Technical Report no. 1, TR 1

Agroforestry Research for Development in Shifting Cultivation Areas of Laos

By

Peter Kurt Hansen and Houmchitsavath Sodarak[1]

Shifting Cultivation Research Sub-programme

Lao Swedish Forestry Programme

Luang Prabang, Lao P.D.R.

December 1996

SUMMARY

Shifting cultivation is the dominant cropping system in the uplands of Laos, often combined with other agroforestry systems, such as economically enriched fallows, homegardens, taungya and living fences. Population pressure and government restrictions are increasingly undermining the productivity and sustainability of traditional shifting cultivation systems.

Alternative agroforestry systems that focus on soil conservation and plant nutrient management have been introduced in recent years, but adoption by farmers has been very limited. Adoption of conservation farming technologies is, however, likely to increase as the need and opportunities of agricultural intensification develops.

Agroforestry research in Laos should focus on solving concrete land-use problem, on making improved technologies available to farmers, and on formulating diversified extension recommendations and development strategies. It is suggested that a research committee is created under Department of Forestry to co-ordinate and monitor agroforestry research. Three main research component are proposed: reviews of available information, descriptive research on current land-use problems and potentials, and field trial experiments. The weak research capability in Laos will necessitate development of appropriate research methods, staff training, and creation of work facilities and procedures.

1. INTRODUCTION

Shifting cultivation is the dominant cropping system in the uplands and mountains of Lao P.D.R. Approximately 300.000 families (Souvanthong 1995), equal to about 1.8 million people or forty percent of the population, are engaged in shifting cultivation. Assuming that each family plants about 1.5 ha per year, the shifting cultivation area used annually would be around 450.000 ha. The total area in the shifting cultivation cycle is difficult to assess, but may be 2 - 2.5 million hectares equal to about 10 percent of the area of Laos.

During the past 20-30 years the fallow periods have progressively become shorter because of population pressure, government restrictions on forest clearing, competing land-use objectives, and concentration of people in areas with road access, urban centres, rivers and irrigation. Farmers are thus clearing fields in young re-growth and are unable to employ adequate fallow periods. The consequent soil degradation and proliferation

of weeds and pests result in lower yields and increased demand for weeding, often beyond the capacity of farmers. Many shifting cultivators are therefore experiencing increasing poverty and uncertain prospects.

The forest area of Laos has been reduced considerably by shifting cultivation, by preventing forest regeneration in already affected areas and by the clearing of mature forest. This diminishes the national timber resources and important natural habitats. Where shifting cultivation is intense, accelerated erosion and changes in the water discharge may impair the water resources for irrigation, hydropower and domestic use.

Stabilisation of shifting cultivation is a major priority of the Lao Government because of the associated environmental and social problems. The development strategy includes land allocation, expansion of the paddy areas, promotion of permanent cash cropping, expansion of livestock production in remoter areas, and social development work. Agroforestry is assumed to have a role in achieving sustainable land use in the hilly areas of Laos by improving the shifting cultivation practices or by facilitating alternative types of land-use.

2. AGROFORESTRY SYSTEMS IN THE UPLANDS OF LAOS

Agroforestry is land-use systems and technologies where woody perennials are deliberately used on the same land-management units as agricultural crops and/or animals, in some form of spatial arrangement or temporal sequence (Nair 1989). Table 1 summarises features of the main agroforestry systems used in shifting cultivation areas of Laos.

Table 1. Benefits and constraints on agroforestry systems in shifting cultivation areas of Laos

Agroforestry type	Description	Benefits	Constraints	Examples from Laos
Traditional systems				
Shifting cultivation	Alternating periods of tree growth and agricultural crops.	Restoration of soil fertility. Suppression of weeds and crop pests.	Requires long fallow periods. Low productivity with short fallows. Government condemnation.	Most widespread cropping system in Laos
Economically improved fallows	The economic benefit of the natural fallow is improved through manipulation of the fallow vegetation.	Increased income or output from the fallow.	Increased labour needs. May require long fallow periods.	Production of paper mulberry bark, cardamom, and benzoin.
Living fences	Hedges of woody species planted around agricultural fields	Mainly to fence off agricultural fields, but also for leaf fodder, mulch, firewood, and wind reduction.	Efficient only after several years. May compete with crops.	Widely used around permanent fields and gardens.
Plantations and orchards	Various other combinations of trees and crops, such as multi-storey gardens, homegardens, and estate plantations.	High area productivity. Good use of the available resources.	Herbaceous components suppressed in older plantations. Rational management may be difficult.	Homegardens and multi-storey gardens common in older villages all over Laos
Taungya	Cultivation of agricultural crops during the early stages of tree establishment.	Economic return from the plantation during the early years. Ensures weeding during the cropping periods. Cheap establishment.	Agricultural land is lost. Land-use rights may be transferred to investors. Farmers may become labourers.	Common along river banks in the North. In recent years also in upland areas. Traditional planting method of the forestry authorities.
New systems				
Biologically improved fallows	The bio-physical effects of natural fallows are improved through enrichment planting or other	Increased restoration of soil fertility. Increased suppression of weeds and pests.	The improved fallow may become a serious weed during the cultivation periods.	Experimental stage at the moment. No extension recommendations

