RESEARCH REPORT

91

When "Conservation" Leads to Land Degradation

Lessons from Ban Lak Sip, Laos

Guillaume Lestrelin, Mark Giordano and Bounmy Keohavong

International Water Management Institute

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Cover photographs are by Guillaume Lestrelin and show (left) an upland field after slash and burn in March and an upland rice field before harvest in October.

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Contents

Acronyms

AEA	Agro-Ecosystem Analysis
FAO	Food and Agriculture Organization of the United Nations
FSR	Farming Systems Research
GLASOD	Global Assessment of the Status of Human-induced Land Degradation
IDS	Institute of Development Studies
IFPRI	International Food Policy Research Institute
IRD	Institut de Recherche pour le Développement (France)
ISO	International Organization for Standardization
ISRIC	International Soil Reference and Information Centre
IWMI	International Water Management Institute
LADA	Land Degradation Assessment in drylands
Lao PDR	Lao People's Democratic Republic
LUPLA	Land Use Planning and Land Allocation program (Laos)
MADIA	Managing Agricultural Development in Africa
MRC	Mekong River Commission
MSEC	Managing Soil Erosion Consortium
MSU	Michigan State University
NAFRI	National Agriculture and Forestry Research Institute (Laos)
UNEP	United Nations Environment Programme
UNDP	United Nations Development Programme
WRI	World Resources Institute

Summary

Despite explicit policy aimed at improving environmental conditions, direct physical evidence as well as indirect indications suggest that land degradation is increasing in Ban Lak Sip, a village located in the uplands of Luang Prabang Province of Laos. While the direct cause of degradation on village land appears related to current farming systems, resolving the problem in Ban Lak Sip and avoiding it elsewhere requires knowledge of the processes that have led to the choice of those systems—systems markedly different from those in existence two decades earlier. In this report, we test the hypothesis that the primary factors behind the farming system changes in Ban Lak Sip lay not in the village itself but rather in the broader Laotian social, economic and political setting. The study uses an integrated approach that examines both the physical and social dimensions of land use and soil erosion in Ban Lak Sip within this broader system environment. The results suggest that while the proximate causes of degradation in Ban Lak Sip are current agronomic practices, the ultimate causes are primarily related to changes in national settlement and land use policies. Ironically, these policies, which aim in part to protect the environment and to conserve land resources, have in fact artificially decreased agricultural land availability and made farming practices unsustainable under current conditions. This finding has significant implications for the formulation of environmental policy, the selection of interventions to mitigate land degradation, and for land degradation research more widely.

When “Conservation” Leads to Land Degradation: Lessons from Ban Lak Sip, Laos

Guillaume Lestrelin, Mark Giordano and Bounmy Keohavong

Introduction

Degraded land has been defined as that “which due to natural processes or human activity is no longer able to sustain properly an economic function and/or the original natural ecological function” (ISO 1996 in FAO 1998a: 31). While there is uncertainty and dispute as to the exact extent and severity of land degradation both globally and within Laos (FAO 2000; Wood et al. 2000; Niemejer and Mazuccato 2002; Swallow et al. 2002), it is clear that land degradation is significant[1] and that its costs can be substantial both to individual farmers and whole societies (Eswaran et al. 2001). Furthermore, there is evidence that the social dimensions of these costs may be especially high in certain tropical developing countries (Stocking 1984; Lal 1990; Barbier and Bishop 1995; Bojö 1996; Enters 2000) such as Laos.

Numerous empirical studies have demonstrated an indisputable link between human activities and many forms of land degradation. However, until relatively recently, analysis of human-induced degradation has remained limited to the proximate connections between natural and anthropogenic systems (e.g., the role of farming practices in soil erosion). With the emergence and development of political ecology over the past two decades,[2] the scientific examination of the human dimensions of land degradation has become far more comprehensive (e.g., Blaikie 1985; Blaikie and Brookfield 1987; Stott and Sullivan 2000). By integrating land degradation within a broad political-economic framework and by making space for new and more socially centered narratives, political ecology has significantly contributed to a deeper understanding of both environmental and social change and led to new options for remediation and prevention.

This study uses an approach based on a political ecology framework to examine land degradation in Ban Lak Sip (“*ban*” translates as “village”), a mountainous Laotian village and study site of the Managing Soil Erosion Consortium (MSEC).[3] Despite an explicit government policy aimed at improving both socioeconomic and environmental conditions in the uplands of Laos,

[1]According to the *Global Assessment of the Status of Human-induced Land Degradation* (GLASOD), 65% of the world 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% is at least moderately degraded. The same study shows that erosion by water represents the most common case of land degradation with agriculture and deforestation as the two major causative factors (Van Lynden and Oldeman 1997). Drawing upon these two studies, a recent FAO report considers that all the land resources of Laos are degraded, with 84% of it at least moderately degraded (FAO 2000).

[2]For a recent critical review of the origins, evolution and stakes of political ecology see Robbins 2004 (Political Ecology: A Critical Introduction). Shortcomings of recent political ecology literature are discussed in the next section.

[3]The Managing Soil Erosion Consortium (MSEC) is a multi-country collaborative effort to better understand land degradation, and its potential solution, in upland areas of Southeast Asia. MSEC is coordinated by the International Water Management Institute (IWMI) with substantial contributions from France’s Institute of Research for Development (IRD). MSEC’s primary partner in Laos is the Soil Survey and Land Classification Center. For additional information, see *www.iwmi.cgiar.org/msec*.

direct physical evidence as well as indirect indications suggest that land degradation in Ban Lak Sip is increasing and threatens the livelihoods and working conditions of its 500 residents. While the degradation problem may be critical to the village itself, it also has negative consequences at wider scales— nationally and internationally. At the national level, declining land productivity and consequent decreases in food production impinge on the already precarious food security situation in Laos. Internationally, some of the eroded soils from Ban Lak Sip enter nearby streams before being carried into the Mekong where, combined with similarly eroded soils from elsewhere, they impact river function with implications for three other basin countries (Douglas 1997; MRC 2003).

There is little question that land degradation in Ban Lak Sip is related to land use practices. However the key issue in reversing the degradation trend in Ban Lak Sip and, more importantly, in providing insights into potential solutions to similar degradation problems elsewhere is understanding the factors that have driven farmers to choose such practices. In this study, we use an integrated approach to test the hypothesis that the primary factors behind degradation in Ban Lak Sip lie not in the village itself but rather in transformations of the broader Laotian economic and policy environment over the last quarter century. To do this, we combine primary survey data, physical measurements from ongoing MSEC work and secondary information sources, in particular those related to economic and policy change.

Because of the inherent complexity of degradation and data limitations, especially time series on social and physical conditions within Ban Lak Sip land, the study does not purport to conclusively prove cause and effect. However, the totality of available evidence strongly suggests that while the proximate causes of degradation in Ban Lak Sip are in fact the agronomic practices farmers apply in their particular environment, the ultimate causes are primarily related to the implementation of settlement and land use policies officially aimed in part at, ironically, protecting the environment and conserving land resources. These policies have artificially decreased the agricultural land availability and increased the population density without providing compensatory resources or, as yet, significant alternative opportunities. In response, farmers have intensified labor use, undermining the long-term viability of the resource base. While the findings have important implications for land degradation policy in Laos and beyond, the approach used in its derivation also highlights the value of using multi-scalar and multidisciplinary approaches to gain insights into “technical” problems such as erosion.

Methodology and Data: An Integrative Approach

As introduced above, political ecology has provided substantial insights into the human dimensions of land degradation. However, two shortcomings of the approach have been cited. First, following the current interdisciplinary debate on globalization and locality (e.g., Escobar 2001; Swyngedouw 2004), the place of the local has been questioned with some authors calling for a more “local political ecology” (Batterbury 2001: 437). These authors argue that despite recent political trends to “localize” development (local governance and local knowledge), the understanding of local variations and complexities of decisions on landscape creation and evolution is often deficient. Indeed, if, as stated by one of the central arguments of political ecology, land degradation can only be understood in its social context, this context is so diverse from place to place and from time to time that only a real “local political ecology” can provide insights into the fundamental issues. Second, recent literature points out the need for a more “ecologically conscientious” political ecology (Vayda and Walters 1999; Peterson 2000; Warren et al. 2001), which integrates biophysical measurements and human perceptions of land degradation in a hybrid research agenda (Forsyth 1996; Batterbury et al. 1997).

