Collecting and hunting; LF: Livestock farming; NLRA: Non land-related activities; TP: Tree plantation; VC: Vegetable cropping.

Figure 3: Annual cultivation: average work time (days), number of workers (persons) and upland rice yield (tons), per hectare and per year, 1990-2003

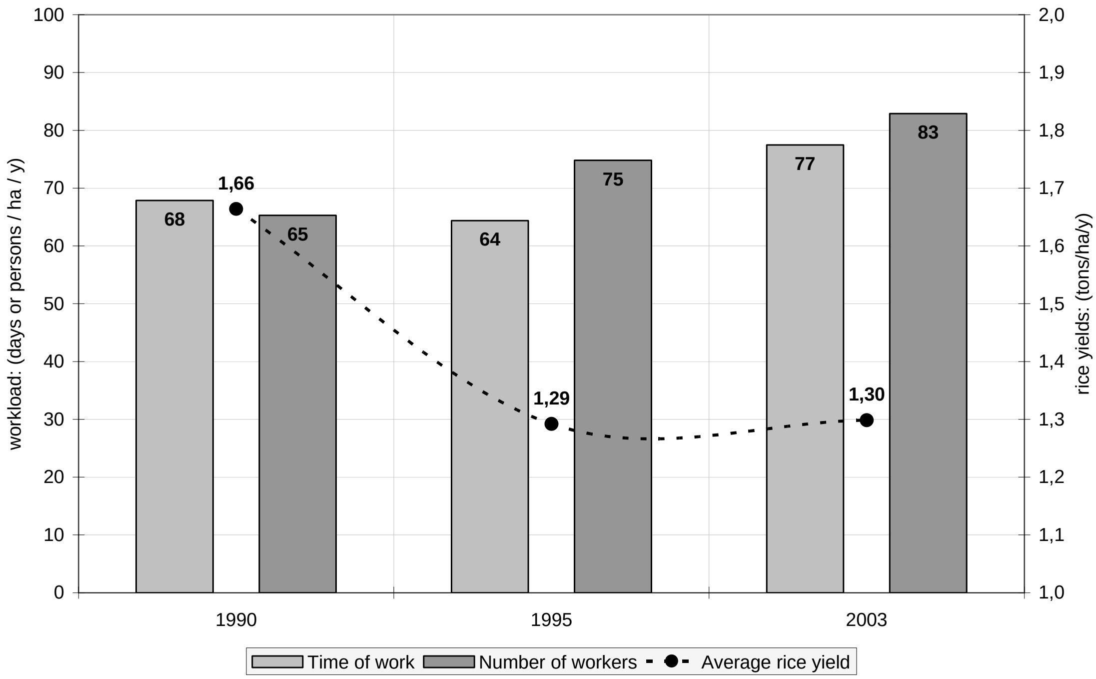


Figure 4: Perceived stages of land degradation in the Houay Pano catchment(Source: Pelletreau, 2004)