	manipulation			
Alley cropping	Belts of woody species alternate with belts of agricultural crops.	Nutrient recycling and nitrogen fixing. May also produce leaf fodder, firewood and mulching material.	Occupies agricultural land. Woody component may compete with the agricultural crops. Requires additional labour.	Introduced by various projects, but little or no adoption by farmers.
Contour hedgerows	Woody species planted in hedges along the contours alternating with belts of crops.	Mainly for erosion control; may have benefits similar to alley cropping.	Occupies agricultural land. Woody component may compete with the agricultural crops. Requires additional labour.	Introduced by various projects, but little or no adoption by farmers.

Most shifting cultivation in Laos may be considered agroforestry, excluding the grass-based systems found especially in areas of higher elevation. Other agroforestry systems traditionally used in Laos are taungya systems for establishing plantations of teak and other species, hedges to fence off fields from wild or farm animals, and integrated gardens. In some areas farmers have used economically enriched fallows by planting or selectively protecting species such as paper mulberry (*Broussonetia papyrifera*), benzoin tree (*Styrax benzoides* or *S. tonkinensis*), or cardamom (*Amomum spp.*).

In recent years various development and research projects have introduced alternative agroforestry systems that focus on improved plant nutrient management and soil erosion control. Such systems include contour hedgerows, alley cropping, and biologically enriched fallows.

3. CONSTRAINTS AND INCENTIVES FOR FURTHER ADOPTION OF AGROFORESTRY SYSTEMS

Although the stated goal is to eliminate shifting cultivation altogether, it is generally realised that cyclical shifting cultivation will remain the most realistic option for many farmers for yet many years. The increasing land pressure and government interventions will, however, eventually induce most farmers to intensify their production through adoption of technical inputs, crop rotations, cash cropping and conservation farming techniques.

The limited market, infrastructure and processing facilities in most shifting cultivation areas limit the scope for commercial agroforestry products, such as wood, fruit, and materials. However, in areas with road access enriched fallows (particularly paper mulberry), commercial fruit production and teak planting have increased dramatically during the past 4-5 years.

Alternative agroforestry systems have been introduced on a trials basis, such as biologically improved fallows, alley cropping and contour hedgerows. These systems aim mainly at plant nutrient management and erosion control, but may also produce firewood, fodder and mulching material. However, adoption has been very limited, probably because these systems provide farmers with few or no immediate economic benefits - real or perceived . Their adoption is further hampered by the relatively easy access to land, fuel wood, grazing and forest products when compared to more densely populated areas.

Current development trends are likely to push for further intensification of the agricultural production, which will make conservation oriented and commercial agroforestry systems more attractive to farmers:

- The rapid population growth, currently at 2.4 percent per year, which will increase the competition or land and other resources.
- Further concentration of people along roads and in areas of public services.
- Land allocation schemes that will allow fallow periods of only 3 years.
- Possible relocation of people from so-called sensitive watershed areas.
- Improved infrastructure, processing facilities, market access and international trading.

4. AGROFORESTRY RESEARCH STRATEGY

The ultimate aim of agroforestry research in Laos must be to contribute to the sustainability and productivity of land-use. Agroforestry research in Laos should focus on solving concrete landuse problem, on making improved technologies available to farmers, and on formulating diversified extension recommendations and development strategies.

In this context 'research' should therefore be defined broadly as any kind of systematic collection and analysis of information on the constraints, potentials and possible improvements of landuse. Also, research should not be seen merely as testing of the bio-physical performance of technologies, but also include economic and social factors and farmers' adoption and adaptations of land-use systems.

If an agroforestry research body were to be created in Laos it would be relevant to conduct:

- Reviews of existing information
- Descriptive research
- Experimental research

4.1 Review of existing information

Much information on agroforestry is available internationally, but few attempts have been made in Laos to take advantage of this resource. The experiences already gained in, e.g., Vietnam and Thailand seem obvious sources of information, considering the similar production conditions and the low research capacity in Laos. Thus, rather than "re-inventing the wheel" systematic collection and analysis of existing knowledge should be made to assess the relevance of technologies for Lao conditions, whether further research is necessary, and if so, what kind of research. The reviews should also be used for making extension strategies and recommendations. Thus, we must accept that our knowledge will never be complete, and that "best bets" are still better than having no recommendations.