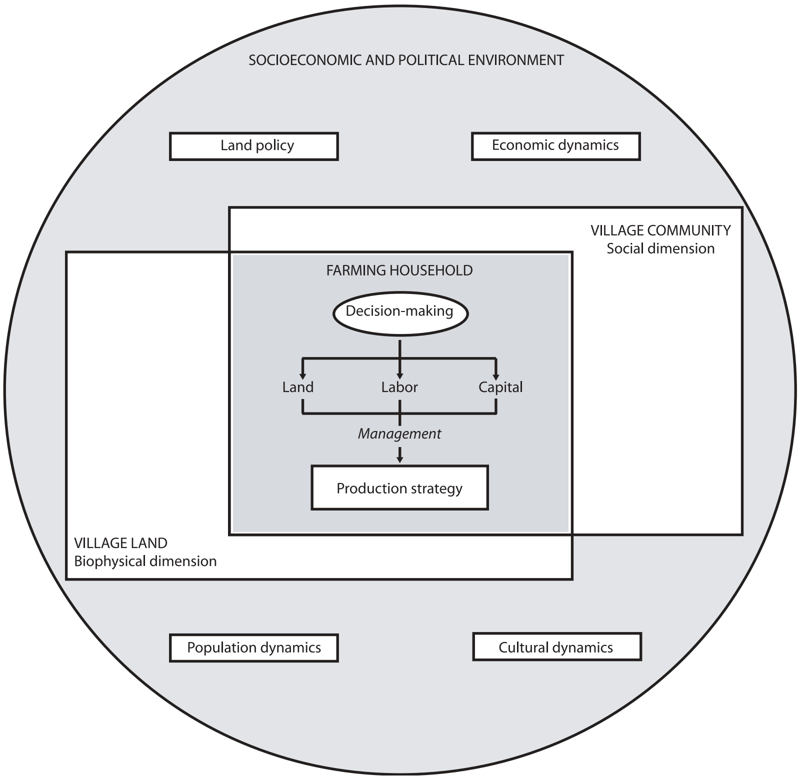
To both take advantage of the political ecology approach and address these two shortcomings, this work applies concepts and methods inspired by Agro-Ecosystem Analysis (AEA) (Conway 1985). AEA is a successor to the Farming Systems Research (FSR) popularized in the 1970s (Norman 1980), and falls partly within the family of approaches and methods known first as Rapid Rural Appraisal (IDS 1979) and later as Participatory Rural Appraisal (Chambers 1994). AEA provides a powerful conceptual and methodological framework for understanding complex interactions between rural livelihoods, farming systems, ecosystems and broader scale socioeconomic and political factors. In our particular case, it ensures that attention to agricultural problems and their solutions are focused not only on observable outcomes but also on the factors behind those outcomes.

A basic idea introduced by FSR is that the farming system used in a particular location results from the decisions taken by farmers in the allocation of production factors (e.g., land, labor and capital) to production processes (crop, livestock and non-farm) for meeting household objectives (e.g., subsistence and accumulation) (Norman 1980; Norman and Gilbert 1982), subject to some set of exogenous conditions and constraints. By integrating farming systems into a wider hierarchy of scales and processes, ranging from micro-local biophysical plant-soil interactions to global socioeconomic dynamics (Conway 1987), the AEA approach acknowledges that the examination of a farming system in isolation from other scales may not provide satisfactory explanations of how that system functions or why it results in particular outcomes, for example land degradation. Using an approach such as AEA allows the researcher “to extend analysis, using the same concepts and techniques, to systems in the agricultural hierarchy above and below the farm” (Soemarwoto and Conway 1992: 95).

More directly, as summarized by Blaikie (1985: 79) with reference to analysis of soil erosion, “there are two sets of specificity to be tackled—that of the physical system and that of the social/economic system—and they both have to be brought together and analytically integrated.” So, to place the problem in a political ecology framework, if a farming system or any of its various components is to be understood, two elements must be considered simultaneously: the environmental dimension, which includes the ecological as well as social, economic and political spheres, and the human dimension representing the direct decision-makers (e.g., farmers, households and communities) that must operate within the environment.

Drawing on these concepts, the farming system of Ban Lak Sip can be conceptualized as the intersection of the village land (the biophysical dimension) with the village community (the social dimension), which coexist within a broader political economic framework as shown in figure 1. The “biophysical dimension” determines the limits within which production strategies are physically possible and viable (e.g., land availability, accessibility and productivity). The “social dimension” determines the limits within which production strategies are socially acceptable (e.g., suitable to the individual and community goals, institutions and beliefs). The farming systems that can result from this intersection are themselves constrained by the broader socioeconomic and political environment within which they exist. This broader environment includes such factors as *land policy* (e.g., the legal and political determinants of land and other natural resource use and management rights), p*opulation dynamics* (e.g., density, migration, and population control), e*conomic dynamics* (e.g., policies, market access and incentives) and *cultural dynamics* (e.g., “modernization,” and resurgence of traditional values).

FIGURE 1.
A stylized view of the farming system in Ban Lak Sip.



Applying such a framework to the study of land degradation in Ban Lak Sip means that explanations are sought not by testing simple cause-and-effect hypotheses such as "land degradation exists because farmers use practices unsuitable for steep slopes." Rather, they are sought through questions that address systematic connections ("Why do farmers choose systems that cause land degradation?") and in explaining increases in degradation ("Why have farming systems changed?").

Clearly the search for answers to such questions requires a multidisciplinary approach and a wide range of data and data sources. In this study, primary data needed to describe village land and community characteristics and understand local perceptions was collected through group discussions and interviews with key informants (e.g., village authorities and first settlers), while that needed to describe rural livelihoods and farming system characteristics was obtained through questionnaires in structured interviews.[4] In addition to this primary data, information was taken from ongoing Managing Soil Erosion Consortium (MSEC) fieldwork, especially as related to the physical environment and the connection between production practices and land degradation in Ban Lak Sip. Government publications, regional and national statistics, interviews with government authorities and development agents, and literature reviews, cited as appropriate in the text, provided information on the broader socioeconomic and policy environment.

[4]Surveys were based on a stratified random sample of 20 households (selected among the 93 households living in the village). Households were stratified into 4 groups based on landholding (0.8-2.0, 2.0-3.0, 3.0-4.0, and > 4 ha with 4, 6, 8 and 2 households, respectively).

Ban Lak Sip, Current Production Practices and Evidence of Land Degradation

Ban Lak Sip (literally “kilometer-10 village”) is located at the 10-kilometer marker along the national road No. 13 linking Vientiane to the northern provinces. The village administratively belongs to the Luang Prabang district of Luang Prabang province. The approximate village center is located at 102°10’ 2” E, 19° 50’ 54” N.

The area of the village land, including the village itself, is 433 hectares, as delimited by government authorities in 1975. The altitude of the village is around 430 meters, though parts of the village land rise above 700 meters. In general, the village land can be considered mountainous with slopes ranging from 3 percent to more than 350 percent.

Luang Prabang province has a tropical, wet-dry monsoon climate with considerable 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 (see figure 3). Runoff feeds several streams that run through the village territory. The main stream, passing through the village itself, is the Houay Xon, a tributary of the Num Dong River, which combines with the Mekong south of Luang Prabang.

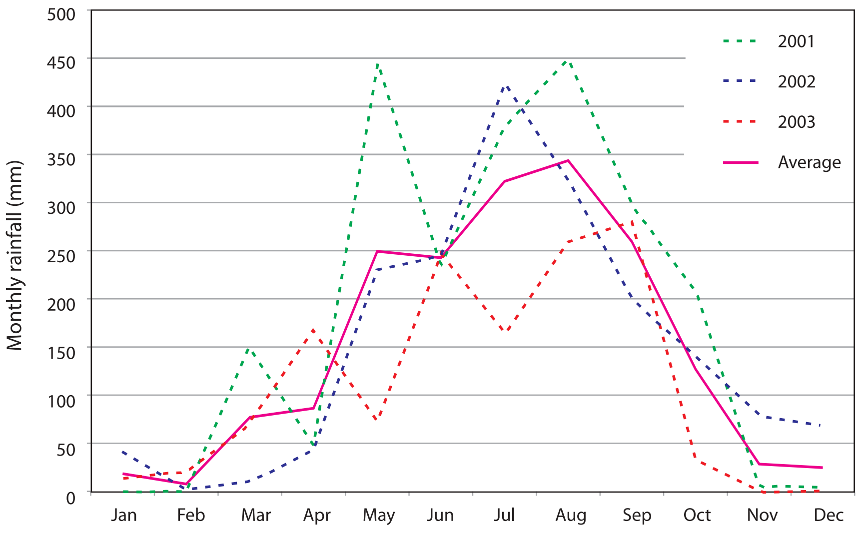
A typical soil transect (see figure 4) in one of the small catchments making up the village land reveals that the soil thickness decreases from over one meter to only a few decimeters as one moves from bottom land to summit areas while the soil structure evolves from a deep organic top horizon to a very thin organic topsoil. Following this soil distribution, soil detachment rates vary from high values in upper slopes to average values in mid-slope and to zero on low ground. (Entisols are not listed in the table of figure 4 because they are accumulating sediments eroded from the slopes and have negative erosion rates.)

FIGURE 2.
Location of the Ban Lak Sip site in Laos.

PHOTO 1.
Ban Lak Sip, March 2003.