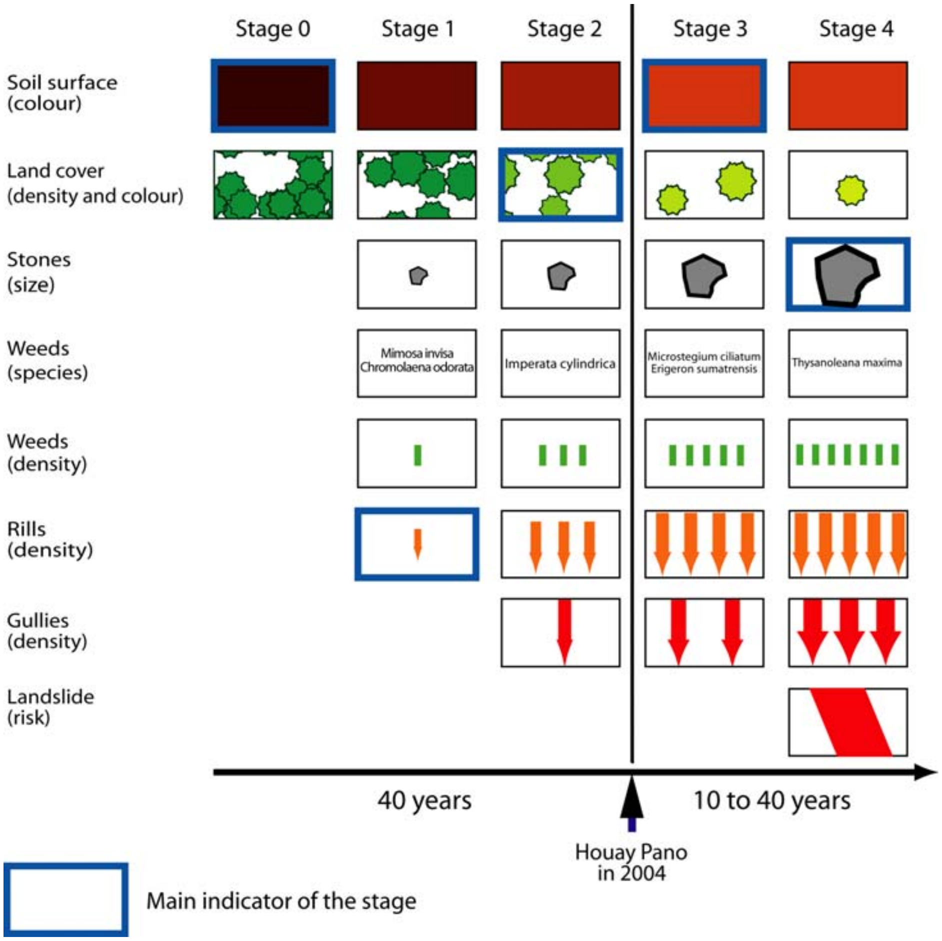


Figure 5: Annual rainfall amounts in Luang Prabang, 1960-2005

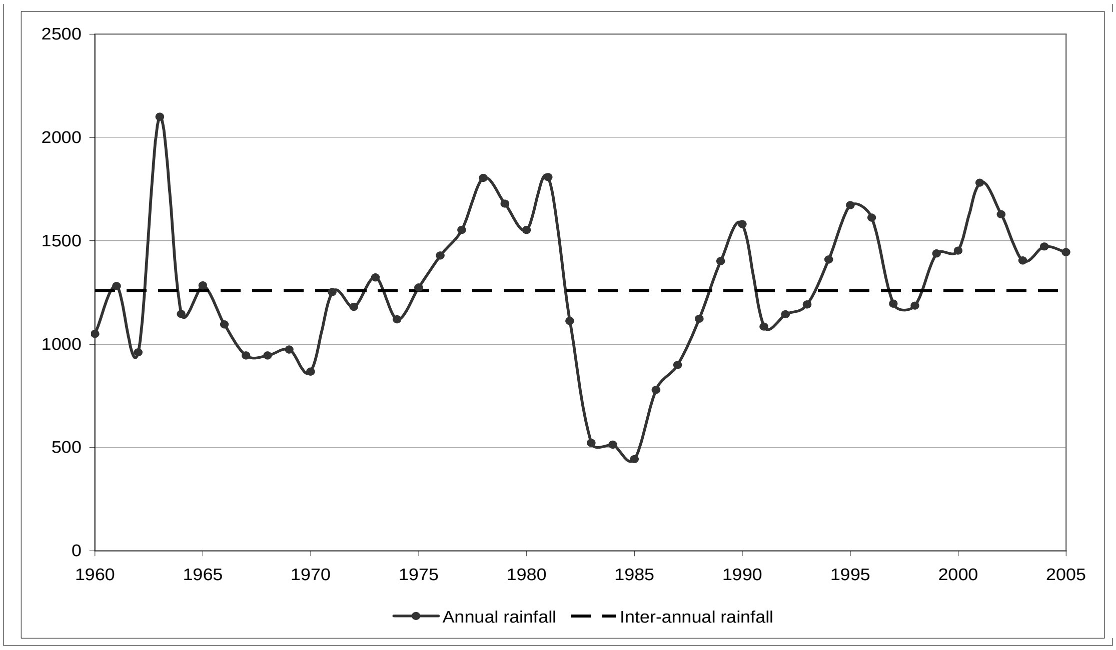
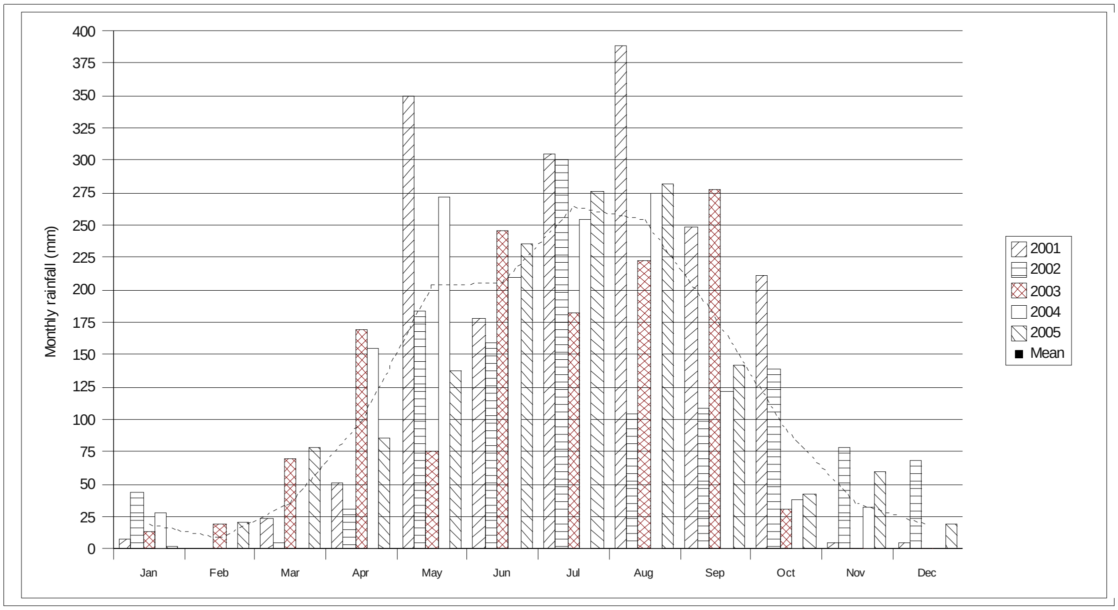


Figure 6: Monthly rainfall amounts in the Houay Pano watershed, 2001-2005


Monthly rainfall (mm)
0
25
50
75
100
125
150
175
200
225
250
275
300
325
350
375
400
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2001
2002
2003
2004
2005
Mean