SHIFTING CULTIVATION SYSTEMS AND RURAL DEVELOPMENT IN THE LAO PDR

Organised by the Nabong Agriculture College Project

REPORT OF THE NABONG TECHNICAL MEETING

Nabong Agriculture College,

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July 14-16, 1993.

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The "Assistance to Nabong Agriculture College Project" UNDP/DDSMS/LA0/92/017 is an institution building project funded by the United Nations Development Programme (LTNDP), executed by the United Nations Department for Development Support and Management Services (DDSMS) and implemented by the Ministry of Agriculture and Forestry of the Lao P.D.R. The project was initiated in 1989 and is due to finish in 1994 with the purpose of upgrading the quality of the teaching programmes provided for Lao students in the fields of agronomy, animal husbandry and farm machinery. Activities include strengthening of the management of the college, curriculum development centered on the concepts of the agro-ecosystems, upgrading the capacity of the teachers to execute the new training system, integrating practical activities into teaching programmes, support to the development of the college farm, development of income generating activities, production of teaching manuals in the Lao language and organisation of special training courses, workshops and seminars for the college staff, students and agriculturists from other Government agencies.

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This report contains papers presented at the Nabong technical meeting on shifting cultivation systems in Lao P.D.R. Authors submitted copies not ready for publication and editing consisted of providing guidelines for writing papers, converting Files or retyping texts into WP 5.1, translating some of the papers from French into English, summarising the report and, correcting syntactical and grammatical English. The papers reflect the personal views of the authors and do not necessarily reflect the views of the United Nations Development Programme, the United Nations Department for Development Management and Support Services and of the Government of Lao P.D.R.

ABBREVIATIONS

AIDAB	Australian International Development Assistance Bureau
CAA	Community Aid Abroad
CCL	Comite de Cooperation avec le Laos pour la Science et pour 1'Education
CIDSE	Cooperation Internationale pour le Developpement et la Solidarite
CSIRO	Commonwealth Scientific and Industrial Research Organisation Chief
CTA	Technical Advisor
CUSO	Canadian University Service Overseas
DOF	Department of Forestry
DPI	Department of Primary Industries (Queensland)
EEC	European Economic Community
ESF	Ecole Sans Frontieres
FAO	Food and Agricultural Organisation of the United Nations
FMCP	Forest Management and Conservation Project
IDRC	International Development Research Center
IFAD	International Fund for Agricultural Development
IRRI	International Rice Research Institute
IUCN	International Union for the Conservation of Nature
JVC	Japan International Volunteer Center
MAF	Ministry of Agriculture and Forestry
MCC	Mennonite Central Committee
NARC	National Agricultural Research Center
NCA	Norwegian Church Aid
NDDP	Nong District Development Project
NGO	Non-Governmental Organisation
OPS	Office of Project Services (UNDP)
QSL	Quaker Services Laos

RIFS	Rice Integrated Farming Systems
RRA	Rapid Rural Appraisal
SAF	Sustainable Agricultural Forum
SEASAN	South-East Asian Sustainable Agriculture Network
SIDA	Swedish International Development Authority
SUAP	Sustainable Upland Agriculture Project
TFAP	Tropical Forestry Action Plan
UNCDF	United Nations Capital Development Fund
UNDCP	United Nations Drug Control Programme
UN/DDSMS	United Nations Department of Development Support and Management Services
UN/DESD	United Nations Department for Economic and Social Development
UNDP	United Nations Development Programme
UNICEF	United Nations Childrens Fund
USDA	United States Department of Agriculture
ZOA	Refugee Care Netherlands

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I would like to express my sincere thanks to all the persons, national or international specialists, who have contributed to this document by writing the papers compiled in this report which is now the first publication attempting to put together the experiences of different projects dealing with development in shifting cultivation areas of Lao P.D.R. This report also contains an important quantity of information on rural development activities in the Lao P.D.R.

In particular, I would like to thank the following persons and institutions: the Ministry of Agriculture and Forestry for its interest and support to this technical meeting, with special thanks to Siene Saphangthong (Vice-Minister), Singkham Phonvisay (Director of Department of Livestock) and Kou Chansina (Director of Department of Agriculture) who participated in the meeting; the staff of the Nabong Agriculture College for having efficiently organised the workshop under the leadership of Sayamang Vongsak (Director), Thongly Xayachack (Deputy director - academic affairs) and Thongphanh Kousonsavath (Deputy director -administration & finance); John Evenson, for having chaired the meeting most of the time with the appropriate flexibility required in such circumstances and also for his invaluable contribution in writing the first paper presented at the workshop; Laurent Chazde for having accepted the challenging task of writing, in a couple of days, the first overview ever written on shifting cultivation practices in Laos and thus producing a very important document for the understanding of shifting cultivation systems in this country; Denis Boutin for having succeded to mobilise the different resource-persons from various NGOs who contributed to the meeting under the umbrella of the Sustainable Agriculture Forum (SAF), Murli Upadhyay for having accepted to relate the past experience of the Muonghom rural development project and also Walter Roder, Bouakham, Somnuk Thirassack, Bounphavanh Kanyavong, Viravanh Phannourath, Bouahong Phanthanousy, Andrew Jenkins, Joost Foppes, Paul Overgoor, Khamhiene, Sombath Somphone, Khaotong Luangchnadavong, Rolf Samuelsson, Houmpheng, Seng Hkum, Saypradeth Chounlamany and Rex Dufour who all contributed to the meeting with enthusiasm.

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SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The Nabong technical meeting

The Nabong Technical Meeting on Shifting Cultivation Systems in Lao P.D.R. brought together about 50 participants having experience in different provinces of the country. During three days, from 14 to 16 July 1993, some of the best knowledgeable national and international technicians working in rural development programmes or projects dealing with the reconversion of shifting cultivation systems into more settled and more productive systems. The Nabong meeting, by bringing together delegates from education, research and extension agencies to discuss technical aspects related to shifting cultivation, was the first of its kind to be organised in the Lao P.D.R. It is hoped that this report will be of useful interest to the Ministry of Agriculture and Forestry in particular and to any other people willing to know more about the present state of knowledge in dealing with shifting cultivation systems in the Lao P.D.R.

The aims of the workshop were 1) to collect the available technical knowledge on shifting cultivation systems in the Lao P.D.R. and the proposed alternatives for educational purpose at the Nabong Agriculture College and other schools, and, 2) to exchange information on shifting cultivation aspects between the various individuals and organisations working in the different agencies and projects.

All the major projects and organisations having experience in dealing with shifting cultivation in Laos were invited to participate and contribute to the meeting. Only a few among them did not attend or did not convey their experience to the meeting feeling they were not ready for that. Guidelines were provided to the participants for writing papers. The papers compiled in this report are essentially relating the experiences of their authors in dealing with shifting cultivation in Laos within their specific projects except for the contributions of John Evenson and Laurent Chazde which are respectively a literature review and a general overview of shifting cultivation practices in Laos. The order of presentation of the papers is following the schedule of the meeting.

Summary of the papers

An overview of each paper is tentatively given in the following paragraphs. Only some key points are reviewed for each paper and, for the reader who is interested in a particular paper it is strongly advised to read the whole text in -which he may find the technical details he is looking for. Some general conclu sions and recommendations are given after the review of the papers.

In his paper entitled **"Slash and Burn Agriculture : the continuing dilemma"**, John Evenson from the Nabong Agriculture College Project is reviewing the present state of knowledge on shifting cultivation through a global perspective, emphasising some particular aspects with direct implications for Laos. Essentially based on the recent annotated bibliography on shifting cultivation and alternatives by Robison and Mc Kean (CAB/CIAT, 1992), the paper includes the following conclusions: agroforestry is not an alternative solution to shifting cultivation supported by many published examples of success; the few successful examples of intensification involving a change to mechanization have occurred on better quality soils; successful intensification usually only occurs in areas close to markets; agricultural development has tended to move first into full tillage systems before minimum tillage is considered; more work needs to be done on mulching and green manure crops practices; more work is needed in farmer participation; more work is needed on the availability of suitable plant species and more work is needed on the integration of livestock. Furthermore the author points out the need to work at the level of a watershed as the smallest biological unit to be considered. The necessity of working for a long duration (about 10 years) on the problem is also pointed out. "Approaches to Slash and Burn limitation - A Review" by John Evenson, is the revised version of an earlier paper already circulated a few years ago. It is made up of two parts 1) Based on modification of existing practices, and 2) Based on replacement of rice with high value crops. This paper is attempting to summarize the possibilities for providing an economically more rewarding and ecologically acceptable series of cropping options for upland farmers in Laos. It is agreed that more information is needed before even

simple economic assessments can be made, for many of the options. The information reviewed shows that the problems encountered in many parts of the world when attempts have been made to intensify traditional shifting cultivation systems, have resulted in the loss of nutrients and organic matter from the system following the burning and during the cultivation phase. When a long fallow phase or a plantation crop is used, the system has time to recover by replacing lost nutrients from those released during soil genesis and the case of plantation crops by the addition of fertiliser. It is suggested that the selection of crops that are perennial and which can be grown under the cover of shade, browse trees or economic tree crops, is one way of providing a stable system. Another option is to include a leguminous cover crop phase or an economic leguminous pasture phase with return of animal manure. In the case of Laos where rice is the staple food two ways of improving the productivity in upland farms are examined: 1) to provide crops and cropping systems that can efficiently give a significantly better cash return while maintaining productivity, thus enabling the farmer to buy rice produced more efficiently elsewhere, and, 2) to provide crops and cropping systems that can efficiently give a significant cash return, and maintain productivity while still enabling the farmer to supply all or at least most of the family's needs of rice.