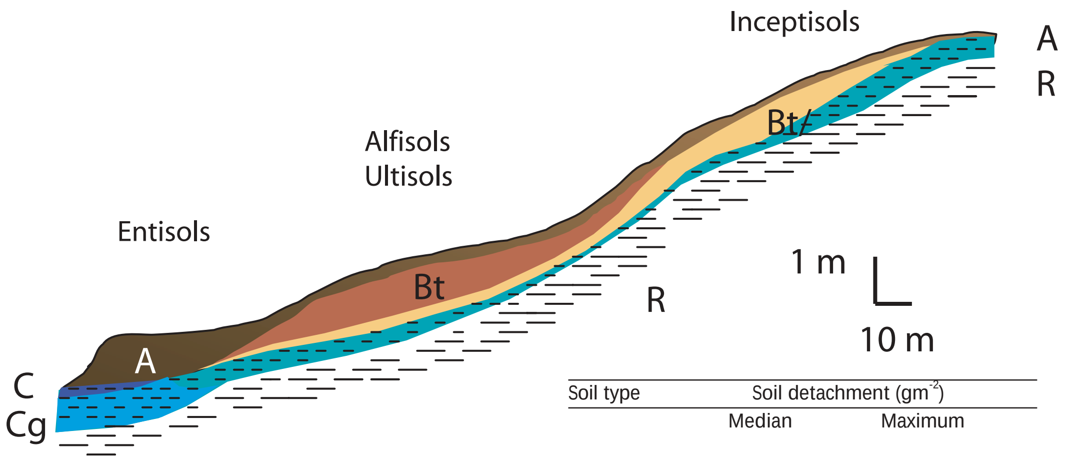
Note: The hills above the village constitute the southern edge of Ban Lak Sip territory.

FIGURE 3.
Monthly rainfall in Ban Lak Sip, 2001-2003.



Source: MSEC 2003.

FIGURE 4.
A typical soil transect and influence of soil type on soil detachment (g m^{-2}) in the Houay Pano catchment.



Soil type	Soil detachment (gm^{-2})	
	Median	Maximum
Ultisols	9.0	34.0
Alfisols	7.6	37.1
Inceptisols	14.1	75.5

Note: The letters A, B, Bt, C, Cg, and R relate to conventional designations for soil horizons/layers (see FAO 1998b).
Source: MSEC 2003.

Settlement of Ban Lak Sip land began in 1962 when three families, two from the neighboring province of Udomxai and one from the neighboring district of Meuang Nan, founded the village of Houay Oup on the current site of Ban Lak Sip. These original families were followed by others, often originating from northern provinces and fleeing the war (1954-1975). Ban Lak Sip was formally created with the relocation of five neighboring villages beginning after the 1975 revolution, when population resettlement policies were introduced. Since 1975, the village has undergone three main immigration phases. In 1975-76, the mainly Catholic population living in the neighboring village of Houay Tong was moved to Ban Lak Sip along with two families from another nearby village (Ban Kiupapaï). In 1982-1983, the families of Ban Naxone, located less than one kilometer away, were moved to Ban Lak Sip. Finally, between 1996 and 1997, several households living in Houay Nokpit (2 km into the mountains) moved to Ban Lak Sip. By 2003, the village community had reached 503 inhabitants. Despite such an eventful history, the spatially disparate origins of the community have never engendered major conflicts within the population (e.g., between first settlers and new immigrants), probably because of a relatively homogeneous ethnic distribution and a common traditional production system.[5]

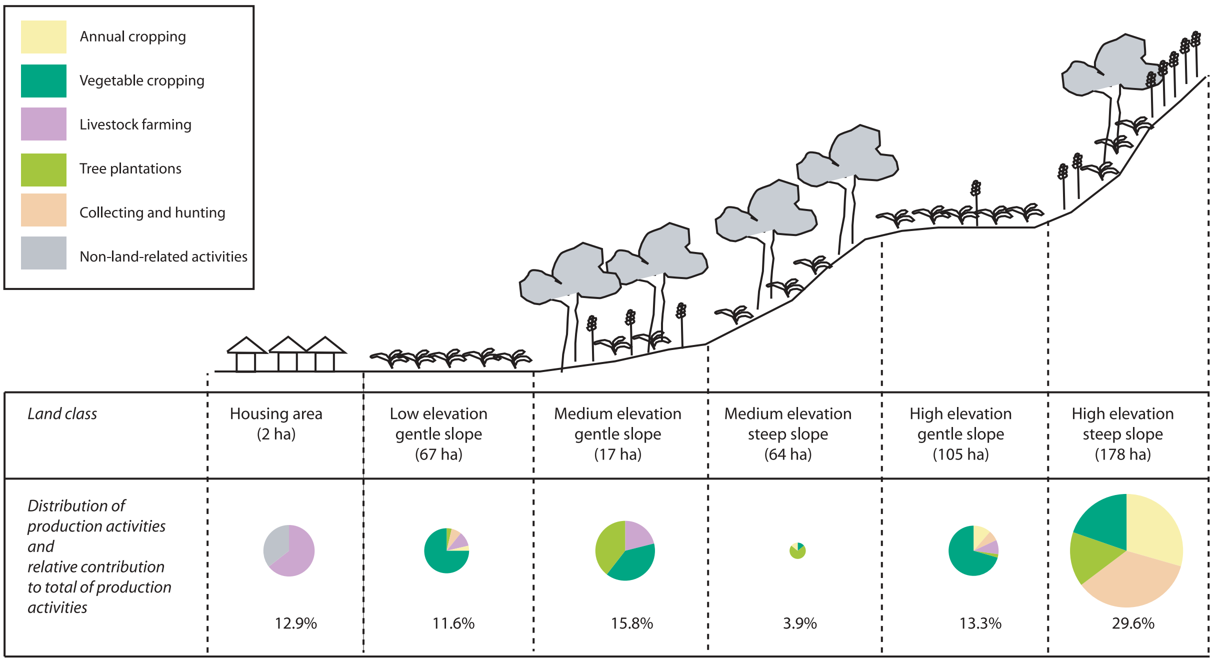
Ban Lak Sip residents are involved in a variety of on-farm livelihood activities, though annual cropping—in particular, upland rice production—constitutes the single most important livelihood activity for virtually all village households. Annual cropping takes place within a shifting cultivation system, and plots are now commonly cultivated for one or two successive

[5] The first settlers as well as most of those who followed belong to the Kh'mu ethnic group. The group now comprises 83% of the population. There is some evidence from informal discussions with individuals from Houay Nokpit, the last group to immigrate, that the apparently peaceful situation may not last. They revealed a deep dissatisfaction with what they perceived as monopolization of Ban Lak Sip land by early residents.

years before a 3-year fallow period. Cropping generally begins in February when plots under fallow are slashed. In March, the fields are burned and the soil usually left bare. Crops are planted at the beginning of June and harvested around November. In addition to upland cropping (often interspersed with vegetables), vegetable production based on a continuous cultivation system, collecting forest products (e.g., fuel wood, mushrooms, bamboo shoots, rattan, and grasses), hunting (mainly small rodents or birds), livestock farming and perennial tree production also form important land-based livelihood activities.

The location of production activities in Ban Lak Sip's mountainous environment varies by slope and elevation as stylized in figure 5. In general, annual cropping activities as well as collection of forest products and hunting are concentrated in the highlands and low-highlands while livestock production is almost exclusively practiced within the village and on lower slopes.[6] Vegetable cropping is practiced across elevated zones that could be differentiated by vegetable

FIGURE 5.
Distribution of production activities, by altitude and slope characteristic, 2003.



Note: the colored pie charts represent the distribution of production activities within an elevation/slope class. Their sizes are proportional to the contributions of a particular elevation/slope class to total of production activities.

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[6]Land use area by location was estimated using villager-derived information superimposed on a Digital Elevation Model of the village land. The five elevation/slope classes were then defined as:

- Lowland: Low elevation and gentle slope (Distance to the road = 0-150 m or 0-30 minute walk; Slope angle $\leq 15^{o}$).
- Low Midland: Medium elevation and gentle slope (Distance to the road = 150-300 m or 30-60 minute walk; Slope angle $\leq 15^{o}$).
- Midland: Medium elevation and steep slope (Distance to the road = 0-300 m or 0-60 minute walk; Slope angle $>15^{o}$).
- Low Highland: High elevation and gentle slope (Distance to the road > 300 m or over 60 minute walk; Slope angle $\leq 15^{o}$).
- Highland: High elevation and steep slope (Distance to the road > 300 m or over 60 minute walk; Slope angle $>15^{o}$).

type. “Dry” vegetables (chilli, beans and some cucurbits) and roots are grown in highland areas intercropped with annual crops, while “wet” vegetables (coriander, lettuce, onions, cabbage, mustards, watercress, mint and several grasses) are cropped in both lowland areas and in the lower parts of the uplands. Tree plantations are now found across the landscape.

