How to Combine Scientific and Local Knowledge to Develop Sustainable Land Use Practices in the Uplands - A Case Study from Vietnam and Laos

Ming Ha Hoang Fagerström, Tran Duc Toan,
Houmchitsavath Sodarak, Meine van Noordwijk and Laxman Joshi

Abstract

Global population growth and increasing wealth exert pressure to convert forests to agricultural, industrial or residential land. Land use changes, together with the diversity in physical and socio-economic conditions in the uplands of northern Vietnam and Laos, require new sustainable land use options for obtaining food security as well as for environmental protection.

A Knowledge-Based System (KBS) approach, whereby local and scientific knowledge are combined to develop new land use options, is being tested by a consortium of researchers, extension agents and farmers in the Dong Cao catchment, Hoa Binh province, Vietnam, and in Pakchae village, Park ou District, Luangprabang, Laos. The methods employed are field measurements of erosion on a catchment scale, computer simulations using the Water, Nutrient and Light Capture in Agroforestry Systems (WaNuLCAS) and Generic Model for River Flow (GenRiver) models, application of PRA/RRA tools and the Agro-Ecological Knowledge Toolkit for Windows – WinAKT 4.06. Effects on soil and water conservation, as well as on household economies of current and future land use options in different landscape units at the two sites have been evaluated.

Introduction

Global population growth and increasing wealth (the Millennium Development Goal is 50% reduction of poverty by the year 2015 counted from the year 2000) exert a pressure to convert forests to agricultural, industrial or residential land. Land degradation followed by declining crop yields have been recognised as major problems in the uplands of the humid tropics when forests are converted to farmland and cultivation becomes more intensive (Pandey and Dang van Minh 1998). The uplands of Vietnam and Laos are characterised by a high diversity in physical and socio-economical conditions, as well as by the effects of these conditions on farmers' livelihoods and agricultural systems. This diversity requires a number of options to meet both the short- and long-term needs for food production and sustainable environmental development.

A combination of proper **watershed management** based on landscape features with a participatory approach involving local as well as external stakeholders, could be decisive for the development of sustainable land use practices. **Farmers' knowledge** of landscape relationships and farmers' perceptions of an underlying logic play an important (although not exclusive) role in their management decisions. However, the knowledge, perceptions and interests of other stakeholders concerning the status of upper watershed areas have traditionally been more effectively communicated and thereby influenced the decisions and plans made by policy makers. Farmers' perspectives, along with those of researchers on land use suitability, can form valuable inputs to a participatory analysis of different land use scenarios as a basis for negotiations of land use change and land use policy. By using both local and scientific knowledge, the quality of research projects may be improved. Furthermore, the dialogue between farmers and scientists may become more efficient and farmers can participate more actively in the decision-making process.

In the Mae Chaem watershed in Chiangmai province, **Thailand** (ICRAF 2001), studies have been carried out to understand **Local Ecological Knowledge (LEK)** and integrate it with **scientific knowledge** in order to understand watershed functions as well as to suggest improved management approaches for monitoring and assessing environmental conditions. The knowledge of different stakeholders has been combined during participatory land use planning, and various tools have been used to facilitate mutual agreements. For evaluating land use impacts; rainfall, stream flow and water turbidity were monitored. For water quality evaluation, aquatic insects were used as indicators. This approach enabled local people to conduct direct measurements of some watershed service variables. In this way, the field observations resulted in the development of detailed local spatial information systems. Efforts were made to apply these tools in strengthening local land use management of and providing good arguments for solving land use conflicts. In **Nepal**, comparisons have been made between farmers' evaluation of the nutritive value of tree fodder and laboratory analytical methods used in animal science (Thorne *et al.* 1999; Walker *et al.* 1999). The results from this have led to a re-consideration in the planning of fodder tree research where tree crown architecture was given a greater importance than before. At the same time farmers also realised how little they knew about below-ground interactions. In **Indonesia** two studies have combined local and scientific knowledge about agroforestry related to jungle rubber (Joshi *et al.* 2001) and soil and water conservation (Chapman 2002).