Laurent Chazee's paper entitled "**Shifting cultivation practices in Laos - Present systems and their future"** is the English version of an original French text "Les pratiques d'essartage au Laos - Les systemes actuels et leur avenir". This paper is the first document ever written with the attempt to give a general overview of the shifting cultivation systems and their possible evolution in the Lao P.D.R. (at the moment of printing this report there is a more expanded and illustrated version of the paper finalised after the Nabong meeting which is now available from the author in both French and English languages). Essentially based on Chazde's field observations throughout the country (109 villages visited between 1989 and 1993 in 28 districts), the paper describes the principles of shifting cultivation, the calendars and practices of shifting cultivation and the different production systems. It also discusses the advantages and disadvantages of the shifting cultivation systems as compared to the sedentary systems of the plains, the natural evolution of the shifting cultivation-based production systems and the conditions for accelerated modifications in the production systems of the slopes. Finally, the article explains the actions undertaken by the UNDP/UNCDF Small ScaleIrrigation Project in the provinces of Oudomsay and Luang Namtha to reduce shifting cultivation practices. In the overview on shifting cultivation in Laos it is estimated that about 300,000 families are practicing shifting cultivation by tradition and also because of a lack of access to land in the plains. Rice is the most important crop in mono-cropping as well as in multiple cropping systems covering 34 % of the total rice area and corresponding to 20 % of the annual production. Other areas under shifting cultivation are planted to maize, cassava, cotton, vegetables, oil crops, indigo, aromatic plants, opium poppy, fruit-trees, etc. In addition to the 300,000 families, about 100,000 families are regularly using the forested slopes in a more restricted way. Here they grow crops thriving better on drained slopes than in the lowlands especially if their lowland rice area cannot ensure family self-sufficiency. Official statistics report that about 310,000 ha of vegetation is annually cleared on sloping land in Laos with 235,000 ha for upland rice, 30,000 ha for maize and 45,000 ha for the other crops (cassava, cotton, soybean, groundnut, beans, tobacco, sugar cane, vegetables, sesame, etc.). By considering 4.5 years as the average fallow period, about 1,400,000 ha are used throughout Laos in the shifting cultivation systems, representing 6 % of the national territory. According to Laurent Chazde, this figure seems underestimated for crops other than rice and for the average fallow period. He considers that the total annual cultivated area is about 380,000 ha and the average fallow period is 5.5 years. Therefore the total area under shifting cultivation is estimated at 2,090,000 ha and the total burnt area (cropped land + fallow land + burnt forest) would reach approximately 2,300,000 ha, representing 9.7 % of the national territory. Based on satellite imagery and aerial photography it is estimated that 4,864,000 ha were used in shifting cultivation systems in 1989 with an average fallow period of 8 years (against 12 in 1981/82), which represents 20.5 % of the national territory. The aerial photographs of 1981/82 and the Spot pictures of 1988/89 show 73 % of increase for the annual crops under shifting cultivation with 352,500 ha against 61,700 ha. The area under shifting culivation is thus increasing in Laos and this is confirmed by several other observers. There is a great diversity in the shifting cultivation

systems of the country and their practices. After explaining the principles of shifting cultivation, the paper gives an overview of the calendar of activities and the practices of slash-and-burn. Cultural practices of the wet season crops are described in relation with the different sequences: tool preparation, decision to slash, slashing, burning, unloading trunks, sowing, fencing, weeding, harvesting, threshing and transport. Associated activities are also described and discussed: collection of bamboo shoots, insects, frogs, rats, birds, mushrooms and others. The advantages of practicing slash¬and-burn are given as follows: the particular flavour of the products harvested from the upland fields; the low requirements in equipment and capital; the low financial costs per hectare; the nutritional quality of life in the forest; the healthier situation in the highlands (less diseases and parasites than in the plains), the maximum exploitation of the territory and the maintenance of a community spirit. The drawbacks of slash-and-burn are considered as follows: the environmental degradation; the low human labour productivity associated with other poor human conditions; the higher dependence on climatic factors (rainfall); the higher incidence of pests on crops (forest animals, insects,etc.) and the economic loss caused by burning the forest. The evolution of the shifting cultivation systems in Laos is also discussed for several geograghic zones in relation with their causes, the effects on the systems and the results. The conditions for accelerated modification of the shifting cultivation systems are summarised in the last section of the paper. Access to lowland paddy fields, to markets, to new techniques and to particular micro-regional modifications have induced some modifications of attitudes and behaviour. The reaction of a farmer to a technique or to a new production system is conditioned by its usefulness for his local environment and its real advantage in economic and/or social/family terms for his local environment.

The next contribution entitled **"The diversity of shifting cultivation in Laos - Preliminary observations from the Nabong area"** is based on my slide presentation during the meeting in order to show the diversity of shifting cultivation systems in the Lao P.D.R. at different levels of the systems. More specific observations are presented for the Nabong area at the level of the cultivated plot. Due to technical constraints for reconverting a slide-show into printed illustrations, a selection of black-and-white photos taken in swidden fields of the Nabong area are given. Intra-plot diversity is great in most of the swidden fields due to different factors. Upland cropping systems of the Nabong area are in fact upland rice-based mixed cropping systems. Many different crops are grown in association with upland rice such as maize, cassava, groundnut, cucurbits, rice bean, Job's tears, cotton, banana, sesame, amaranth and sorghum. A close look at the field reveals that farmers have a logical way of placing crops in their fields. Termite mounds are common in swidden fields and are also used for growing specific crops such as papaya, Job's tears or cotton. Animal husbandry activities are very important in the Nabong area and involve species such as cattle, buffalo, pigs, goats, chickens, turkeys, geese and ducks. Communal grazing is a common practice. Due to population pressure, the area under shifting cultivation in the Nabong-Naphok area is increasing every year. It is recommended for the Nabong college to study the evolution of the shifting cultivation systems in the surrounding area taking into account the diversity of the systems and the indigenous knowledge of the farmers. New on-farm research methodologies should be developed and tested for research work in shifting cultivation areas.

The following series of documents is representing the contribution of several NGOs and were presented under the framework of the NGO **Sustainable Agriculture Forum** (SAF). This joint presentation was coordinated by Denis Boutin, agronomist of the CUSO Sustainable Upland Agriculture Project. The presentations covered the following subjects: overview of the role of the Sustainable Agriculture Forum; presentation of the CUSO Sustainable Upland Agriculture Project; experiences from the Mennonite Central Committee in alley cropping; RIFS experience in alley cropping with emphasis on Vientiane province; CIDSE's experience with rice banks with emphasis on Bolikhamsay province and finally, a synthesis of the NGO approach to shifting cultivation by Sombath Somphone which emphasises the use of a bottom-up multi-sectoral approach, grassroot based and with strong community participation when dealing with shifting cultivators. In general the presentation of SAF puts more emphasis on the methodological aspects rather than the technical aspects of projects dealing with shifting cultivators. The Sustainable Agriculture Forum (SAF) is an autonomous coalition of international non-government organisations (NGOs) and Lao development workers who are promoting sustainable agriculture,

community forestry and other environmentally sound and participatory approaches to rural development in the Lao P.D.R. Regarding shifting cultivation SAF members recognise that there is a need to develop and promote approaches and technologies which are socially and ecologically appropriate for the sloping and mountainous regions of the country. NGOs believe that progress towards more sustainable farming practices must not only involve identifying appropriate technical solutions, but also focus on the process of developing and extending them. Farming systems appropriate for upland and highland areas in Lao PDR should have the following characteristics: addressing immediate, short-term needs such as food and income; being based on existing practices and traditional knowledge; promoting diversification; minimising capital/resource requirements and the use of external inputs; providing acceptable economic returns; minimising and discouraging burning of crop residues and being appropriate given existing labour constrainst. Specific techniques for upland and highland areas currently promoted and tested by NGOs in various parts of Lao PDR include alley cropping, cover crops, crop diversification and agro-forestry. The paper also reports that in one village of Vientiane province alley cropping was promoted but not adopted by farmers for various reasons. In this programme, living fences using Jatropha curcas, contour hedgerows using a mix of Leucaena sp., Cassia siamea and Cajanus cajan sown together and cover cropping using Vigna umbellata were combined. It is thought that a mix of Gliricidia sepium and Cajanus cajan (Pigeon pea) is more suitable for hedgerows on acid soils. It is reported that there are farmers interested in alley cropping in llouaphan and Phongsaly province but it will need several years to evaluate if the technique is appropriate for them.