Of particular note in the spatial distribution of production activities are the high elevation, steep slope zones. Almost one third of all activities carried out by an average household are concentrated in these areas. More importantly, such areas are responsible for the majority of all annual crop production, the mainstay of Ban Lak Sip’s still largely subsistence production system. Unfortunately highland areas are probably also at special risk of degradation from tillage and rill erosion due to slope, and because their already thin soils (as discussed above) increase the marginal production impact of any erosion that does occur. As such, highland areas appear to be critical zones not only in the Ban Lak Sip’s livelihood system, but also in understanding the interaction between farming systems, farming system change, and land degradation.

PHOTO 2.
Gully formation on Ban Lak Sip land, 2004.

Unfortunately available information makes it impossible to fully quantify land degradation or its trend in Ban Lak Sip. However, a variety of available evidence suggests that degradation is problematic and getting worse. For example, simple visual examination of village land reveals gullies and land slides/slumps, which have damaged crops or removed land from cultivation (photo 2).

In an effort to measure such features on Ban Lak Sip land, a survey of the village’s 67-hectare Houay Pano watershed was undertaken in 2001 and 2002. The survey consisted of gully counts, measurement of their length and assessment of their volumetric evolution in the rainy season (Chaplot et al. 2003). Fourteen gullies appeared during the first year of the survey and twenty-five during the second year, each time mainly in highland fields used for annual crop production. In these cropped fields, gullies were estimated to have resulted in annual soil losses of 18 t/ha in 2001 and 1.5 t/ha in 2002, whereas rates for the entire watershed were measured at 2.4 t/ha and 1.1 t/ha during the same periods.

Further evidence of a connection between annual crop production and erosion was found by the measurement of sediment loads (suspended sediment and bed load) in a concrete weir at the outlet of the largest sub-catchment (60.2 ha) of Houay Pano watershed. Here, total eroded sediment yields in 2001 and 2002 were measured at 4.1 t/ha and 6.8 t/ha, respectively. While annual and monthly rainfall (see also figure 3) decreased substantially between 2001 and 2002, eroded sediment yields increased, likely as a result of increased annual crop production, as shown in table 1. While similar data from earlier periods or longer time series are not available, measurements using the same methods in four small upland watersheds of Thailand present the same patterns with erosion rates varying between 0.06 and 0.35 t/ha in undisturbed forests and 4.1 to 6.85 t/ha in forests disturbed by agriculture (Douglas 1999).

TABLE 1.
Eroded sediment yields in the Houay Pano sub-catchment No. 4 (60.2 ha) and land use distribution in the Houay Pano catchment (67 ha), 2001-2002.

		Eroded sediments in the sub-catchment No. 4 (t/ha per year)			Land use in the Houay Pano catchment (% of the total land surface)		
Year	Annual rainfall (mm)	Total	Bed load	Suspended load	Annual crops	Fallow	Forest
2001	2,222	4.09	1.46	2.63	8.56%	60.2%	14.2%
2002	1,807	6.75	1.80	4.95	39.3%	35.1%	14.2%

While additional physical measures to show an undisputable land degradation trend are lacking, indirect analysis based on the observations of those who know Ban Lak Sip land best, its farmers, point to a growing problem, which corresponds with the available biophysical data. Group discussions and the results of a questionnaire survey indicate that a large majority of farmers believe that there has been a strong increase in soil erosion across the entire village land in the last one and a half decades. For example, in a questionnaire survey carried out among 16 of the 27 farmers working in the Houay Pano watershed mentioned above, 87 percent answered that erosion had generally increased over the past 15 years. All of them identified the expansion of the cleared areas for annual crops and the consequent lack of soil coverage as the main cause. Consistent with those observations, 85 percent of farmers surveyed said their yields had declined over the same period. In fact, a reconstruction of upland rice yields based on survey data shows a notable decline since 1990 (figure 6). While yield has stabilized in more recent years, this is likely in part due to an increase in labor inputs as shown in figure 7 and discussed further below.

In summary, no single source of quantitative information is available to establish unequivocally a degradation trajectory on Ban Lak Sip land. However, the totality of available evidence—visual observation, available physical measures, farmer

FIGURE 6.
Average yield of upland rice in Ban Lak Sip, 1990-2003.

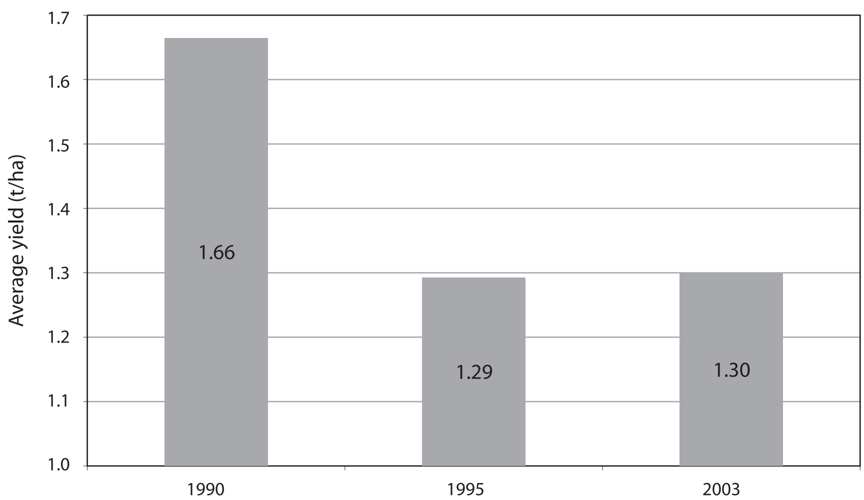
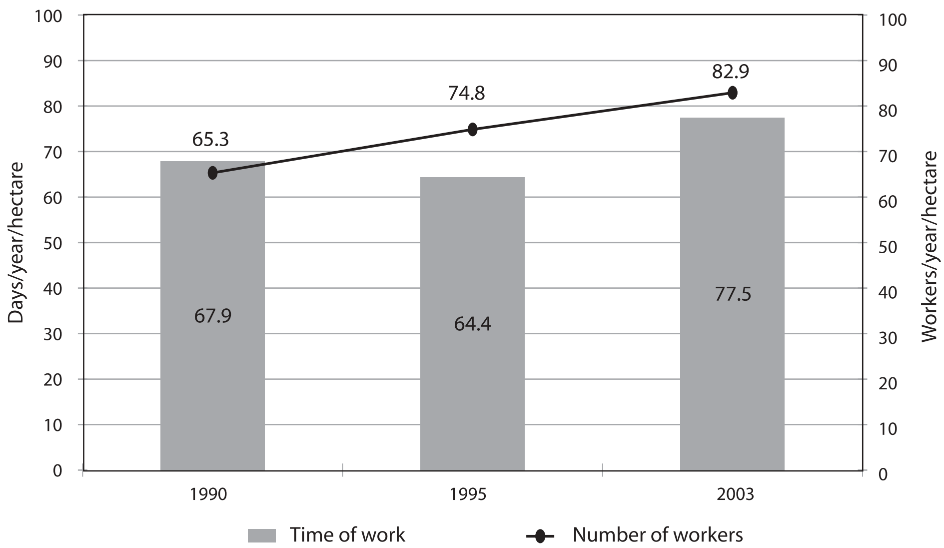


FIGURE 7.
Average work time and number of workers per hectare and per year for annual crops, 1990-2003.



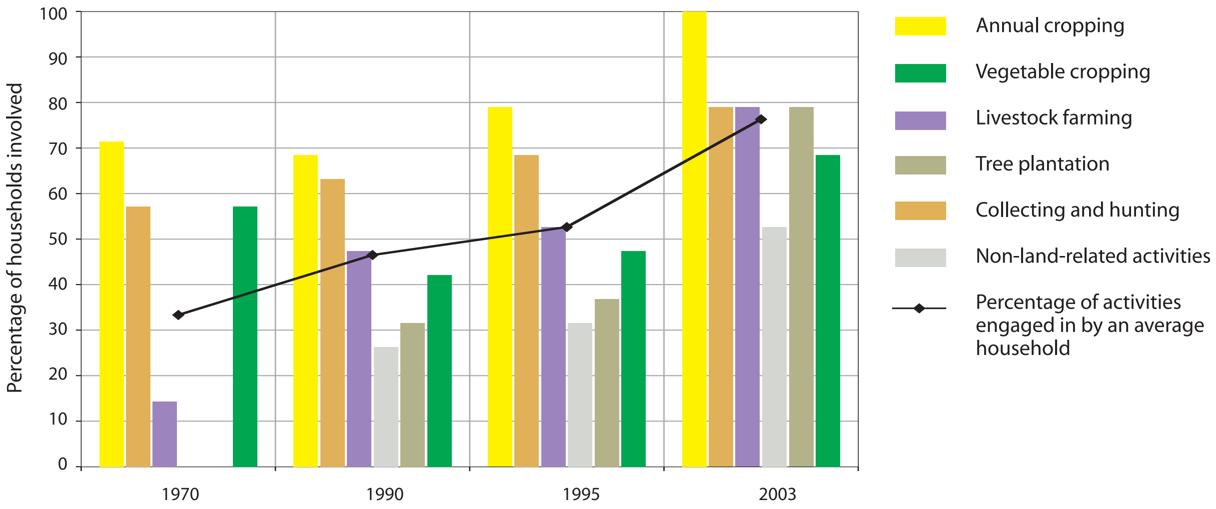
impressions, and reconstruction of rice yield and farm labor trends—strongly suggests that land degradation in Ban Lak Sip is troubling in absolute terms and that the trend is one of continued decline. Analysis of the geography of the current farming system also suggests that the area of greatest concern, both in terms of absolute contribution to village land degradation and in terms of impact on farmer livelihoods, is the high elevation, annual cropping zones.