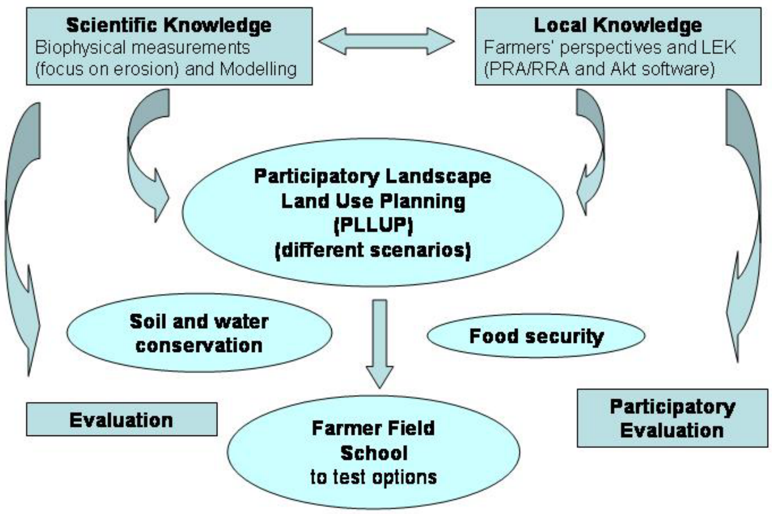

Figure 1: Knowledge Based-System (KBS) approach, which is being developed by the LUSLOF project

Table 1: Some characteristics of the study sites

Study sites	Ethnicity	Average temperature rainfall	Elevation (masl) and slope (degrees)	Main soil types	Main land use types
Dong Cao village, Hoa Binh[1]	Muong, Kinh	25 C 1,500 mm/y	100-700, 15° -40°	Acrisols	Forest and upland crops
Pakchae village, Luangprabang	Leue	25 C, 1,400 mm/y	320-800	Luvisols	Forest and shifting cultivation

[1] *Fagerstr�m et al. 2002 and Toan et al. 2001*

A Knowledge-Based System (KBS) approach (figure 1), whereby local and scientific knowledge is combined to develop land use options is being tested by a consortium of researchers, extension agents and farmers at Dong Cao catchment, Luong Son district in Hoa Binh province, Vietnam as well as in Pakchae village, Park ou District, Luangprabang, Laos. This is part of a project called "Sustainable Land Use Practices for the Uplands of Vietnam and Laos: Science and Local Knowledge for Food Security – LUSLOF". The project duration is from 2002 through 2004 (Hoang Fagerstr�m 2001). The research process and some of the first findings of the KBS approach are presented in this paper.

Materials and Methods

The study site

Dong Cao catchment, Luong Son district Hoa Binh province, Vietnam and Pakchae village, Park ou district, Luangprabang, Laos (20� N, 105� E) are situated in the same agro-ecological zone. This area receives a mean annual rainfall of about 1,500mm that falls mainly between April and September (table 1).

Research process and methods used

<u>*Dong Cao catchment, Vietnam*</u>: The land use options were developed in two steps. Step one is called Participatory Landscape Land Use Planning (PLLUP) while step two focuses on participatory testing and predicting the effects of the identified land use options.

Step one - Participatory Landscape Land Use Planning (PLLUP), carried out during 2002-2003:

The Managing Soil Erosion Consortium MSEC/IRD – Vietnam team have been conducting erosion measurements since 1999 (Toan *et al.* 2001). In 2002, measurements were carried out simultaneously with a WaNuLCAS survey, i.e. a survey for gathering input parameters for the modelling work, and three participatory surveys. The participatory surveys include:

- Participatory Landscape Analysis (PaLA), (Hoang Fagerstr�m *et al.* 2002),
- Participatory Household Economy Analysis (PHEA) (Hoang Fagerstr�m *et al.* 2003),

- Local Ecological Knowledge (LEK) survey on soil-tree-crop interactions along a landscape transect (Johansson 2003).

During the ***PaLA survey***, with participation of 14 farmers, farmers' perceptions concerning current land use both in time and space, as well as visions for land use change were investigated using PRA/RRA tools such as village modelling, village sketch maps with local names, transects and timelines (Hoang Fagerström *et al.* 2003).