In the paper presented by Bouahong Phanthanousy **"The experience from the shifting cultivation stabilisation programme of the Department of Forestry"** , an overview of shifting cultivation is given first, followed by a presentation of the case study of the Thongkhang pilot area in Nane district, Luang Prabang province, acquired through the Lao-Swedish Shifting Cultivation Project supported by SIDA. The three main objectives of the pilot project are the following: 1) establishment of a research and demonstration programme in agriculture and forestry stabilization, 2) information and training support for the establishment of upland agriculture and forestry, and, 3) assessment of the extent and impact of shifting cultivation. Beside his written contribution the author also intervened during the meeting discussions to explain the different steps involved in the methodology used in his programme when dealing with shifting cultivators. The paper reports that the forest cover of Laos has decreased from 15 million hectares in 1981 to 11.2 million hectares in 1987, equivalent to about 300,000 hectares destroyed every year due to slash and burn, forest fires and logging. It is considered that, in 1990, there were 277,000 families practicing shifting cultivation in Laos (of which 45 % were Lao Sung, 35 % Lao Theung and 20 % Lao Lum). Shifting cultivation is broadly divided into three types based on a combination of landform and ethnic criteria: 1) on the plains, practised by the Lao Lum, 2) at the feet of the mountains, practised by the Lao Theung, and, 3) on the steep slopes of mountains, practised by the Lao Sung. The data collected in the various provinces show that Luang Prabang province has the largest shifting cultivation area with 62,660 hectares and 73,718 families of shifting cultivators while the second largest area is only 29,560 hectares in Oudomxay with 34,776 families of shifting cultivators. The project has conducted a socio-economic survey involving a sample of 230 households resulting in collecting data on demography, farming systems, ethnic groups, and productivity of rice cultivation. Land use and land capability studies were also conducted in the project area, using the slope as the main criterion. Although the project started in 1989 the time frame is still considered too short to draw any conclusion on technological changes that occurred in the project area and the technical packages to be used for the reconversion of the shifting cultivation systems. The paper also states that results of experiments and trials will be available by the year 1995. The principal lines of action are considered as follows: integration of shifting cultivation and reforestation (agro-forestry), improvement of productivity in shifting cultivation systems, and, transformation of shifting cultivation into permanent upland agriculture.

The paper "Shifting ideas about shifting cultivation" by Joost Foppes, Thong Fanh Phongsavanth and Andrew Jenkins represents the contribution of the Lao-EEC Micro-Projects in Luang Prabang province. This rural development project aims to get a better understanding of the problems of shifting cultivators and to assist them in trying to find answers to their problems. In

the project pilot area the population growth has been monitored during three years showing an annual increase of 3.5 % corresponding to a doubling of the population in 20 years. Therefore it is assumed that the fallow periods have shortened rapidly, halving in the last 20 years (from 6-8 years to 3-4 years) and may halve in the next 20 years from 3-4 to 1-2 years. Estimated upland rice yields vary from 2.5-3.01./ha after long fallow (more than 8 years) to 1.2-1.4 tlha after short fallow (2-3 years). Upland fields produce about 65 % of total family rice consumption. A yield survey has shown that farmers' estimates of yields were lower than the estimates from crop cuts. The correlation observed between yield and fallow period was not very strong probably due to other factors such as soil conditions. Regarding land use planning, a more recent village survey has shown the following: the average family cannot produce enough rice to satisfy family consumption from the upland rice fields of which the size is determined by the family labour availability; expansion of the upland rice area is not possible; paddy rice production is not sufficient to cover demand; cash income will be increasingly necessary to buy rice for consumption; fruit-tree establishment is limited by the lack of market and limited area of good soil; the semi-permanent cropping systems are not sustainable due to very high erosion rates; cash crops in upland fields were not successful (low yields and low price); raising cattle and pigs can be productive; forest products give an extra income, forests are used as grazing areas and firewood is abundant in the surveyed village. To modify the existing shifting cultivation systems, the project aims to develop a sustainable use of land through a combination of participatory land use planning, low cost anti-erosion measures (grass strips with lemon grass Cymbopogon citratus), tree crops establishment (Tectona grandis, fruit-trees and firewood) and rotation of crops with legumes (rice-pigeon pea rotations considered as promising). The project also supports family planning activities to enable people to control their fertility and examines ways to diversify family income. Livestock raising is promoted through vaccination programmes, cattle credit, pasture establishment and fish pond development. Rice banks have been established to improve food security.

In the paper **"Upland agriculture - activities by Lao-IRRI project"** by W. Roder, B. Phouaravanh, S. Phengchanh, B. Keoboualapha and S. Maniphone one can find an overview of the upland activities conducted by the Lao-IRRI Rice Research and Training Project. This research project is funded by the Swiss government and is supporting the national rice research programme of the MAF under the National Agricultural Research Center.

The upland component is based in Luang Prabang province. Objectives and research priorities of the project include the following: characterization of production systems and environments; collection, characterization and improvement of traditional cultivars; assessment and development of cropping systems optimizing production, incomes and soil conservation; development of weed management practices; yield loss assessment and pest and diseases control through Integrated Pest Management (IPM). That Lao-IRRI project has already produced many data, available from previous reports and therefore only selected results of the project are given and discussed in the present paper with emphasis on the three folowing topics: I) household survey in Oudomsay and Luang Prabang: land use, constraints to upland rice production, labour inputs, weeds, shift in weed population, and reduction of fallow period, 2) monitoring of soil loss, weed population and fallow population dynamics, and, 3) introduction, selection, establishment and effect of potential legumes to replace fallow vegetation. Due to the enormous quantity of data contained in the paper only some selected results can be given in a summary like this. Following the results of the survey, the Lao Sung farmers appear to be better farmers in many ways including: highest rice yields, lowest rice deficit, highest number of fruit trees, highest number of livestock and highest crop diversification. Among the constraints, weed competition was generally considered as the single most important constraint to upland rice production. Weed control is by far the most labour demanding task in upland rice production accounting for 40-50 % of the total crop labour inputs. Other important constraints reported after weed competition included: rodents, insufficient rainfall and land availability. Chromolaena odorata is the most frequent and most abundant weed species in the surveyed area and other important species are: Ageratum conyzoides, Lygodium flexuosum and Commelina sp. Imperata cylindrica is present but rarely a problem. In terms of change in the fallow period during the last 4 decades, reported fallow periods were 38, 20 and 5 years for the 1950s, 1970s and 1992,

respectively. In general, soil loss monitoring did not show any significant soil loss in three different sites. Chromolaena odorata was again found to be the most important weed species at rice harvest and the most important fallow plant. Observations on legumes for improved fallow have shown that Cajanus cajan ICP 11298, Stylosanthes guianensis, Dolichos lablab and Brachiaria brizantha are the most promising species considering weed suppression, ease of seed production and biomass production. The species Crotalaria anagyroides, Tephrosia vogelii, Calopogonium caerulum, Centrosema plumieri and Pueraria phaseoloides are also considered promising but have been under observation for one year only. When established by broadcasting in a standing rice crop, Calopogonium mucunoides, Pueraria phaseoloides and Centrosema pubescens were showing a good establishment when broadcasting seed between June and August while the rice harvest was not affected by the legume. Mixing seed with rice seed at the time of planting appears to be a possible method of establishing leucaena and other perennials with similar growth dynamics. Several conclusions are given in the paper, among others: the strong dependence on rice is a major obstacle towards a shift to more productive systems; the present upland rice production system practiced by the Lao farmer provides only marginal returns on labour; the high labour requirements coupled with government intervention put heavy pressure on the farmers to change to other systems and it can be expected that changes will take place. The general recommendations include the following: land tenure, market, education, alternative employement opportunities and population planning have to be seriously addressed by the Government; agricultural development objectives should aim at a better living standard rather than rice production; market risks should be minimised through diversified and flexible systems; production systems requiring large areas but moderate labour inputs are expected to be most competitive, therefore livestock and timber production may have the best potential; vaccination programmes and credit facilities are important. Technical recommendations include the following: perennials (fruit trees, timbers, spices, fodder) should be the main focus in development; field preparation without burning is essential to allow the combination of annual crops with perennials and to conserve moisture; tillage should not be considered as an alternative to the present traditional "non-tillage" system; Chromolaena odorata should be used for studies comparing fallow systems since it is a good fallow plant; improved fallow plants superior to Chromolaena odorata will have to provide benefits such as forage and make it possible to convert fallow to crop without burning; at least 20 years would be required to evaluate whether a 3-5 year fallow system maintains or improves the existing resource potential.

The paper "Traditional upland rice varieties in Laos" by B. Phouaravanh, W. Roder, P. Inthapanya and K. Vannalath reports the results from the research work conducted under the Lao-IRRI project. Upland rice is the major crop grown in all provinces of the country in the shifting cultivation systems. Collection, characterization and improvement of traditional cultivars are some of the major activities of the Lao-IRRI project. So far about 544 upland cultivars have been collected in 7 provinces. All entries collected are evaluated in observation nurseries at the Houay Khot station in Luang Prabang province and also forwarded to IRRI Philippines for inclusion in the global germplasm collection. The most promising entries are selected for further on-station and on-farm experimentation to indentify high yielding cultivars which are well adapted to the prevailing conditions, using the following selection criteria: drought tolerance, adaptation to a wide range of soil conditions, tolerance to major pests and diseases and acceptable grain qualities. Laos is the geographical center of a zone where peoples prefer to eat glutinous rice. Therefore most farmers prefer glutinous, aromatic rice, while non-glutinous rice is generally only produced for the market or for special preparations such as noodles. A few ethnic groups mostly belonging to the category of the Lao Sung, especially the Hmong and Yao, prefer non-glutinous rice. Some properties of the glutinous rice endosperm are also described in the paper.

Farmers usually plant 3-6 varieties characterised by long panicles, medium to long haulms, thick stems and large grains. Farmers clearly differentiate between early, medium and late varieties. Medium maturing varieties are by far the most important group for the farmers in terms of number of varieties available and area planted. The material observed showed a wide range of characteristics such as plant height (85 to 185 cm), days to flowering (84 to 132 days) with about 90 % of the varieties observed flowering within 90-120 days, and panicle numbers (2 to 17

panicles/hill). Plant height showed a strong positive correlation with yield and lodging was not a serious problem.