It is crucial that such reviews are critical, especially considering the prevalence of overly optimistic agroforestry research and extension, and the questionable reliability of some technical recommendations. As one observer has noticed:

> "There is a dynamic flux transforming the theory and practice of conservation farming for hillslopes in the tropics. Much of the conventional wisdom of even 10 years ago has been challenged by recent research and farmer experience" (Garrity 1995).

It is likewise important that reviews take into account not only technological aspects, but also the questions of social acceptability, labour demands, economic returns, and the implications for gender roles and tenure rights.

4.2 Descriptive research

The environment, socio-economic conditions and land-use in the uplands of Laos are extremely variable, as are the potentials and constraints on agroforestry development and innovations. Gaining a better understanding of these aspects will facilitate extension and further research. Three areas of research are suggested below.

AGRO-ECOLOGICAL ZONATION

The ecological conditions in shifting cultivation areas of Laos are very diverse, e.g., regarding rainfall, temperature, soil conditions, topography and vegetation (Table 2). In mountainous areas such changes may take place within short distances because of differences in elevation, aspect, and conditions for soil formation.

Table 2. Ranges of some environmental factors in shifting cultivation areas of Laos and their implication for land-use.

Environmental factor	Implication for current and potential land-use
Climate	

Annual rainfall: 1100-2500 mm	Water balance, disease and pest problems, crop suitability.
Length of dry season: 2-7 months	Length of cropping season, possibilities of double cropping, rate of forest regeneration, risk of fire.
Mean annual temperature: 14-26℃	Crop suitability, yield levels.
Absolute minimum temperature: -3 - +9°C	Crop suitability, risk of frost damage.
Soil properties	
pH: 3.5 - 8	Yield levels, crop suitability.
Organic matter contents: 0.8-8 %	Plant nutrient supply, soil physical properties.
Plant nutrient status: poor to very fertile	Yield levels, need of amendments, rate of forest regeneration, length of fallow and cropping periods.
Soil texture: coarse sand - heavy clay	Plant moisture supply, nutrient retention and leaching.
Erodibility: very low - very high	Risk of erosion - need of soil conservation measures
Topography	
Elevation: 180-2600 m.a.s.l.	Temperature, rainfall, moisture availability, soil humus accumulation.
Slope conditions: flat to very steep	Erosion risk, soil properties, soil water availability.
Vegetation	
Age of fallows: 2 to >50 years	Yields, nutrient accumulation, weed competition, loss of timber resources, organisation of work.
Forest regeneration: slow to rapid	Frequency of recultivation, risk of degradation, carrying capacity.
Types of vegetation used for shifting cultivation: grassland, bamboo, shrub, young forest, old forest	Yield level, weed competition, land clearing technology, prevalence of agricultural pests.

An agro-ecological classification system would be valuable in both research and extension by helping to:

- Organise our knowledge of the bio-physical production conditions.
- Evaluate the applicability of research results to other geographical areas.
- Make extension recommendation for local environmental conditions.
- Form local development strategies.

The development of such a system would include:

- Establishing meaningful ecological zones, for example based on criteria such as those listed in Table 2, and
- Identifying environmental requirements and constraints on crops, tree and cropping systems. This may be based on literature reviews, field observation and trials.

An agro-ecological classification system is of course not relevant only to agroforestry, and may therefore be expanded to include crops, pastures, orchards and tree plantations.

TECHNOLOGY EVALUATION

Description and evaluation of existing agroforestry technologies may provide considerable knowledge for modification of research priorities, extension recommendation and even policy strategies. Studies should include adequate description of the technologies and of the local environment, socio-economic conditions and production systems. The agroforestry systems may then be evaluated regarding, e.g., the:

Productivity:	How does the return on land or labour input compare to alternative land-uses?
Sustainability:	Does the technology improve the land-use sustainability?
Equitability:	Does the technology facilitate equitable access to resources and production outputs?

Adoption:	Who and under which circumstances adopt the technology?
Adaptation:	How do farmers adapt technologies to fit their household resources and production conditions?

Improved productivity, soil conservation and nutrient management may be achieved through other means than agroforestry systems. The agroforestry assessment should therefore be compared with alternative technologies, including both traditional methods and innovations such as lay farming, grass strips, cover cropping, strip cropping, mulching and various forms of terracing.

LAND-USE SYSTEM EVALUATION

The objective of this type of research is to reach a holistic description and evaluation of land-use systems to help plan, implement and monitor development and research activities. Of particular interest in the current context is the role, potentials and constraints of agroforestry technologies in relation to the production conditions and to other local land-uses practices.