The focus points in the landscape – including weak points such as sensitivity to erosion (figure 2), and filters, i.e. the strategic water supply area in the catchment (figure 3) were identified both in reality and on maps. The characteristics of the focus points, including their soil-plant-water-light interactions in space and time, were studied using timelines, brainstorming techniques as well as the Agro-Ecological Knowledge toolkit for Windows: WinAKT 4.06 software (Dixon *et al.* 1999). Ten farmers were interviewed in order to get information concerning their knowledge and understanding. Farmers from both upstream and downstream areas in the catchment were consulted and the distribution of knowledge in the electronic knowledge base was verified following the recommended methodology (Dixon *et al.* 2001). Farmers' knowledge was analysed with respect to their understanding of erosion and filter functions in the landscape. Particular attention was given to the filter efficiency of plant species such *Acacia mangium, Vemicia montana* and bamboo species.

Based on the PaLA survey, a number of issues regarding sustainable land-use were identified. For each of these issues, hypotheses were formulated about soil-plant-wa-

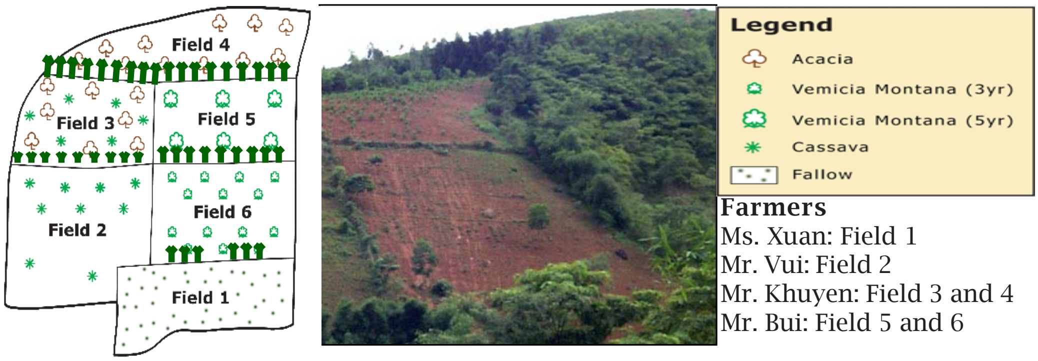

Figure 2: Transect 1 - The most eroded part of the catchment (Sketch and Photo by Dan Olsson, 2002, A bamboo hedgerow is being grown on the borders between fields).

Figure 3: Transect 2 - The filter place, i.e 'water supplier', for the downstream catchment area (Sketch and Photo by Dan Olsson and Kerstin Schwan, 2002)

ter interactions. From the hypotheses, modelling scenarios were suggested for the WaNuLCAS simulation (Olsson and Schwan 2003). Four key informants (two women and two men: Head of village women's association, one randomly chosen woman, village leader and village party secretary) wealth ranked all 40 households in the village. Following this, a ***PHEA survey*** was completed with 14 households, representing the three wealth groups in the village, and whose fields are located in the three representative landscape units (table 2). The findings from these surveys were presented to local stakeholders on a poster during a one-day workshop organised in February 2003. This workshop, together with several field visits by the local farmers to experimental sites and demonstration sites, assisted land users/farmers to select some of the land use scenarios (figure 1).

Step two - Participatory testing and predicting the effects of the land use options

Local farmers are testing the scenarios using the ***Farmers Field School*** (FFS) approach (Lubis 2003; Puentes 2003) and the water and soil conservation effects of different land uses are being simulated using the WaNulCAS (van Noordwijk and Lusiana 2000) and GenRiver (Generic Model for River Flow, van Noordwijk *et al.* 2003) models. The WaNuLCAS model simulates soil and plant water balance, lateral water flow, dynamic soil structure and agroforestry interactions at the plot level, while GenRiver simulates the water flow in a whole watershed (catchment) containing sub-catchments that receive partially independent rain and have separate land use trajectories. The sub-catchments all feed into a single river that drains the whole catchment (van Noordwijk *et al.* 2003).

Pakchae village, Luangprabang, Laos: Similar PaLA and LEK surveys to those conducted at the site in Vietnam (described above), were carried out at Pakchae village in 2003. Three sub-catchments, Pahi, Pu Phadeng and Pu Nan Ut, were selected for transect walks. 14 farmers, whose fields are located in the sub-catchments and are representative of different land use types and different landscape units, were selected for the interviews. The farmers' perceptions concerning current land use on a temporal and spatial scale as well as their visions of land use change were gathered using PRA/RRA methods (figure 4). The findings gained during the surveys were reported to the local farmers on a poster during a one-day workshop at the site.