Explaining the Change: Modifications in Farming Systems

A simple hypothesis is that the land degradation observed in Ban Lak Sip is caused in large part by land clearing on steep slopes. While likely true, even if verified, such a hypothesis does not contribute significantly to our understanding of the ultimate causes of, and potential solutions to, land degradation. The key question is what has changed to induce increased erosion and decreased land productivity over a relatively short period. The first part of the answer lies in the farming system and its change. The second, discussed in the following section, involves the factors behind that change.

Data do not allow a full examination from the foundation of the Ban Lak Sip village in 1975, but analysis of available information from even 1990 indicates a marked change in farming systems. While annual cropping has been important since the village was settled, it has become increasingly widespread since 1995 and now engages virtually all village households (figure 8). Likewise, livestock farming (poultry, pigs, goats and cows) has expanded since 1970 as has plantation production (mostly teak and banana) and several non-land related activities (e.g., craftwork, seasonal factory labor, and small trading). Vegetable cropping (mainly Chinese chive, Chinese mustard, ginger, coriander, chilli, and several cucurbits) has also increased sharply since 1995. More generally, the village

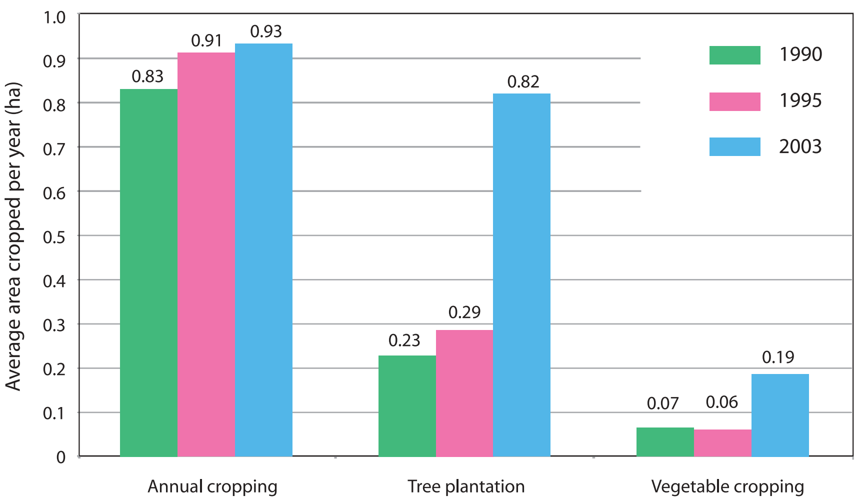
FIGURE 8.
Household involvement in production activities, 1970-2003.



households have shifted from relatively specialized production to diversification (as shown in figure 8 by the increasing number of activities in which an average household is involved).

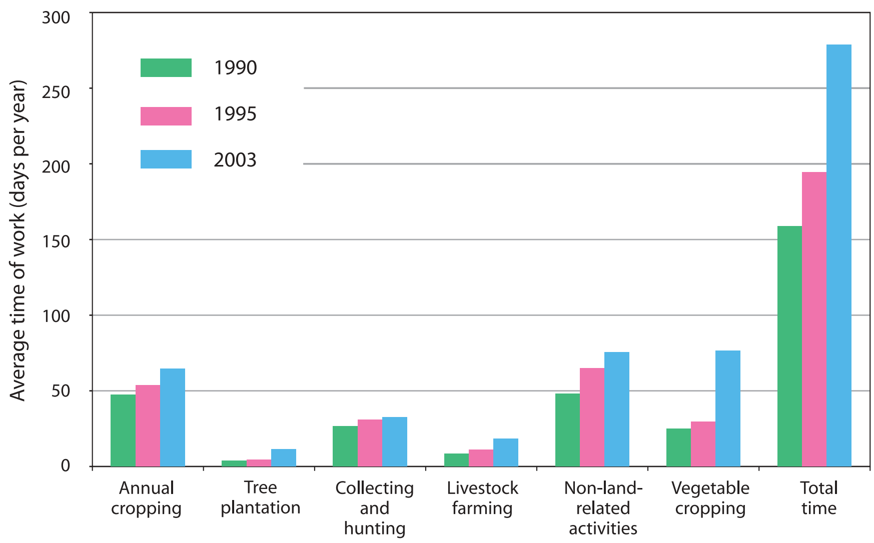
At the same time that the households have diversified their production, they have also increased the cultivated area (figure 9) and the amount of time spent on production activities (figure 10).[7] In terms of area, the largest increase has been in tree plantations, which nearly quadrupled in extent and now occupy nearly as much area as the area of annual crop production.

FIGURE 9.
Average area cultivated per household, by crop, 1990-2003.



[7]In most of the figures after figure 9, data before 1990 is not presented due to the small sample size (only 7 of the 20 households surveyed were present in 1970) making meaningful comparison problematic.

FIGURE 10.
Average household time allocation (days per year), by production activity, 1990-2003.



Vegetable cropping has shown a percentage increase almost as great, though from a much smaller base.

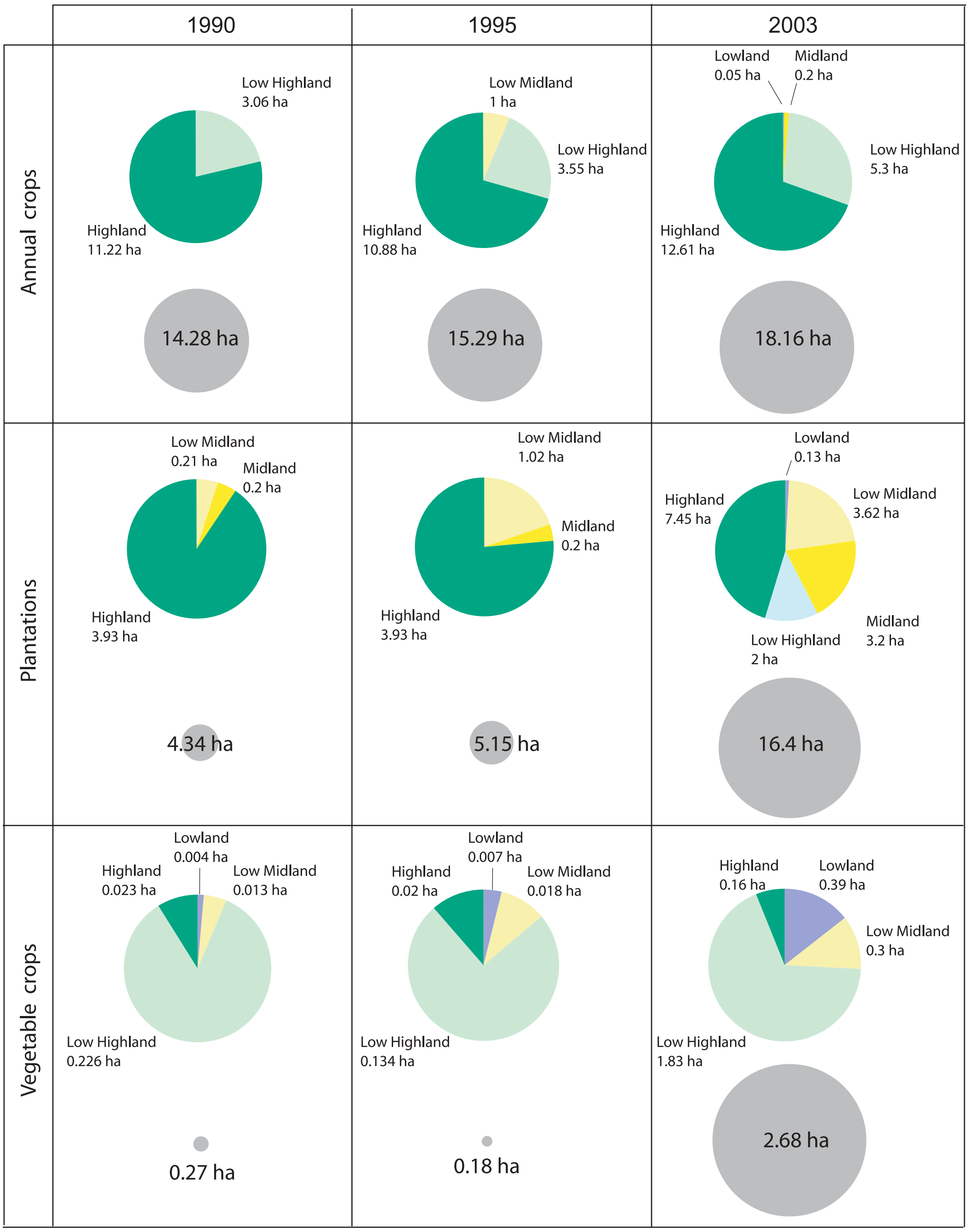
Most of the increased labor usage has been devoted to vegetable cropping and "non-land-related" activities. The latter were primarily linked to the adoption, between 1992 and 2003, of small trading, craftwork and temporary factory labor by five households. The annual cropping workload also increased during the period both in terms of the number of workers and average workload. In fact, the average household workload has sharply increased over the entire survey period, almost doubling in only 13 years.