The paper, **"Cotton and shifting cultivation in Lao PDR"** by Somnuk Thirassak relates the experience of the Lao-French/CCL cotton project implemented by the National Agricultural Research Center (NARC) of the Ministry of Agriculture and Forestry (MAF). This is the only research and development project in Laos which has published a synthesis of the experiences accumulated during the last five years in a publication entitled "Le cotonnier au Laos". During the Nabong meeting it was also pointed out that the cotton project was virtually the only one to have used the concepts of economic analysis to assess the performance of a crop during project implementation. It was felt that there is a need to do more work in this sense in all the other rural development projects. The paper gives an overview of the agro-ecological conditions of the cotton growing areas in Laos. The socio¬economic conditions are also explained. Cotton is grown on an estimated 30,000 ha with about 14,000 tons of seed cotton annually produced at an average yield of 400 kg per hectare. Considering a ginning out-turn of 33 % this produces about 4,660 tons of short fiber. There are various cropping systems in use for cotton production. In shifting cultivation systems cotton is often grown in association with upland rice. Itineraries of techniques are varying according to the situation. The most important pests and diseases have been monitored at different stages of development of the cotton plant. The present marketing system for cotton is almost confined to the Vientiane textile center. Two main types of cotton have been studied: the traditional type with short staple such as "Fay Noy" and "Fay Nyay", and the improved type with medium-long staple such as Khamkhao 1.

The document **"Mixed farming systems in the rolling hills of Bolikhamsay"** is a presentation of the work done by Viravanh Phannourath and Bounphavanh Kanyavong from the NARC under an IDRC funded project. That project has started only recently and is therefore not in a position to present any important findings related to the technical aspects of shifting cultivation in the project area. The paper starts with an overview of the diversity in the agricultural systems of the Lao P.D.R. A preliminary classification of the systems is given based on the major production systems and topography: 1) the lowland areas, 2) the foot hills, 3) the high plateaus. and, 4) the highlands. The background and justifications of the project are also given. The objectives of the project are: a) to characterize agroecosystems in selected sites of Bolikhamsay, b) to design and implement on-farm interventions activities, c) to evaluate the effectiveness of the interventions in the study area and extend the technologies to similar areas, and, d) to increase the professional capacity of researchers in the National Agricultural Research Center (NARC) and the Department of Livestock and Veterinary Services (DLVS) and extension personnel in Bolikhamsay province. The programme of activities is given year by year. The results of a diagnostic survey conducted in Nonesomboun village, Bolikhamsay province are given including the identified constraints to crop and animal production.

The paper **"Shifting cultivation systems in Muonghom district, Lao P.D.R."** by Murli Upadhyay gives a general overview of the experiences gained by the Integrated Rural Development Project of Muonghom in Vientiane province which was financed by UNDP and executed with the technical assistance of UN/DDSMS (DDSMS was known as DTCD until 1991 and DESD until 1993). The organisers of the meeting were lucky to have Murli Upadhyay working at Nabong after completing his assignment in Muonghom so he could relate the experience of his former project during the meeting. This paper is one of the few following the format sent to the participants for writing their paper. It contains information on the context of the project and its objectives, the ecological conditions of the project area, the socio-economic conditions, the cropping systems in use, the animal production systems, the silvicultural/forestry systems, the processing and marketing systems, the alternatives to shifting cultivation as perceived by the project and, finally, conclusions and recommendations. Although it is recognised that a three to four year involvement in agricultural development is not enough time to draw conclusions regarding stabilized upland farming systems to replace shifting cultivation there are some technical aspects which seem to be promising such as the use of grass strips with setaria and signal grass. Provision of new lowland paddies is a means to reduce upland shifting cultivation.

"A picture of shifting cultivation in the Palavek project zone" by Leik Boonwaat is relating the experience of the Highland Integrated Rural Development Pilot Project funded by UNDCP and executed with the technical assistance of UN/DDSMS. The project zone covers the sub-districts of Palavek and Phou Ngou in Muonghom district, Vientiane province. The main objective of the project is to reduce opium production in the zone. In accordance with the proposed format presented by the organisers of the meeting, the paper provides the information: project zone and project objectives, ecological conditions, socio-economic conditions, cropping systems, animal production systems, silvicultural systems, processing and marketing systems, alternatives to shifting cultivation and, finally, conclusions and recommendations. The forest cover of the project zone is still relatively important with about 60 % of primary forest. The main ethnic group of the project area is the Hmong. Upland rice, maize, cassava and to a smaller extent opium and chillies are reported as the main crops while a wide range of other crops are also grown. Rice varieties include both the non-glutinous and the glutinous type. The average fallow period is 6-7 years. Eight different varieties of maize are reported and two varieties of cassava. Opium is cropped for two to more years in the same field. Animal production is important and includes pigs, poultry, cattle buffalo, goats and horses. Several commercial timber species are found in the project zone. Of special interest is the "Kissana" wood (Aquilaria sp.) producing an aromatic resin as a result of insect infestation. Fruit-trees are common. The main reasons for abandoning fields after a year or two of cropping is reported to be decreasing yields and serious weed infestation. Provision of new lowland paddies appears to be a major factor in reducing upland shifting cultivation areas. To control erosion, contoured grass strips have proved to be the most effective way to decrease soil erosion, using setaria, signal or ruzi grass. If available, rocks and log bunds have also proved to be effective. Intercropping of coffee and other tree crops appears to be promising. Nitrogen fixing trees are also planted along the contour for demonstration. Availability of arable land, need for permanent fences to prevent livestock damage and an appropriate land tenure system are considered as some of the major problems to be addressed in the project area.

In the paper **"Shifting cultivation practices of Xiengkhouang province"** by Seng Hkum and Saypradeth Chounlamany one can find an overview of the situation in Xiengkhouang province through the work being done by the Xiengkhouang Highland Development Programme 1FAD/UNDCP/OPS/LA0/91/551-3. This programme which combines an IFAD loan with UNDCP technical assistance through OPS is in fact made up of three projects: agricultural development of Xiengkhouang province, district development in opium-growing areas (Nonghet district) and labour-based construction in opium-growing areas of the province.

The paper, in relation with shifting cultivation, puts emphasis on the agricultural development project which has the following objectives: to ensure food security for poor households, to increase agricultural productivity, production and household incomes, and, to introduce alternative farming systems in opium-growing areas. The paper also explains the project objectives, the ecological conditions of the project area, the socio-economic conditions of the project area, the main products and activities in the province, the situation on health and education, the road network and the accessibility of markets, the access to government extension services, the management of natural resources and a general overview of shifting cultivation practices in the province for the three main agroecological zones: I) the rolling hills and savannah grassland, 2) the warming valleys, and, 3) the mountainous zone. The activities conducted by the project to stabilise shifting cultivation are also described: development of small sr2le irrigation schemes, development of road network, agroforestry practices, grass strip cultivation, fallow crop improvement, maintenance and improvement of local fruit trees, promotion of livestock activities, organizing non agricultural activities and promoting potential cash crops. In genera] it is too early for this project to be able to measure the impact of these activities on the shifting cultivation systems of the province.

The article **"The Lao-American Project and Shifting Cultivation"** by Rex Dufour is a contribution from the Lao-American rural development project operating in Houaphan province. This project is an integrated rural development project, with the elimination of commercial opium production in two districts (Hua muang and Viengtong) of Houaphan province, as a main objective. A secondary objective is to increase the irrigated riceland in order to preserve the

remaining forest areas. The strategies of the project in attempting to reduce shifting cultivation are the following: 1) developing paddy land for swidden farmers, 2) increasing yields of existing paddy land, 3) extending new crop varieties that may be used as permanent crops in swiddden fields, and, 4) developing cattle-, buffalo- and rice banks as sources of village credit so that villagers are able to make capital improvements on their land and/or diversify their incomes. Developing paddy land for swidden farmers is considered as a successful activity, using two different approaches: helping villagers to develop the local streams in their areas with appropriate irrigation systems through labour intensive efforts and development of intervillage irrigation systems through construction of relatively large dams and irrigation canals. Increasing yields in the existing paddy land has been considered as unsuccessful because of the land tenure situation. The project has introduced new crops and several new cultivars in the area. Arabica coffee (catimor f6 cultivar) is a new crop in the area. New cultivars include apple, grape, peach, pear, lychee, longan, soybeans, mulberry and rice. Pigeon pea and citrus are tried as shading intercrops. Several years are still required to assess the impact of these activities. Cow-, buffalo- and rice banks are sponsored as a source of village credit in order to diversify incomes and decrease the dependence on shifting agriculture. Ecological conditions of the project area are described. The remaining primary forest with subtropical evergreen species mixed with temperate deciduous species is under the continuing pressure of the shifting cultivators. The Lao Loum is the predominant ethnic group with about 50% of the total population. Several Lao Pang villages are found in the Hua Muang district. The road network is also briefly described. Land tenure is considered as the most important issue facing the villagers and district administrators, because a system of rotating the paddy among the users every three or four years is in use. This creates a disincentive to invest labour or money into making the land more productive as many investments will then be lost in a few years to the next user of the land. Considering the cropping systems most project area villages claim rice shortages of 2 to 6 months. Some of this deficit is made up by foraging, some by other food production, such as corn or cassava. Rice and opium are the most important crops. Opium is illegaly grown in different situations: generally on good limestone-based soil and often rotated with maize, also planted in paddy fields after rice harvest, sometimes in valley bottoms next to streams and even on hillsides. Most opium fields are also planted with a wide variety of other vegetables and fruit trees. Timber is also significant for the project area. Other important crops include maize, cassava, soybeans, mulberry and pigeon pea. There are also other crops such as cabbage, various mustards, tobacco, peach, pear, banana, guava, citrus and grapes. The rotation of upland ricefields in the project area is on a 3-4 year cycle. Animal production systems include the following species: buffaloes, cows, horses, goats, pigs, ducks and chickens. Animal raising might have the best potential for providing alternative incomes to shifting cultivators. It is considered that disease prevention, feed management, breeding and manure collection could be improved but are presently constrained by the inaccessibilty of vaccines and government extension services. The paper also report that the Hmong, the Kamu and the lowland Lao all feed their pigs with the Hmong even taking exceptional care of their swine by making boiled maize/cassava/soybean mash for them. Among the conclusions is the following: socio-economic factors such as health, water supply, education, local administration, planning and law enforcement, land tenure and others should be considered to improve farm management practices. Agricultural extension and non-formal education services can provide the necescary loral training. In terms of personnel it is felt that generalists "community development workers" are recommended rather than specialists in order to understand the wide range of problems. Development workers should be well versed in extension techniques based on villager participation. Project planning, budgeting and management skills would also be valuable and based on the experience of the Houaphan project the most valuable characteristics of development workers are motivation, leadership, a willingness to listen to villagers and a willingness to experiment.