Some findings and further actions

Land use-erosion interactions: Farmers' perceptions and knowledge gathered through Participatory Landscape Analysis (PaLA) as a complementary tool to scientific erosion measurements

This section answers a number of questions:

Are planted trees good for erosion control?

During the PaLA survey, land use changes during the last 30 years in different landscape units in the Dong Cao catchment were recorded. Planted trees, mainly *Acacia mangium, Cinamon spp, Ecalyptus spp*, and *Vemicia Montana,* had been planted at different places in the catchment during 2000 – 2001. It was found that the high amount of bed load (sediment amount measured at the weirs) did not only reflect the effects of

Figure 5: Village sketch drawn by the male and female farmers groups (Photo: Minh Ha Fagerström.)

the current land use, but also those of previous changes in land use (figure 6 and table 2). For example, zone one (the lower part of the catchment), was the most eroded partly due to a long period (30 years) of intensive cassava monocropping in some fields. This intensive cultivation may be a result of the easy accessibility of this zone. Free grazing was another factor contributing to the high erosion level in this zone. On the other hand, zone three (the upper part of the catchment), had a smaller number of planted trees compared to zone one. However, due to the long fallow history (16 years), erosion was less than in zone one. This shows that although planting trees may have a retarding effect on erosion, it takes some time before the effect becomes apparent.

Does cassava always give bad effects regarding erosion?

Different ways of cultivating *Cassava* affect erosion differently. *Cassava* in a rotation with long fallow (tauguya system) did not lead to obvious erosion hazards (see zone three in figure 6 and table 2). Reasons for planting *Cassava* or trees do not seem to be connected with household economy, since both rich and poor farmers planted *Cassava* (table 2).

What are the underlying reasons behind farmers' decisions?

The main factors behind the farmers' decisions seem to be

- Land quality.
- "Do the same as my neighbours do".
- The economical benefit of the species.
- Need for *Cassava* in the taugya system (farmers considered *Cassava* to both protect young trees from cattle grazing and trampling as well as to suppress weeds (table 2).

These diverse factors indicate that there is a need for a holistic view when proposing any new land use practices to be adopted by farmers. Moreover, it is necessary to evaluate land use practices both on a spatial and a temporal scale. A package of different research tools is needed for this purpose.

Model simulations may be suitable for predicting the effects of tree-based land use systems for a long time period, while a PaLA survey is useful both for spatial and temporal aspects (in cases where there is no data on land use changes in the past, farmer

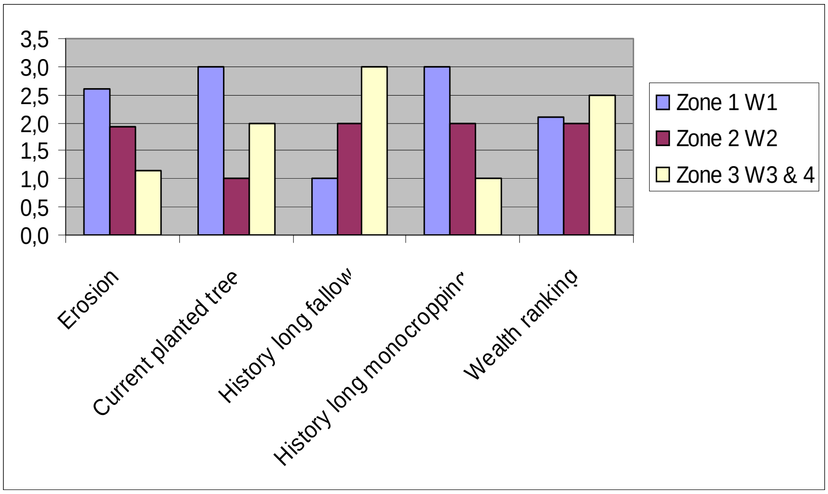

Figure 6: Matching between erosion measurements and the Participatory Landscape Analysis (PaLA); the data on the figure are ranked scores; W = gauged weirs, where erosion was measured by MSEC/IRD Vietnam.

knowledge is important).