In addition to a change in the production mix, there has also been a relative reorientation in the location of production activities. Annual cropping and vegetable cropping have expanded mainly in the flattest parts of the landscape, while plantation agriculture has expanded across all elevations (see figure 11).

While these findings indicate fundamental changes in farming systems and, as discussed below, suggest the sources of pressure for these changes, their probable net impact on land degradation is ambiguous. For example, cropping on flat areas is typically believed to induce less erosion than on steep slopes, and the development of plantations on highly slopping areas can be seen to increase soil coverage and conservation. However, closer inspection reveals that there has been neither a relocation of cropping activities from steeply sloping areas nor a replacement of crops by plantations on steep slopes. Rather, the change was an increase in utilized areas. Furthermore, recent experiments conducted by MSEC in Laos and Thailand suggest that the spread of annual cropping towards flatter areas combined with a shortened fallow period (see below) may produce erosion in areas not normally considered susceptible. While flat areas are only minimally subject to tillage erosion due to high friction forces (Dupin et al. 2002), they are more sensitive to sheet erosion than steeply sloping areas (Janeau et al. 2003).

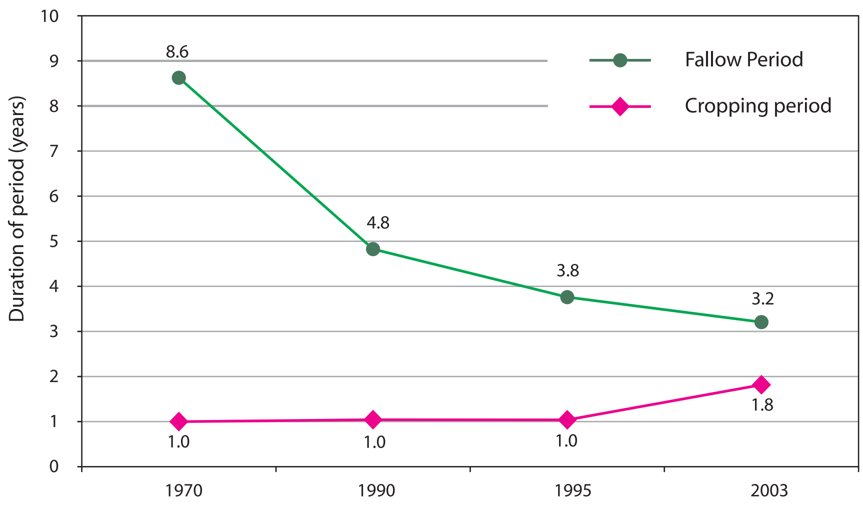
Almost certainly more important in terms of land degradation than the factors just discussed has been a change in farming practices, in particular the intensification of land and labor use in upland cropping as evidenced in a shortened fallow period, lengthened cropping period, increased labor input per land unit, and increasing frequency of tillage and weeding operations. Since 1970, fallow periods have declined by almost two thirds and the cropping period (number

FIGURE 11.
Crop and plantation area by elevation class, 1990-2003 (from a 20-household sample).



of years a field is cropped before being fallowed) has nearly doubled (see figure 12). While the decline in the fallow period has been fairly constant over the entire period, the lengthening of the cropping period has occurred only since 1995. This more recent change has also been accompanied by the intensification in labor inputs—both time of work and number of workers—per hectare and per year (see figure 7 above), which in part has supported a minor increase in weeding and tillage operations (figure 13). While the increase in the absolute number of weeding and tillage operations was minimal, farmers reported during group discussions that

FIGURE 12.
Average fallow and cropping periods for the fields under annual crops, 1970-2003.

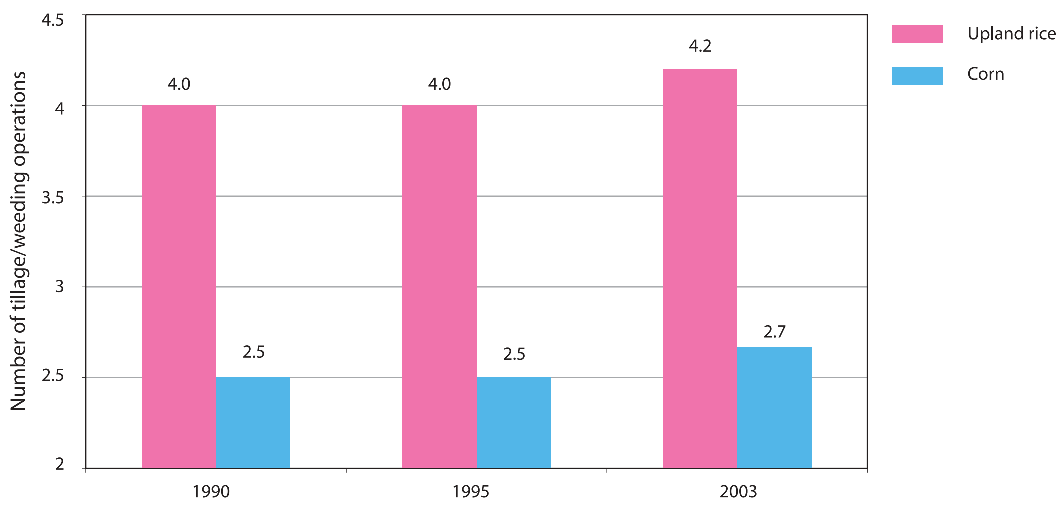


the additional time spent on each operation was responsible for most of the reported intensification in labor used for annual cropping.

There is strong evidence that the intensification of labor and land use documented in Ban Lak Sip can precipitate a chain of events leading to both land degradation and a decline in farmers' working conditions. Beginning from the field scale, both the agronomic literature on shifting cultivation and experiments done by MSEC in the Houay Pano catchment have shown that the shortening of the fallow period causes:

- A weak regeneration of vegetative cover during the fallow period, increasing the potential for run-off erosion, and a reduction of the biomass available for burning activities to replenish soil nutrients and organic carbon (de Rouw 1994; Jullien 2002).

FIGURE 13.
Average number of tillage and weeding operations per cropping cycle for upland rice and corn, 1990-2003.



- Weed infestation in cultivated fields and the appearance of new weed species both better adapted to the increased perturbation frequency and more "weeding-resistant" (de Rouw 1995; Jullien 2002).
- More frequent weeding requirements that (i) delay sowing operations, (ii) increase the risks of water erosion when soils are bare between weeding and sowing operations, (iii) increase the risks of tillage erosion through the use of hoeing to control weeds, and (iv) increase the workload (Dupin et al. 2002).
- Loss of soil organic matter, both through erosion and through mineralization, and hence loss of nutrients for plants.

Together, the loss of soil organic mater—through mineralization and water and tillage erosion—and the competition between weeds and crop species can cause a decline in soil fertility and crop yields consistent with that observed for Ban Lak Sip. The decrease in yields only further increases pressures to intensify production, inducing a chain of degradation in both the natural resource system and farmers' working conditions. Such outcomes are especially troubling in the context of Ban Lak Sip given the predominance of annual cropping activities in livelihood generation, their concentration on steep slopes and their continued, albeit slowed, expansion on such slopes.

Explaining the Change: Reaction to Environmental Policy

Clearly there is no single explanation for the wide-ranging changes in Ban Lak Sip's farming system just described. The transition towards a market economy, beginning with the New Economic Policy in 1986, increased the farmers' needs for cash incomes, thereby encouraging the production of livestock and cash crops such as vegetables and timber. Such production changes were also encouraged through official policy as implemented by agricultural and forestry offices. The change towards cash-oriented production was simultaneously facilitated by the emergence of new markets, in particular in the nearby town of Luang Prabang. Economic change has likewise led to new opportunities for non-farm employment, which at least some Ban Lak Sip residents have pursued. Thus the transition taking place in the Laotian economy has played a role in encouraging farming system change.

However, one should be careful not to exaggerate this role since, despite recent economic change, the economies of the rural Lao communities are still fundamentally oriented toward subsistence production and not comparable to those of neighboring Thailand or even Vietnam.[8] Furthermore, market integration is particularly low in the mountainous areas of the remote northern provinces such as Luang Prabang, and so it seems unlikely that, without other forces at work, the farming system changes in Ban Lak Sip would have been as great as those observed. The economic transition in Ban Lak Sip may have *oriented* the farming system changes but probably not *propelled* them.