Depending on the concrete objective of the research, different hierarchical levels of "land-use systems" may be put under investigation, e.g., farm, village or district level.

The inquiries may include the following steps:

Definition:	Which system is under investigation?
Description:	What are the objective, organisation, function of the system?.
Evaluation:	What are the problems, constraints and trends?
Solutions:	What solutions and improvements are possible?
Priorities:	What extension and research activities can be recommended?

Farmers will naturally be major partners in such research and should preferably be involved in all its stages. We suggest that a framework for land-use system evaluation is devised within Department of Forestry and applied in test areas representing some of the major agro-ecological zones of Laos.

4.3 Field trials

Field trials using standard experimental techniques involve the comparison of various treatments laid out randomly in replicated blocks. Such trials may be used to develop new technologies, and to adapt or verify the suitability of technologies in new geographical or ecological areas. Considering the limited research capacity in Laos and the availability of information from nearby countries 'adaptive field trials' should be prioritised.

Experiments may be conducted at research stations or in farmers' fields. On-station trials are useful for screening crops and technologies that are new to an area, for carrying out long-term trials, for trials that require detailed data collection, and for training staff in carrying out field trials. However, the conditions on research stations are usually different from those in farmers' fields regarding, e.g., environmental conditions, labour availability, and production objectives.

Many technologies that looked promising in on-station field trials failed when introduced to farmers because the conditions and management at the station were too unrealistic for farmers. On-farm trials are useful for testing promising technologies, for testing technology under different conditions and for studying farmers' adoption and adaptation of technology, preferably in close co-operation with farmers.

If properly carried out under suitable conditions field trials can produce results that give a good basis for making practical extension recommendation. Unfortunately, field trials usually requires several years of experimentation, especially when involving perennials as in agroforestry systems. Moreover, soil conditions in upland areas of Laos are usually extremely heterogeneous, which often obscures the effect of treatment. Another problem is the heterogeneous or unknown genetic composition of the woody component of agroforestry trials, which complicates the interpretation and applicability of trial results.

Based on our experience in the Shifting Cultivation Research Sub-programme we recommend

- That only essential trials should be carried out.
- That extreme care is taken in site selection.
- That as many as 6-8 replications are made at each site.
- That on-farm trials are prioritised over on-station trials, and
- That "subjective" trial evaluations are made in co-operation with farmers.

Results from descriptive research and reviews of existing information will be very useful in deciding on research designs and on what are "essential trials". One kind of trials we consider of high priority is testing of tree provenance and types in different environments, and subsequent selection, propagation and distribution of suitable material. This is relevant for traditional timber species as well as for multi-purpose tree species.

5. CONCLUSION

Research into traditional and innovative agroforestry systems in Lao P.D.R. is relevant to the improvement of land-use, especially in shifting cultivation areas. To make best use of the available resources, agroforestry research must focus on solving concrete land-use problems and should take maximum advantage of already existing information. High priority should be put on understanding the existing land-use types, their relations to environmental and socioeconomic conditions, and their constraint and potentials.

Little research on agroforestry has been carried out in Lao P.D.R and the research capacity remains low. Improving agroforestry research will therefore involve the creation of:

- Staff capability in carrying out research.
- Appropriate research methods.
- Research facilities and infrastructure.
- Institutional cooperation in research and extension.
- Research results relevant to development, planning and extension.

REFERENCES

Garrity, D.P. (1995): Improved agroforestry technologies for conservation farming: pathways towards sustainability. In: International Workshop on Conservation Farming for Sloping Uplands in Southeast Asia: Challenges, Opportunities, and Prospects, p.145-168. IBSRAM Proceedings no. 14. International Board for Soil Research and Management, Bangkok. 357 pp.

Nair, P.K.R. (1989): Agroforestry defined. In: P.K.R. Nair (ed.), Agroforestry Systems in the Tropics, p. 13-18. Kluwer Academic Publishers, Dordrecht, 664 pp.

Souvanthong, Pheng (1995): Shifting Cultivation in Lao P.D.R.: an overview of land use and policy initiatives. IIED Forestry and Land Use Series No. 5. International Institute for Environment and Development, London, 38 pp.

Paper presented at the "National Seminar on Research Planning", Vientiane, Laos 9-11 December 1996. Department of Forestry - FAO/FORSPA - Lao Swedish Forestry Programme

1 Advisor and Director, respectively, Shifting Cultivation Research Sub-programme, Lao Swedish Forestry Programme, P.O. Box 487, Luang Prabang. Tel. 071 212 099, Fax 071 212 467