Role of trees for soil and water conservation – Formulation of hypotheses for simulation work based on LEK and PaLA

When asked about their visions for land use change, the farmers in the Dong Cao catchment mentioned tree planting (table 2). Specifically, the interviewed farmers mentioned the role of trees in "absorbing" and "releasing" water, as well as in providing "soil softness and dark/fertile soil". Farmers Used *Acacia mangium*, *Vemicia montana*, and *Bamboo spp, i.e.* the most common "woody" species in the Dong Cao catchment as examples, when explaining the mechanisms by which size, colour and density of leaves, as well as rooting behaviour of different kinds of vegetation influence soil erosion and fertility (figure 7). Farmers believe that:

- Trees retain water during the day and, by doing so, resist heat from the sun.
- Leaf litter covers the soil and also absorbs rainwater.
- Tree crowns reduce splash erosion by intercepting raindrops before they hit the soil.
- Good soil can be retained in fields where vegetation functions as a living fence along the fields' lower boundaries.
- Dong Cao farmers perceive that tree roots actually release water into the soil leading to higher and continuous water flow in the streams.
- The more trees there are in the catchment, the higher the uniformity of water flow and its discharge volume into streams.

Farmers regard bamboo as a very good hedgerow plant along field boundaries. This is because according to local farmers, bamboo:

- Prevents animals from moving into fields.
- Slows the downward movement of soil.

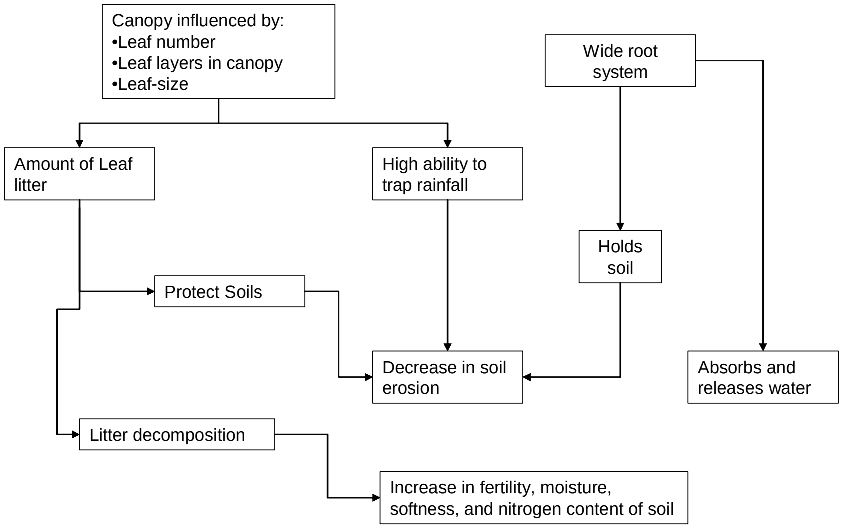

Figure 7: Dong Cao farmers' understanding of the role of trees on soil erosion and fertility (Johansson, L., 2003).

- Traps and retains soil through its dense clumps (locally called *boi*).
- Keeps soil from being washed away through its fine and wide spreading roots.
- Stems reduce water runoff.

However, farmers said that the extensive and fine roots of bamboo also absorb or 'eat' soil fertility, and thereby significantly affect annual crops in the vicinity. Hill farmers in Nepal reported similar observations of root competition and they consequently maintain bamboo only along field boundaries and never in the middle of fields (Thapa et al., 1995).

Hypotheses were formulated, mainly based on the gathered farmers' perspectives and knowledge, and used for the simulation work. This was done in order to predict long term soil and water conservation effects of tree-based land use options associated with low cost, i.e. no need for long-term erosion measurements. Some examples of such hypotheses are:

For the weak points of the catchment –Transect 1 (figure 3):

- Hedgerows of bamboo are better for preventing erosion than *Acacia mangium* and *Tephrosia candida* hedgerows. (WaNuLCAS simulation)
- Improved fallow of *T. candida* (two years) in rotation with cassava (two years) prevents erosion better than hedgerows of bamboo intercropped with Cassava (WaNulCAS simulation)

For the strong points in the catchment –Transect 2 (figure 3):

- Trees in transect 2 (the strategic water supply place) will conserve water for the whole catchment. (GenRiver simulation)
- Acacia and bamboo species are better than weeds/short natural fallow for water conservation (WaNuLCAS simulation).