The paper entitled **"Experiences from the Nong district development project working with shifting cultivation farming systems"** by Rolf Samuelsson is relating the experience of the Norwegian Church Aid (NCA) assisting the Nong district in the province of Savannakhet through the Nong District Development Project (NDDP). This is a community development project aiming to stabilize shifting cultivation rather than abolish it. NCA recognises the need to ensure people's

participation and to emphasize, in the dialogue with the government, the importance of understanding the social and cultural factors in the transformation of the shifting cultivation practices. The author has already been associated with development programmes dealing with shifting cultivation for many years and reports that shifting cultivation in Laos, according to several studies, has been increasing. Shifting cultivation is not mainly a "forestry" or "agriculture" problem, but is also linked to health improvement, securing of land-titles and general socio-economic development in rural areas of Laos.

In the paper entitled **"Extension experiences for introduction of a system for sustainable upland agriculture"** by John Connell and Phouvong Ravong one can find some ideas about the extension activities of the Lao Upland Agriculture Development Project which is a World Bank loan project, being implemented by the Ministry of Agriculture and Forestry with technical assistance from the Australian (AIDAB) and French (CIRAD) governments. The paper is based on the experiences acquired by the project in the Hin Heup area, Vientiane province. This paper was not presented nor discussed during the Nabong technical meeting because the authors were not able to attend the workshop due to other commitments.

Some general conclusions

(1) In the Lao PDR there is a wide range of shifting cultivation systems and practices.

(2) In districts with a low population density, shifting cultivation practices are not necessarily degrading the environment especially if fallow periods are still long enough to allow the regeneration of the forest (about 15 years).

(3) In districts where the population pressure is higher, the fallow periods are becoming too short for a normal regeneration of the forest, creating an imbalance and degradation of the system.

(4) There is no easy way for the reconversion of the shifting cultivation systems of Lao PDR into more stabilised and productive systems. It requires many years (5 to 10 years) to really change something.

(5) Shifting cultivation is practiced in all parts of Lao PDR, in the lowlands, in the midlands and in the highlands, by all the ethnic groups of the country.

(6) There is enough indication to say that the total area under shifting cultivation in Laos has been increasing during the last 10 years and this is certainly due to the population increase.

(7) The reconversion of unstable shifting cultivation systems into more stabilised and productive systems must be approached through rural development involving various activities aiming at improving overall living conditions of the rural peoples: irrigation construction, road construction, improved health services, improved education, family planning, more productive cropping systems, more productive animal husbandry systems, sustainable agro-forestry systems, improved wildlife management, etc.

(8) A grassroot participatory approach, involving the shifting cultivators themselves, is necessary for any successful programme or project aiming at reconversion of their production systems.

(9) Very few technical solutions have been confirmed as successful in reducing shifting cultivation. Among them: development of lowland irrigated paddies.

Some general recommendations

(1) The participants to the Nabong meeting recommended that this kind of meeting should be organised more often.

(2) More work is needed in Lao PDR in order to get a better understanding of the shifting cultivation systems of the country, before testing and demonstrating alternatives.

(3) More Government agriculturists should be trained in understanding the traditional principles of shifting cultivation practices and their potential technical alternatives.

(4) Shifting cultivation should be approached through multidisciplinary teams of technicians.

(5) More work is necessary to promote animal production in shifting cultivation areas.

INAUGURAL ADDRESS

Siene SAPHANGTHONG

Vice-Minister

Ministry of Agriculture and Forestry

Vientiane, Lao PDR

Mr. Chairman, distinguished delegates of national and international organizations, ladies and gentlemen.

Since ancient times the people of Laos have developed systems of natural and semi-natural agricultural practices of rice growing for sustaining their lives. The topography of the country varies from region to region within the land area of 236,800 square kilometers. As a result of the varieties within ethnic groups and land diversity there are different traditions. There are two ways of growing rice in Laos: upland and lowland rice cultivation. In the mountainous areas the farmers practice upland rice cultivation while on the plains they practice the lowland technique.

After revolutionary day the Lao party's and the government's policy on constructing the nation have been centered on improving the social welfare of the ethnic groups of Laos by taking agriculture and forestry as a primary focus for change as well as expanding the agricultural production and processing industry in order to improve the people's standard of living. Therefore, agriculture and forestry have become major issues and directly and indirectly affect the national economy of the country. For almost two decades the people have continuously suffered from natural disasters every year such as droughts, floods, dried up streams, erosion, and so on. This resulted in lower yields and it endangered the self-sufficiency of people.

The party and the government as well as the Ministry of Agriculture and Forestry understand and know that these problems are caused by the destruction of forests. One cause of forest destruction is the people's slash and burn cultivation. Nowadays more than 200,000 families still practice this kind of cultivation, and more than 200.000 ha of forest are destroyed annually, particularly in the Northern part of the country which is mountainous.

This problem must be solved as soon as possible and the Ministry of Agriculture and Forestry is concerned and committed to solve the lack of food for the ethnic groups and preserving the environment by setting up the following projects:

- Integrated Agricultural Production Projects in the areas, 6 large plains, within 7 provinces in the middle and Southern regions.
- Agricultural Commodities Producing Projects for internal supply and export.
- Slash and Burn Cultivation Limiting and Stopping Projects.
- Rural Development Projects.

Not only the Ministry of Agriculture and Forestry committed itself and made an effort to solve the problem of inadequate food supply and preserving the environment, but also many international organizations have been giving their cooperation and assistance in providing us with rather large budgets for this purpose. On this occasion, on behalf of the Ministry of Agriculture and Forestry, I would like to express our enormous thanks and praise to these organizations who have given us this cooperation and assistance.

This Technical Meeting is one of the effective approaches which also contributes to the attempt to solve the problem of food shortages and preserving the environment in Lao PDR and in the world.

I hope that the participants of this meeting, with their wealth of experiences, exchange their knowledge in order to provide useful ways of solving the problems centered on food shortages and preserving the environment for future sustainability.

In addition, data information, methodology and comments given in this conference will be most valuable for the college, particularly, for the teachers who will transfer the obtained experience to teach students who will be able to practically use the ideas and knowledge, passing it on to the people in the rural areas, after they have graduated from the college.

There may be many approaches that can be used in solving the problem of slash and burn cultivation in Lao PDR. One of them is providing the people with stable cultivation land instead of relying on shifting cultivation. It is important that their living conditions will be improved through changes in farming. Furthermore, it is important to make people understand the impact of deforestation and its consequent influence on their lives and the environment in order to encourage them to be engaged in production of other commodities such as: handicrafts, cultivated cash farming of trees and crops, animals for marketing and so on.

In some provinces where these facilities are not possible the farmer has to be encouraged to practice constant rice cultivation (hand hoe prepared swidden, in row-prepared swidden) and 'the necessary techniques should be transferred to them in order to increase the yield and to preserve the soils good condition.

Finally I wish the participants good health and success at this conference.

Thank you.

WELCOME SPEECH

Sayamang VONGSACK

Director

of Nabong Agriculture College

Vientiane, Lao PDR

On behalf of the college, the coordinators of UNDP/DESD/LAO/92/017 Project and the teachers of Nabong Agriculture College, I have the pleasure to welcome all of you, especially, I would like to thank you for sparing your valuable time to take part in this Technical Meeting on Shifting Cultivation Systems in Lao PDR from 14 to 16 July 1993.

Distinguished guests:

- H.E. Mr. Siene Saphangthong, Vice-Minister of Agriculture and Forestry.
- Ms. Ameerah Haq-Perera, Resident Representative, UNDP in Vientiane. Ms. Annamaria Bruno, Program Officer, Food and Agriculture Organization of the United Nations, Vientiane.
- Mr. Rik Delnoye, Associate Professional Officer, Food and Agriculture Organization of the United Nations, Vientiane.
- Director of Department of Agriculture, MAF.
- Director of Department of Livestock, MAF.
- Director of Department of Forestry, MAF.
- Director of Department of Personnel, MAF.
- Director of department of Irrigation, MAF.
- Director of Department of Extension Agency, MAF.
- Heads of different Divisions and the teachers of the College.
- Lao and Foreign Directors of different Projects.