A closer analysis of the nature of farming system change also suggests that other factors were at play. For example, the growth of labor-intensive vegetable production and the increase in non-farm employment are adaptations consistent

[8]Subsistence farmers represented 67% of the total population and 75% of the total rural population of Laos in 1996/1997 (UNDP 2001).

not only with new market opportunities but also with rising population densities, increasing land-use pressure, and the growing need for economic alternatives to cope with agricultural productivity losses. The critical role of population in inducing change becomes even more prominent when one considers the land and labor intensification in Ban Lak Sip's upland cropping systems described above.

There is a well-established literature that links changes in intensification such as those recorded in Ban Lak Sip with increased population pressures (Boserup 1970; Lee 1988; Bilsborrow and Okoth-Ogendo 1992). For shifting cultivation systems, land scarcity is commonly seen as a major driver for agricultural intensification, which generally manifests itself in a shortening of the fallow period and/or a lengthening of the cropping period and the introduction of perennial crops (Rutenberg 1980 in Angelsen 1995). Accordingly, in Ban Lak Sip, a rapid growth in population, from 16 in 1962 to 503 in 2003,[9] and an even more rapid decline in per capita agricultural land availability described further below, also suggest that population may be the primary agent for much of the farming system change. But it appears that the demographic change has largely been occasioned by rural development policy rather than by a "natural" population growth as might be assumed.

Since 1975, rural development policy in Laos has officially had two directions. One was the provision of services (e.g., medical and educational services) to remote populations, and the other was the eradication of shifting cultivation, in order "to stabilize communities, enhance resource productivity, improve the socioeconomic environment and minimize the degradation of natural resources" (Lao PDR 1999: 10). In fact, service provision has essentially meant resettlement of highland populations in "focal zones" such as roadsides, river bottoms and other more accessible areas. The results of the resettlement policy have been substantial both in terms of population movement and the impact on those populations. According to a 1997 UNDP study, approximately one third of all highland villages in six provinces (Luang Namtha, Oudomxai, Xieng Khouang, Attapeu, Sekong and Saravane) had been displaced, often with dramatic consequences, including increased rice shortage, chronic indebtedness, increased mortality and loss of cultural identity (Goudineau 1997; Evrard and Goudineau 2004).[10]

Ban Lak Sip's location along a major road and near an urban center made the village an ideal candidate to receive new residents as part of the relocation scheme. As a result, the village was the recipient of three immigration waves since 1975 described earlier, one in 1976, one in 1983 and one in 1997.

At the same time that the government introduced resettlement schemes, it also attempted to eradicate shifting cultivation. The New Economic Mechanism (1986) emphasized that one stage of the transition from a subsistence to a market economy is the abandonment of slash-and-burn practices in exchange for stable and market-oriented agriculture. In the same vein, the Medium Term Socioeconomic Development Plan (1993), which ran up to 2000, recommended a stabilization of agriculture for highland populations (Goudineau 1997). More recently, the Lao government has reaffirmed the sedentarization of farmers as a key development priority for the upland areas and has envisioned total eradication of shifting cultivation by 2005 (Lao PDR 1999).

[9]The demographic history of the community has been reconstructed using a variety of sources. Recent population characteristics (number of households and individuals from 1998 to 2003) come from official village statistics. 1985 data comes from a FAO-UNDP project that took place in Ban Lak Sip (Sharma 1988). Remaining demographic data has been derived from interviews with key informants on the number of households living in and resettled in the village. The average household size from 1985 and 1998-2003 (5.3 persons per household) was used to estimate the village population from household data.

[10]The manner in which relocation policies were formed and their obvious negative consequences have lead some authors to suspect a hidden agenda by the political elite, including "appropriation" of forested areas by the state for economic profit (Ireson and Ireson 1991) and, through a "de-territorialization" process, the political, ideological and cultural control of the remote populations often composed of ethnic minorities with cultures considered too different from the national "lowland Lao" model (Goudineau 2000).

The rationale behind the policy to end shifting cultivation is fundamentally environmentalist and based on the long-questioned belief (e.g., Spencer 1966; Dove 1983; Schmidt-Vogt 1998) that the practice is a major cause of deforestation and land degradation. In carrying out the policy, a set of decrees and instructions on agricultural and forest land management were issued to support the national Land Use Planning and Land Allocation program (LUPLA). Land allocation being a first step toward "private ownership of land and increased tenure security," this program is expected "to encourage agricultural investment, intensive use of land and the rise of a market-oriented agriculture" (Evrard 2004: 1). Along with an effective reduction of land per capita, two of the main objectives of this program—"to encourage people to use their creativeness, efforts and capital in the reform and development of the land in a serious manner" and "to produce commercial products" (Lao PDR 1995: 4-5)—clearly indicate that the land reform process is expected to reorient farming systems (i.e., by reducing the extent of the land available for agricultural purposes, farmers would be forced to intensify their production practices and to develop economic alternatives such as market-oriented production). Despite the aims, recent studies have begun to highlight the negative consequences of land reform in terms of increased poverty and marginalization of upland populations (State Planning Committee 2000; Ducourtieux et al. 2004) and the uncontrolled migration of resettled populations (Vandergeest 2003).

The Land Use Planning and Land Allocation program has been in operation since 1989, and Luang Prabang province has been one of its focal areas. As practiced in Ban Lak Sip, the allocation program has consisted of a simple agreement between village authorities, organized in a committee for the occasion, and the national authority represented by District Agriculture and Forestry Officers and other district financial and planning officers.[11] The agreement reached determined the boundaries of the land available for agrarian purposes, with the remaining land (old fallow, preexistent forests, summits and riparian land) classified into various categories of restricted use to be managed as common property of the village community. Agricultural land distribution within the village community remained with the village authorities who were instructed to limit each household to three plots. This simple restriction, to which was later added a rule limiting fallow periods to 5 years, was designed to reduce cropping rotations and, in line with rural development objectives, make shifting cultivation no longer viable.

The area put aside for agrarian activities was set at 136 ha (31% of the village land). Protected areas (*paa sangouane*) and production forests (*paa tamgkan palit*) were set at 281 ha (65% of village land) and the remaining 16 ha was devoted to housing. Most of the land bordering streams and located on hilltops, crests and upper slopes was classified as protected forests and banned from agricultural use. While the land reclassification program largely succeeded in its goal to preserve forest cover on a major part of the village land, a secondary effect was a sudden and substantial reduction in available agricultural land. Brought to the household scale, in one year the average agricultural land availability was reduced by one third, from 3.9 ha to 2.7 ha.

Putting the three main factors impacting agricultural land availability together, the combined impact of "natural" population growth, resettlement, and change in land use and reclassification policy has been a 10-fold increase in population density per unit of agricultural land over the last quarter century (figure 14). Of the three factors, resettlement was the dominant

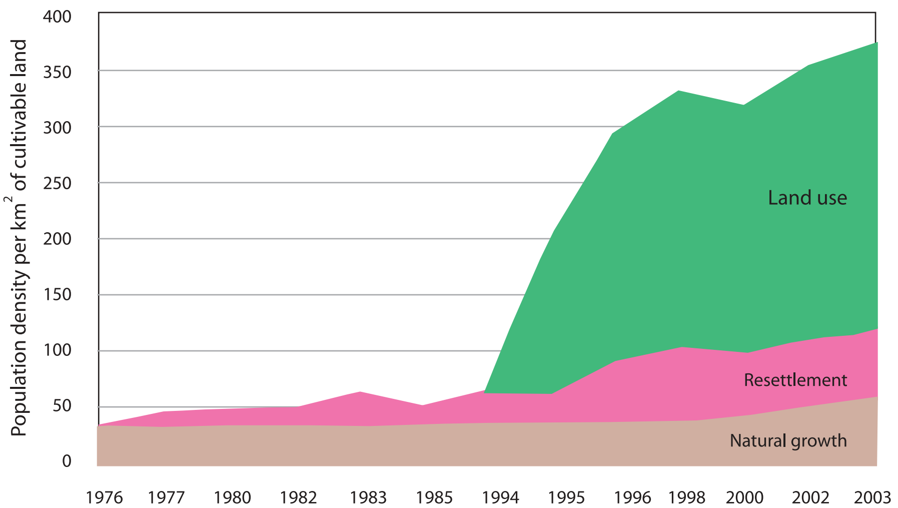
[11]There are effectively two forms of LUPLA in Laos (Dupar and Badenoch 2002). In contrast to the form described here, the other, set up few years later in villages where land was not yet allocated, is more elaborate and involves the mapping of village land, classification of land into use and forest types, and allocation of plots to households. Allocation criteria include a maximum of three plots per household (plot surface areas are determined in accordance with household size and workforce) and, in the case of villages with sufficient water resources and easy road access, a 3-year rotation system on highland plots. Forested land remains common property of the village community.

source of change before 1995 and land use reclassification after. However, in terms of total impact, the land use and reclassification policy has had the dominant effect, causing almost the same reduction in per capita arable land availability in one year that natural population growth and resettlements did in ten.