Identifying options for the short-fallow crop rotation in the upper part of the landscape in Pakchae village, Laos - A combination of PaLA, LEK, PHEA and modelling is suitable

One of the most important findings of the PaLA survey in Pakchae was the dilemma relating to the short fallow-crop rotation in the upper part of the landscape, in connection with a new land allocation policy whereby local farmers were allocated two or three pieces of land where they rotate upland rice and fallow (personal communication with a local policy maker). The fixed four-year rotation crop-fallow system in the upper part of the hills seems to face serious weed problems. The Integrated Upland Agricultural Research Program (IUARP) of the National Agro-Forestry Research Institute (NAFRI) made efforts to find several useful innovations (table 2) for the lower part of the landscape. The strategy was to increase income for farmers, thereby reducing the pressure on the upper part caused by cropping intensification. Production options under this strategy seem to be suitable for places that have good market access, because most of the tested options provided products that could be sold at the market. This was the case for Pakchae village. A Participatory Household Economy Analysis (PHEA) is recommended in order to predict the effects of these innovations on the household economy. It is important to see to what extent the lowland options can repay the opportunity cost of not planting upland rice in the upper parts of the landscape. The WaNuLCAS and GenRiver models, which are being calibrated for the site in Vietnam, could be used to predict effects of different tree-based systems and to evaluate their suitability for replacing the current problematic fixed four-year rotation crop-fallow system.

Farmers in Pakchae clearly explained the reasons why they select different species for different landscape units (table 2). This shows that the PaLA survey is a good tool to use when searching for more land use options. It is recommended that a PaLA survey is carried out in a village that is more remote than Pakchae. The options for a remote village, with restricted access to the market, will certainly be different from the Pakchae case. Experiences from the Vietnam site on how to explore the LEK and PaLA surveys for formulating hypotheses for simulation work should be shared with the Laos site.

Conclusions

The combination of local and scientific knowledge, using a holistic approach for evaluating and planning land use on a catchment level, has proved to be powerful due to its cost efficiency and dynamics. During one year, the awareness of both local and external stakeholders of the strengths and weaknesses of the natural resources at the Dong Cao catchment has been raised by a considerable extent. This has helped people to meet the needs of a quickly changing reality. The focus related to poverty reduction and environmental protection for the Dong Cao catchment should be on tree management and the market for tree products. As a result of the planning process, local stakeholders recently showed great interest for some new land use options, which are now under the Participatory Testing and Predicting Step. As discussed in the previous section, the KBS approach developed at the Vietnam site has been shown to be useful for the Laos site. This can be explained by the fact that the two sites belong to a similar agro-ecological zone.

Acknowledgements

This research is funded by the Rockefeller Foundation and the Swedish International Development Agency – Sida/SAREC. The authors are grateful to farmers at the study sites for their active participation in this research. The erosion measurements at Dong Cao catchment were done by the MSEC/IRD – Vietnam team, under the lead of Dr. Didier Orange. Several researchers and students from Vietnam, Laos and Sweden contributed to this work. They are Prof Thai Phien, La Nguyen, Tran Si Hai, Do Duy Phai, Tran Dinh Tuan and Le Xuan Anh (NISF); Thongsavanh K., Saysana, I., Phonekeo, P., Boonhom, S. (NAFRC and PAFO); Johan Iwald, Dan Olsson, Kerstin Schwan, and Linda Johansson (SLU). The training and fieldwork in Laos in 2003 was carried out in collaboration with ICRAF Chiangmai and North Watershed Research Center, Chiang Mai, Thailand. Special thanks to Prof. Ingvar Nilsson (SLU) for editing this manuscript and Prof. Mats Olsson (SLU) for the development of research ideas.