Laos is a developing country, the ethnic groups of Laos still practice the traditional agriculture and forestry which used to be sustainable. This can be recognized from the following data: from the total cultivated area of 800 000 hectares (3%), 300 000 hectares are under slash and burn cultivation which is practiced by 253 000 families or 1.5 million people and the forests are destroyed largely by the people living in the mountains and some by the people living in the plateaux and in the plains. These people grow rice, sesame, cotton, jute, sweet-potato and other crops to sustain daily life, but they still suffer from a lack of food and supply. Although the people in some places have a surplus of rice that can be sold, the surplus can not be transported to other places or markets because there are no routes connecting the towns with remote areas. Furthermore the provision of consumer goods and food stuff for daily needs, disseminating education, culture and public health services are still limited and do not reach every part of the country.

Because of the above mentioned reasons the people living in the mountainous and remote areas have to continuously practice slash and burn cultivation. This is inconsistent with the party's and the government's policy which says that " There must be a phasing out of slash and burn cultivation (to eventually) stopping it completely, providing the people in the mountainous and remote areas with a permanent occupation and gradually improving their living (standard)".

Therefore, in recent years there have been a lot of international projects assisting the government of Lao PDR in research, information collecting and seeking the appropriate approaches to solve the problem of slash and burn cultivation in each part of the country. The information and the particular work and the achievements of each project will be heard during the presentations

whereafter there will be time for discussion and exchanging comments amongst ourselves. All of this information will be a very valuable resource for us at Nabong for research and teaching.

Therefore, on this wonderful and rare occasion I, on behalf of this educational institution' would like to express our thanks and appreciation to H.E. Mr. Siene Saphangthong, the Vice-Minister of Agriculture and Forestry, the directors of the different departments, Heads of divisions and particularly to the Foreign and Lao directors of different projects who prepared the information from their own projects and promised to present papers at the conference in order to make it more meaningful and substantial.

Finally, I wish H.E. Mr. Siene Saphangthong, the distinguished guests participating in the conference and Directors of different projects good health and success with the meeting.

Thank you.

INTRODUCTORY SPEECH

Dirk van GANSBERGHE

Project Coordinator and Agrotrainer

of the Nabong Agriculture College project

UNDP/DESD/LAO/92/017

c/o UNDP, P.O.Box 345,

Vientiane, Lao PDR

Distinguished guests,

Ladies and Gentlemen,

Dear colleagues,

Environmental degradation in connection with population growth is for the Lao PDR, as for many other countries, one of the most important problems to be addressed in the context of its growing agricultural sector. Indeed, the population increase in Laos has already induced some modifications in the shifting cultivation systems which are now often becoming more and more destructive for the environment especially when the fallow periods become too short to allow a complete regeneration of the forest.

Shifting cultivation, which is also known as "swiddening" or "slash-and-burn", involves different farmers' strategies and management techniques which are generally recognised as ecologically sound as long as the population density is low. Thanks to various scientific studies conducted in different tropical agroecosystems, shifting cultivators are now more and more recognised as farmers who have developed a wide range of techniques demonstrating that they are in fact thinking in terms of forest regeneration while they are exploiting it. Some recent studies even suggest that shifting cultivation could be a positive factor for the maintenance of the biodiversity when it is practised in a well balanced manner.

Forest products and hydro-electricity being the most important export earnings for Laos, the Government is legitimately trying to decrease the negative impact of shifting cultivation on these resources in the interest of the nation. However, the problem is very complex. It requires a multi-sectoral approach and it is very clear that in several regions of the country, the local authorities do not really know how to technically assist the shifting cultivators in stabilizing their production systems through a progressive process of reconversion.

Fortunately, there are now several research and development programmes and projects in various provinces which have generated a significant knowledge on different aspects connected with the reconversion of unstable shifting cultivation systems into more stable cultivation systems. This has allowed us to organise this meeting, which I hope, will only be the first of a series. This workshop has been organised in order to collect the available technical information on shifting cultivation in Laos with two objectives in mind: (1) to use the information for pedagogic purpose in the agriculture colleges of the country and, (2) exchange information between various institutions, agencies and projects which often have very little opportunity to exchange their views and experiences between them.

Therefore I would like to invite all the participants to really express themselves and talk about their positive and negative experiences in dealing with such a complex problem. By doing this I also would like to remind you that an institution like the Nabong Agriculture College has a mandate to train high-level technicians in the fields of agronomy and animal husbandry. Thus, I also invite you to think of what could possibly be the technical contribution from the graduates of Nabong in dealing with reconversion of shifting cultivation systems. In other words what do you

think they should learn here in order to become more efficient in dealing with shifting cultivation when they will be working in a multidisciplinary team?

On behalf on the United Nations I would like to thank all the participants for having responded with so much enthusiasm to our invitation and also for having written the papers which will be integrated in the report of the workshop for further distribution not only to the participants but also to the concerned government agencies. I really hope that this report will provide the Minisitry of Agriculture and Forestry with some useful technical information for its rural development programmes.

Finally I would like to thank the authorities of the Ministry of Agriculture and Forestry for making this workshop possible and especially the management and the staff of the Naborig Agriculture College involved in its day-to-day organisation. I also want to express my sincere thanks to the UNDP office in Vientiane for its continuous support to our project including to this workshop.

I wish you all a fruitful participation in this meeting.

Thank you very much.

SLASH AND BURN AGRICULTURE: THE CONTINUING DILEMMA

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1. Introduction

It is now thirty three years since the publication of the first major study of shifting cultivation (Nye, P.H. and Greenland, D.J. 1960). This study showed that where adequate fallow periods followed cultivation ecosystem maintenance was possible. However the system, if abused, was capable of producing rapid eco-system degradation (see Evenson J.P., Approaches to Slash and Burn Limitation, Section 1. available as separate handout).

Since 1960, rapid population increase has occurred and today over 250 million people still depend on the system. Reduced fallow periods and soil degradation have inevitably resulted in damage to watersheds which are already causing massive and permanent ecosystem degradation worldwide. Figures quoted by one author for Papua New Guinea suggest that the critical limit of population density at which slash and burn agriculture becomes unsustainable is 25 persons per km sq.(Clarke, J.W. 1971).

In the Lao PDR the population is set to double in 25 years (Hull & Hull, 1992). Using the official 1990 figures for population density by provinces and doubling it to provide an estimate of likely population density in the year 2015 shows that while at present only three provinces have densities greater than 25 /sq.km. (Savannakhet, Champassak & Vientiane Municipality) and Luang Prabang having a density of 20/sq.km, by 2015 twelve Provinces (Bokeo, Luangnamtha, Luang Prabang, Houaphanh, Xayaboury, Khammouane, Savannakhet, Saravane, Vientiane, Oudomxay & Champassak & Vientiane Municipality) will be at, or over, the critical limit. This demonstrates the urgency of the need to find solutions that meet the requirements for improving the productivity, stability, equitability, and sustainability of agriculture in the country.

2. Previous Work Worldwide

In 1992 an annotated bibliography of publications on shifting cultivation and alternatives, examined some 5500 abstracts of publications and published a collection of 1394 of the more significant (Robison, D.M. and McKean, S.J. 1992).

These abstracts were grouped under a series of 10 headings and in an introduction to each section the compilers attempted to synthesize the current state of knowledge. The most important of these syntheses are repeated here.

3. Farming Systems Descriptions

Evaluation of indigenous practices was seen as having increased importance in the search for alternatives to current practices, and the compilers distinguished two modes of shifting cultivation-swidden systems where land is used under a continuous crop-fallow cycle, and frontier systems which operate at the forest frontier and usually have a few short cropping cycles before being converted to pasture.

Subsequent to this publication an important paper analysing indigenous practices in relation to resource management in the humid tropics was published (Warner, K. 1991).

4. The Cropping Period

Repeated burning accelerates degradation and shifting cultivation increases the frequency and intensity of floods, transportation and deposition of sediments. The introduction of the plough increases the risk. Productivity of savannah grasslands and even some improved pastures is shown to rapidly decline under such treatment.

5. Improved Fallow

Clear comparison of the relative value of deep rooted versus shallow rooted plants in the fallow has not been undertaken as the main emphasis has been on study of leguminous cover crops. Studies of the bush fallow to assess the potential uses of the natural fallow species also seems to have been overlooked (# see comments on page 5).

The impact of grazing upon bush fallow has not been well studied and further work is needed on management to increase sustainable forage productivity of grazed fallows.

6. Other Intensified Cropping Systems

Several major conclusions reached from a study of the abstracts were that;

a. agro-forestry, although the most frequently touted alternative to slash and burn agriculture, is not a solution supported by many published examples of success.

b. generally, published examples of successful and sustainable change from slash and burn to mechanized agriculture are lacking, but where successful examples of intensification involving a change to mechanization have occurred it has been on better quality soils.

c. successful intensification usually only occurs in areas close to markets.

d. agriculture development has tended to move first into full tillage systems before minimum tillage is considered.

e. more work needs to be done on mulching and green manure crops practices which have not as yet been widely adopted.

f. more work is needed on farmer participation.

g. more work is needed on the availability of suitable plant species.

h. more work is needed on the integration of livestock.

7. Soil and Water Conservation Studies

Several conservation alternatives have been proven agronomically but there is little published evidence to suggest that they have become common practice. These practices include alley cropping, live barriers, shelter belts, terracing and biomass transfer in the form of mulching. Of these alternatives mulching was the only outstanding practice in terms of the published abstracts. It appeared to be more effective than barriers for counteracting erosion, conserved moisture, improved infiltration, reduced weed competition, and recycled nutrients.