In summary, the farming system changes that have occurred in Ban Lak Sip and the linkages between political processes and land degradation can be separated into two phases. The first phase, which likely began sometime before 1990 and lasted until 1995, is typified by community adaptation to changing economic conditions, increasing population pressure and land shortage induced by both natural population growth and resettlements. This phase is characterized by a minor expansion in area used for tree plantations and annual crops but more importantly by a shortening of the fallow period. The impact of the shortened fallow appears to have been a decrease in yields of the primary crops supporting household consumption and, as an adaptation to maintain output, a substantial increase in labor inputs per unit of land along with a slight expansion of annual crop area.

The second phase, with more pronounced outcomes, began in 1995 with land reforms and continues to the present. In this phase, the declining soil fertility (that began in the previous period) combined with a profound decrease in agricultural land brought about through land reclassification. In the critical highland area, the zone most impacted by land reclassification, the ban on the use of forest areas caused a decrease in the areal extent of farming activities and hence might be argued to have decreased land use intensity and land degradation pressure in the area of primary concern. However, the reduction in area available to farming along with growing food demand has translated into increased land use intensity in the remaining areas not included in the protected zones. This in turn appears to have led to continued pressure to increase yields through added labor inputs. This combination appears to have contributed to increased erosion in the remaining cropped area. Residents have also

FIGURE 14.
Natural population growth, resettlement and land reclassification impacts on population density per square kilometer of effective arable land, 1976-2003.



Note: "Natural growth" was calculated by subtracting resettled households from the total population. However, the descendants of resettlers were not removed. Consequently, "natural" population growth figures can be seen as an overestimate.

expanded their annual crop production and vegetable crop production in the low-ground areas that are less affected by the land limitation and, at least in the short term, are more consistent in terms of crop productivity (due to deeper stocks of organic matter in the soil).

Discussion and Conclusion

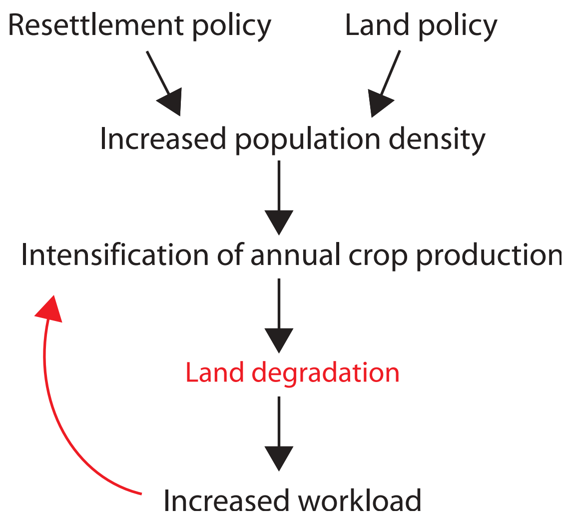
The causes of land degradation are clearly complex and their analysis must rely on multidimensional approaches. Here an integrative approach inspired by political ecology and based on Agro-Ecosystem Analysis was used to test the hypothesis that the ultimate causes of land degradation in Ban Lak Sip lay not within the spatial confines of the village itself but rather in the broader political and economic environment of Laos. While establishing cause and effect linkages relating to degradation is difficult in general, let alone in the data poor environment of the study site, the totality of the evidence strongly suggests that the major cause of land degradation has been a farming system change, largely induced by the imposition of national resettlement and land reclassification policies. This conclusion is consistent with the work of Fox (2000) who, based on broad-scale land use and land cover surveys in upland areas of Southeast Asia, outlined the role of government in encouraging high-density settlements under conditions where maintenance of long fallow periods is impossible and shifting cultivation is unsustainable. These policies have themselves contributed to the poor reputation of shifting cultivation and have thus, in some senses, been self-legitimizing.

The resettlement and land reclassification policies as applied to Ban Lak Sip have been successful in meeting two of their primary objectives, namely, encouraging farmers to change from shifting cultivation to more sedentary production and to develop market-oriented production. However, these same policies have also engendered an artificial land shortage without providing either additional resources for farmers to adapt to new conditions or, as yet, meaningful livelihood alternatives for village residents. In response, farmers have shortened fallow periods, lengthened cropping periods and increased labor in an effort to maintain crop production and household food security. The unfortunate outcomes of these changes appear to have been a decrease in land productivity, a deterioration of working conditions and an increase in land degradation and soil erosion—the exact opposite intentions of the policies' ultimate goals.

The manner in which intensification has occurred is consistent with Boserup's (1981) concept of "labor-led" intensification (more labor allocated to the production process), as opposed to "capital-led" intensification (more nonlabor inputs such as fertilizers, technical innovations or land conservation infrastructures). Without compensatory management of soil fertility, labor-led land use intensification is generally considered to be unsustainable (Lele and Stone 1989; Ananda and Herath 2003). Indeed, the intensification process observed in Ban Lak Sip may well represent the first phase of a chain of degradation of both natural resources and working conditions which, without some sort of perturbation or intervention, will result in a "vicious cycle" of decline as shown in figure 15.

The question for government officials, development agencies and researchers involved with Ban Lak Sip and other similar villages in Laos is how to break the cycle. Placing the results of this study in the context of figure 15, it should be clear that multiple avenues can be pursued. For example, government policy could of course be changed. While moving residents out of Ban Lak Sip is probably not viable as a policy,

FIGURE 15.
The policy, population and degradation cycle now present in Ban Lak Sip.



reconsidering the land classification scheme and its actual implementation may be. At a minimum, understanding the impact that resettlement and land use policy have had on land degradation in Ban Lak Sip should inform the formation of future policy for other parts of Laos. In contrast, farmers could also be encouraged to adopt farming technologies better adapted to the new farming conditions. While such "technological" solutions may work, it must be remembered that, first, they are in effect addressing a symptom rather than a cause and that, second, they must be appropriate to the overall farming systems, influenced by local and broader economic conditions, and their likely continuing evolution. Thus, for example, care must be taken in advocating the introduction of terracing systems, which, though they may be appropriate for some areas with population densities similar to Ban Lak Sip, require capital inputs and assured land tenure not now present in the village.

Taking the broader view encouraged by an integrative and multi-scalar approach, the effective population density, and hence land use pressure, could also be reduced through a shift to non-farm activities or towards more labor-intensive crops such as vegetables as is already occurring. Understanding how such processes can be facilitated, for example through increased education, improved transport networks or market development consistent with Laos' now more open economic environment, may also provide relief. Understanding how not to hinder such processes is a minimum step.

Beyond the case of Ban Lak Sip, the results presented here have a number of broader implications for land degradation and conservation research in general. First, they suggest that preliminary experimentation (e.g., medium- or long-term follow-up of pilot areas and participatory monitoring) should occur before policies are implemented on a large scale. At a minimum, substantial consultation with those upon whom policies will be imposed may help to reduce potential negative consequences. For instance, in the case of Ban Lak Sip, villagers appeared to be fully aware of the negative impacts that land reform would have on farming systems. In particular, residents clearly understood the link between the "three plots criterion" and the forced reduction in the fallow period with changing agricultural practices and environmental outcomes.

Second, the results suggest that the application of a policy that uses constraint to drive change should also be complemented by opportunity. For the farmers in Ban Lak Sip, the removal of livelihood options (e.g., some land uses) was not accompanied by significant new opportunities, leaving the population with few short-term options except to use their remaining environmental resources more intensively and to increase labor input. The result was reflected both in increasing land degradation and declining working conditions for a population already disadvantaged in relative and, by any measure, absolute terms.

Third, at the same time that additional resources may have improved the situation, it is also necessary to consider options in which populations are both *able* and *willing* to invest. In the uplands of Laos, as in many other areas of Southeast Asia, a policy threatening household self-sufficiency in rice also threatens cultural and traditional values and, as such, may also result in conflicts translated into environmental degradation. This again argues for consultation with—and, perhaps education of—affected communities in policy design.

In the end, the primary point in this discussion is not precisely what should or should not be done to reduce land degradation in any particular location. The point is that land degradation can be caused by farming system changes whose drivers may lie far outside the spatial confines of the village or system in question. In the case of Ban Lak Sip, the drivers of change appear to be primarily resettlement and land use policies imposed from the outside and inspired by changing national economic and political environments as well as a desire to protect upland environments. By looking beyond the direct, proximate causes of land degradation in Ban Lak Sip, it was possible to develop an understanding of the ultimate causes of change. The lesson is that by examining land degradation problems through a multi-scalar approach it is possible to better understand interconnections, knowledge of which can be used to inform policies to reverse degradation or help to ensure that new policies do not have unintended consequences.

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