Authors

Dr. Minh Ha Hoang Fagerstr□m works with the World Agroforestry Centre (ICRAF), Southeast Asia program and is a professor at the University of Agricultural Sciences, Department of Soil Sciences, Uppsala, Sweden. E-mail: minh-ha.fagerstrom@mv.slu.se

Tran Duc Toan is the Vice Director of The National Institute for Soils and Fertilisers (NISF), Vietnam. E-mail: tdtoan@fpt.vn

Houmchitsavath Sodarack is the Director of the Northern Agro-Forestry Research Centre (NAFRC)/NAFRI in Luangprabang, Laos. E-mail: frclpb@laotel.com

Meine van Noordwijk works with the World Agroforestry Centre (ICRAF), Southeast Asia, Bogor, Indonesia. E-mail: M.Noordwijk@cgiar.org

Laxman Joshi is an Ethnoecologist at World Agroforestry Centre (ICRAF), Southeast Asia, Bogor, Indonesa. E-mail: l.joshi@cgiar.org

Bibliography

Chapman, M. 2002. *Local ecological knowledge of soil and water conservation in the Coffee gardens of Sumberjaya, Sumatra*. BSc Honours thesis. Bangor, UK: University of Wales.

Dixon, H., Doores, J., Joshi, L. and Sinclair, F. 1999. *Agroforestry knowledge toolkit for windows (WinAKT): Methodological guidelines, computer software and manual.* Bangor, UK: School of Agricultural and Forest Sciences, University of Wales.

Dixon, H., Doores, J., Joshi, L. and Sinclair, F. 2001. *Agroecological knowledge toolkit for Windows: methodological guidelines, computer software and manual for AKT5.* Bangor, UK: School of Agriculture and Forest Sciences, University of Wales. 171 pages.

Hoang Fagerstr□m, M. 2001. Sustainable Land Use Practices for the Uplands of Vietnam and Laos: Science and Local knowledge for Food Security. *Research & Education proposal to the Rockefeller Foundation.* Uppsala: Swedish University of Agricultural Sciences (SLU). 10 pages.

Hoang Fagerstrom, M., Messing, I. and Wen, Z. 2003. "A participatory approach for integrated conservation planning in a small catchment in Loess Plateau, China: Part 1. Approach and Methods". In Ritsema, C. ed. Soil erosion and participatory land use planning on the Loess Plateau in China. *Catena* 54, issues 1-2: 255-271, special issue.

Hoang Fagerstr?m, M., Toan, T., Iwald, J., Nhuyen, L., Hai, T., Schwan, K., Olsson, D., Phai, D., Hien, N. and Anh, L. 2002. *A Participatory Landscape Analysis of Dong Cao catchment, Tien Xuan commune, Luong Son district, Hoa Binh province, Vietnam.* Fieldwork report. Hanoi, Vietnam: LUSLOF project, NISF.

ICRAF, Chiangmai 2001. *Landscape Agroforestry in Northern Thailand : Impacts of Changing Land Use in an Upper Tributary Watershed of Montane Mainland Southeast Asia.* Studies based on ASB-Thailand Benchmark Site Mae Chaem District, Chiangmai Province. A report on Progress during 1997-2001.

Johansson, L. 2003. *Local Ecological Knowledge on soil and plant interactions in a landscape in northern Vietnam.* A Minor Field Study report. Uppsala: SLU.

Joshi, L., Wibawa, G. and Sinclair, F. 2001. *Local ecological knowledge and socio-economic factors influencing farmers' management decisions in jungle rubber agroforestry systems in Jambi, Indonesia.* An output from DFID Project R7264. Bangor, UK: School of Agricultural and Forest Sciences, University of Wales.

Lubis, M. 2003. "Overview of Farmer Field Schools". pages 5-9. In "Farmer Field Schools: From IPM to Platforms for Learning and Empowerment. Users' Perspectives With Agricultural Research and Development". *CIP-UPWARD.* Los Banos, Laguna, Philippines: 83 pages.

Olsson, D. and Schwan, K. 2003. *WaNuLCAS as a tool to predict erosion control effects of land use alternatives in a small catchment in Northern Vietnam.* A Minor Field Study report. Uppsala: SLU.

Pandey, S., and Dang van Minh. 1998. "A socio-economic analysis of rice production systems in the uplands of northern Vietnam". *Agriculture, Ecosystems and Environment* (70): 249-258.

Puentes, R. 2003. "Implications: Managing Changing Demands and Relationships". *CIP-UPWARD. Farmer Field Schools: From IPM to Platforms for Learning and Empowerment. Users? Perspectives With Agricultural Research and Development.* Los Banos, Laguna, Philippines. Pages 26-39.