An important conclusion was that agro-forestry alone does not stop erosion. The benefits may arise more from mulching rather than having trees on the land. The authors commented that, in spite of these findings, agro-forestry still continues to be a universally adopted solution to erosion.

8. Alternative Input Strategies

The compilers point out that shifting cultivation is essentially a strategy for manipulating ecosystem nutrients and therefore alternative strategies must also be considered from this point of view. (e.g. Weeds in one place can become mulch in another). The use of deep rooting plants to recycle nutrients from depth is a case in point.

Little has been published on the use of domesticated animals to concentrate nutrients in manure. This system can have disincentives in the form of labour for fencing and collection and possible ecological disadvantages resulting from grazing out useful fallow species.

9. Alternative Crops

The general listing of crops provided little if any economic evaluation of their potential as alternatives. Although ecological alternatives exist, their value and farmer acceptability was often reduced by remoteness of many slash and burn areas. The requirement for this is development of high value low volume alternatives with superior keeping and transportation qualities. There was also a need to find alternatives among species that occur naturally in the bush fallow, recognizing that such plants have no recognized agronomy, potential uses and market potential (see separate note on the planting of native timber and resin producing species in the Palavek Project and the Compendium of Lao Food Plants, Nabong Agriculture College, 1993).

10. Land Rehabilitation

Few published accounts of successful land rehabilitation were found. Those that did dealt with reforestation and control of Imperata cylindrica grasslands. In both cases agro-forestry was proposed, but there were few examples of successful reclamation in the absence of strong central authority and investment of funds, and few examples of successful rehabilitation of land where occupants have carried out rehabilitation and made a living at the same time. Any exceptions are worthy of further study. The question being how to rehabilitate land while providing adequate social returns.

A serious limitation of !arid rehabilitation using agroforestry is usually the long period before any financial returns are obtained. This is recognised as a problem in Australian Landcare programmes and one suggested solution to the problems has been the payment of advances on the final estimated value of harvested timber - a very difficult economic plan to establish and manage.

11. Social and Policy Aspects of Intensification

It was clear that land tenure and tree tenure were vital aspects of intensification, but there were no accounts of cases where stabilisation of land tenure automatically resulting in reforestation.

Much information has come from studies in Thailand, Indonesia, India and the Philippines. However little was said about the success of transmigration programmes and the success or failure of transferring indigenous technology to colonists who are less experienced with the ecosystem.

The compilers concluded: "Farmer's perceptions and decisions, economic trends and governmental policy all affect the problem and will need to be reconciled in order for the problem to significantly reverse overall trends of degradation."

12. Development of Improved Systems as a Substitute for Slash and Burn

Rising populations and government policies aimed at restricting slash and burn both have 'the effect of placing increased pressure on land that is allocated for farming. The doubling of the population in the Lao PDR will create an average population density in 11 of the provinces that will make slash and burn agriculture unsustainable [Papua New ,Guinea experience suggests that an average population density of 25/sq, km is the critical limit above which land recovery after cropping will be restricted by the reduction in the fallow period, where a ratio of fallow to cropped period of 10:1 is sustainable in a slash and burn system (see Evenson loc. cit.)].

However, in the face of this increasing pressure, ad hoc attempts to find solutions to the problems, even using experience from similar isoclimes, are likely to prove unsuccessful in the long term and may even be counter-productive for the reasons given in the next paragraph.

A selection of comments from the compilers of the abstracts of publications marked # above are worthy of recapitulation and reinforcement. All these comments were encapsulated by Blood 1.ongworth and Evenson (1975) who in the context of another ago-ecosystem (cotton production) emphasized that " ...programmes should originate as near as possible (constraints of agronomy and economics permitting) to the natural end of the ecosystem spectrum."

Biological systems are 'open systems' and as such have a. multidirectional characteristic in approaching their end point (Law of Equifmality). Thus the whole system needs to be understood to avoid undesirable results. It seems therefore necessary to outline the methodologies open to us in a properly planned systems approach. Options that are available are discussed below.

13. Preservation and Management of Natural Biodiversity

The health of an eco-system can generally be assessed by the biodiversity of it's components. Perhaps one easily judged and telling yardstick is the presence of large numbers of birds and small mammals in the environment.

The review of slash and burn agriculture commented on the need to understand and quantify native food plants to assess their value in the ecosystem. Once again the disappearance of food plants gathered from the wild is another measure of ecological damage arising from mans activities. For example the large diversity of known food plants in the Lao PDR compared with. Thailand (where natural ecosystem destruction is nearly total) is a factor which should be given preservation priority. A listing of many of the wild food plants of the Lao PDR already exists (Nabong Agriculture College 1993) and has been arranged so that vernacular names in one section are indexed in Lao language to make field use possible.

14. Agra-ecosystems and Farming Systems Approaches

Both of these systems described by Conway (1986) and Trehuil (1988) respectively, have many basic similarities and properly used provide an accurate assessment of problems inherent in the system. They can be used to assist farmers prioritize their problems and help development agencies in appropriate planning.

15. Land Capability Assessment

Assessment of land capability is essential before attempting agricultural change. Classification systems have been produced by FAO, USDA, and Queensland DPI, all of which have a common ancestry.

A system derived specifically for assessment of land limitations and agricultural land use potential in Papua New Guinea (Haantjens 1969) may for our purposes be more useful than the earlier methods because;

1. land is classified into four kinds of agricultural use and is therefore more specific than other methods;
2. each mapping unit as a whole is weighed, based on the suitability of each unit according to a sliding scale;
3. limitations are cumulative.

Tables 1 and 2 summarize the approach.

While these methods make generalized assessments of drought risks, inundation hazards and fertility they do not involve great detail.

16. Rainfall Assessment

If a greater amount of detail is required in the assessment then it is possible that computer models capable of analyzing rainfall data and providing information on probabilities of timing

successful planting to obtain optimum crop development can be used (e.g. the RAINMAN package).

17. Assessment of Plant Growth Limitations

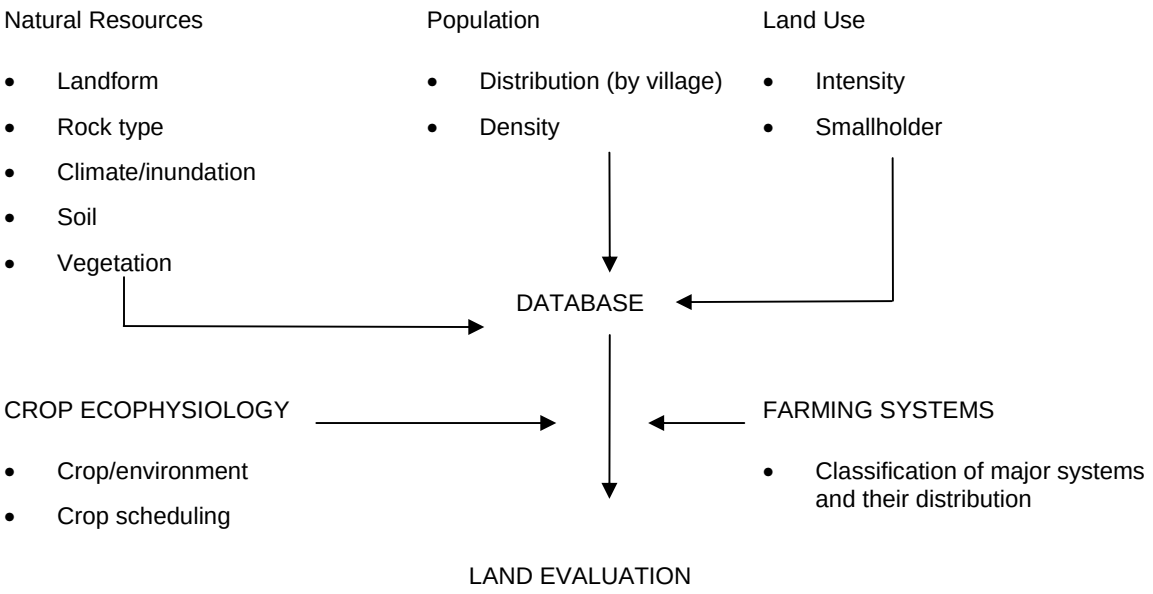
For greater accuracy, programmes giving a coarse assessment of the effect of both soil and climatic factors at any site on the growth of a specified plant species could be employed. One , such system is PLANTGRO developed by CSIRO Australia. The program is simple to use and has a preloaded set of crop and agro-forestry species ready to use in conjunction with soil and climatic data provided by the operator for the site being studied,

18. Economic Assessments

Finally one of the most difficult assessments to make in subsistence or semi-subsistence agriculture is comparison of the comparative economics of various alternative crops or cropping systems. A system proposed by Evenson and De Boer (1978), may be utilized. Although it was used in a particular situation to compare the value of root crop production against other staples the Two Goods Model proposed allows insights into crop choice and crop improvement in mixed cropping systems in semi-subsistence agriculture.

19. SYNTHESIS OF RESULTS

Information gathered from the above systems can then be compiled to form an inventory of project components with the following headings:



SOURCE: Papua New Guinea. Inventory of Natural Resources, Population Distribution and Land Use. CSIRO Div. of Water and Land Resources, Natural Resources Series No.6

20. Watershed management

A vital consideration in any attempt to ameliorate problems of land degradation is that the work should be carried out within the ecological framework of the watershed in which the programme is to be executed. A watershed is the smallest biological unit that can be considered as any activity within the watershed has a direct effect on the ecosystem below it in that watershed.