Thorne, P., Subba, D., Walker, D., Thapa, B., Wood, C. and Sinclair, F. 1999. "The basis of indigenous knowledge of tree fodder quality and its implications for improving the use of tree fodder in developing countries". *Animal Feed Science and Technology.* (81): 119 – 131.

Toan, T., Phien, T., Nguyen, L., Phai, D. and Ga, N. 2001. ? Soil erosion management at the watershed level for sustainable agriculture and forestry in Vietnam". In: Soil erosion management research in Asian catchments: Methodological approaches and initial results. *Proceedings of the 5th Management of Soil Erosion Consortium (MSEC)* Assembly, Semarang, Central Java, Indonesia, 7-11 November 2000.

van Noordwijk M., Farida A., Soyamto D. and Lusiana B. 2003. *GenRiver and Spat rain model description.* World Agroforestry Centre, ICRAF-SE Asia.

van Noordwijk, M. and Lusiana, B. 2000. *WaNuLCAS 2.0, Background on a model of water nutrient and light capture in agroforestry systems.* Bogor, Indonesia: International Centre for Research in Agroforestry (ICRAF). 186 pages.

Walker, D., Thorne, P., Sinclair, F., Thapa, B., Wood, C. and Subba, D. 1999. "A systems approach to comparing indigenous and scientific knowledge: consistency and discriminatory power of indigenous and laboratory assessment of the nutritive value of tree fodder". *Agricultural Systems.* (62): 87-103.

Table 2: Links between land use and erosion at the study sites

Landscape units	Zone 1 - Lower part	Zone 2 - Middle part	Zone 3 - Upper part
I. Dong Cao catchment, Vietnam (Erosion ranking in this table was based on measurements during 1999-2002, while the other data were synthesised from the findings of the participatory surveys during 2002).			
Accessibility	**Most**	**Less**	**Least**
Wealth ranking of land owners	3 households are average, 2 are rich and 1 is poor	4 households are average	2 households are average and 2 households are rich
Land quality compared to the whole catchment	One field was considered as being the weakest point, i.e. very sensitive to erosion, due to soil compaction, and run-on from above fields	No specific comments	One hill/ field was considered as a filter, which supplied water for the paddy fields and for other uses throughout the year.
Current land use	Mainly trees and fallow	Cassava is the dominating species. Hedgerows of Vernicia, T. candida, Vetiver grass, Acacia intercropped with Cassava	Mixed long-fallow and Cassava (Fig. 4)
Reasons for choosing species	Degraded land which does not give yield any more if planted with Cassava	Cassava was planted since it is easy to sell and the neighbours also plant it.	Cassava was planted in a tauguya system while trees are still small, or to prepare land for planting trees
Land history	Cassava, if planted, was used for monocropping over a long time (30 years). Some N and P- fertilisers were used.	Cassava is being planted during the last 4-5 years without inputs, after a fallow period of 4-9years	Cassava, if planted, is in rotation with a long fallow of 9-16 years.
Vision for land use change	Valuable trees, such as Acacia, Cinnamon, fruit trees, if funding is available	Trees such as Acacia and fallow	Continue with trees and fallow. Some Cassava is still grown since the land is still good (fertile)
Erosion ranking of three zones	Most eroded	Medium erosion	Least eroded

Landscape units	Zone 1 - Lower part	Zone 2 - Middle part	Zone 3 - Upper part
II. Pakchae village, Park Ou district, Luangprabang, Laos (data was synthesised from the participatory surveys in 2003)			
Accessibility	**Most**	**Less**	**Least**
Current land use	Fishponds, Teak, Paddy and bamboo.	Upland crops, fallow and some tree patches	Upland crops, fallow and forest.
Reasons for species choice	Soil has more rocks. This part is suitable for fruit trees and Teak. Teak gives better price	The upper part of the slope is more suitable for upland rice, because the forest keeps more moisture	
Focus issues	Rotation fields converted to permanent fields. Some of the innovations being tested are fruit trees, fishponds, paper mulberry, and 'improved fallow' with pigeon pea, paper mulberry and fishponds.		Weeds invaded the upland rice fields after a 4 year- rotation. No options are being implemented
Vision for land use change	Fruit trees if labour is available		Teak integrated with upland rice for one year, and then shifted to Teak only, may shade out weeds