21. Finale

This paper is intended to be read in conjunction with the other contributions to this meeting. It poses questions which require urgent answers and it is to be hoped that possible solutions to some of the problems raised will be answered during the course of the meeting.

One of the most serious difficulties faced by all workers in this area of activity is the relative shortness of project durations in relation to the long time frame of the ecological processes being modified. In general terms a 10 year period of development of a new technology is the minimum to be able to assess whether the introduced system will conform with the essential requirements already mentioned in the introduction of improving the productivity, stability, equitability and sustainability of the farming system. In most cases a much longer period is required.

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Table 1. explanation of factor ratings

Factors are rather arbitrarily arranged from most to least important (left to right)

Rating	Slope steepness (erodibility) E or e	Flooding and/or inundation hazards F or f	Drainage status D or d	Drought risks M or m	Factor Altitude (m) L or l	Surface rocks and/or stones (%) R or r	Fertility N or n	Salinity S or s	Soil reaction A or a
0	Level or sloping < 2°	No flooding and/or inundation	Well drained	No drought risks	1200	< 1	Apparently relatively fertile	No salinity	Weakly acid to neutral (field pH 6·0–7·0)
1	Slope 2–6°	Occasional seasonal flooding	Imperfectly drained	Possible drying out of upper horizons of profile for short periods	1200–2400	1–2	Appears to have low fertility	Saline (conductivity < 6 mmhos/cm)	Acid or weakly alkaline (field pH 5·0–6·0 or 7·0–7·5)
2	Slope 6–9°	Occasional irregular flooding or inundated for up to 1 month	Poorly drained; easily improved	Profile dries out for indefinite periods	2400–3000	3–7			Alkaline (field pH 7·6–8·5)
3	Slope 9–17°	Inundated for 1–3 months	Very poorly drained; relatively easily improved		> 3000	8–30			Strongly acid (field pH < 5·0)
4	Slope 17–30°	Frequent irregular flooding, or occasional deep devastating flooding, or inundated for 3–6 months	Poorly to very poorly drained; difficult to improve			> 30			Strongly alkaline (field pH > 8·5)
5	Slope > 30°	Permanently or semi-permanently inundated, or subject to very frequent or tidal flooding	Swampy						

Table 2. assessment of suitability levels* for arable crops (C), tree crops (T), improved pastures (P) and flooded rice (I)† according to factor ratings

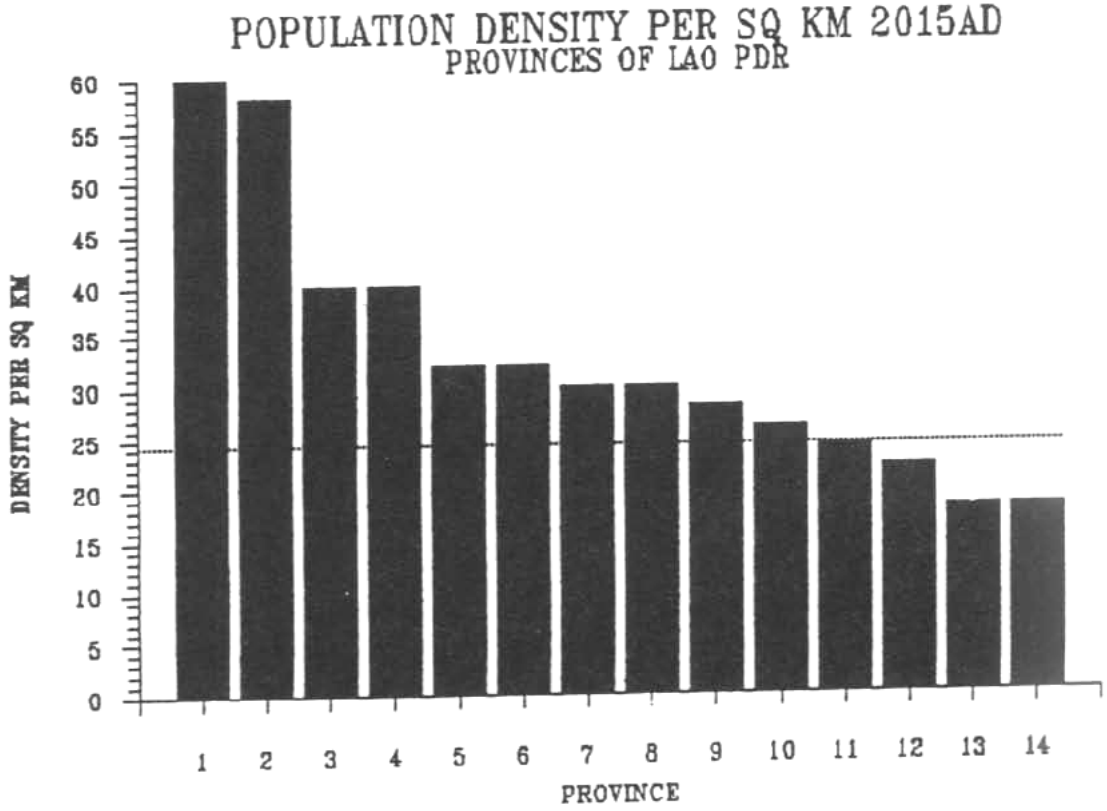
Rating	Erodibility E or e	Flooding and/or inundation F or f	Drainage status D or d	Drought risks‡ M or m	Factor Altitude (m)‡ L or l		Surface rocks and/or stones (%) R or r	Fertility N or n	Salinity S or s	Soil reaction A or a
0	$C_1T_1P_1I_1$	$C_1T_1P_1I_1$	$C_1T_1P_1I_1$	P_1I_1	0–600	P_1I_1 ·	$C_1T_1P_1I_1$	$C_1T_1P_1I_1$	$C_1T_1P_1I_1$	$C_1T_1P_1I_1$
					600–1200	P_1I_2				
1	$C_2T_2P_2I_2$	$C_2T_2P_2I_2$	$C_2T_2P_1I_2$	P_2I_1	1200–1800	P_1 —	$C_2T_2P_2I_2$	$C_2T_2P_2I_2$	$C_2T_2P_2I_2$	$C_2T_2P_2I_2$
					1800–2400	— T_2P_2 —				
2	$C_3T_3P_3$ —	$C_3T_3P_3I_3$	$C_3T_3P_3I_3$	$C_3T_3P_3I_3$		— — P_3 —	$C_3T_3P_3I_3$			$C_3T_3P_3I_3$
3	$C_4T_3P_3$ —	C_4 — P_4I_3	$C_4T_3P_3I_3$			— — P_4 —	$C_4T_3P_3$ —			$C_3T_3P_3I_3$
4	— T_3P_3 —	Flooded C_5 — P_4I_4 Inundated C_5 — P_5I_4	C_5 — P_4I_3				— T_3P_3 —			$C_4T_3P_3I_3$
5	— — — —	— — — I_5	— — P_5I_3							

* Suitability levels are indicated as 1, very high (VH); 2, high (H); 3, moderate (M); 4, low (L); 5, very low (VL); —, nil (N).

† In the assessment of the suitability for flooded rice, problems related to getting the irrigation water onto the land and difficulties in the construction of rice bays are *not* taken into account.

‡ Ratings 0 and 1 for factors M and L are not given for arable and tree crops because these depend strongly on the choice of crop.

Figure 1. population density per square km 2015 AD



1. Champassak
2. Savannakhet
3. Luang Prabang
4. Saravane
5. Vientiane
6. Xayaboury
7. Khammouane
8. Houaphanh
9. Oudomxay
10. Bokeo
11. Luangnamtha
12. Xiengkhuang
13. Borikhamxay
14. Phongsaly
15. Sekong
16. Attapeu

APPROACHES TO SLASH AND BURN LIMITATION

a review

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PART 1 BASED ON MODIFICATIONS TO EXISTING PRACTICES AND FALLOW LENGTHS

1. Introduction

The area of land under both primary and secondary forest in Asia is still large and undeveloped. These areas are currently under threat from human activity. Firstly from indiscriminate logging in which clear felling of timber is practiced and secondly from slash and burn agriculture (also commonly called swidden agriculture or shifting cultivation) in which due to population pressure or restrictions on land use, the recovery interval or fallow period is reduced until insufficient time is allowed for the natural recovery of the fertility of the system.

Attempts to use these areas for continuous cultivation of annual food crops has not been successful. However development of plantation crops such as rubber, oil palm, coffee and large fruit trees has been very successful. It seems therefore that the examination of the reasons for this success of these perennial crops should show the way to manage this forest resource more effectively for the benefit of the people.

Evenson et al. (1970) described agricultural systems as follows (see also Fig 1):

1. Conservative systems; in which a generally low level of productivity was maintained without the use of fertilizers, pesticides or irrigation, as in traditional shifting cultivation on a long fallow rotation.
2. Optimising systems; in which the use of chemical inputs or irrigation raise crop yields to a higher level than the conservative systems and sustain them. Examples are some mechanized farming practices. Misuse of the system can easily cause it to become exploitive.
3. Exploitive systems; in which cropping has resulted in loss of soil fertility and a decrease in yield as in the case of land use leading to massive erosion. This can happen also in shifting cultivation when too short a rotation is used.

Using these descriptions as a framework it is then possible to build an analysis of the problems involved in forest clearing for arable agriculture.

Von Uexkull (1984) has pointed out that Acrisols are the most common soils in south-east Asia and it is these soils that we are considering as they are common in the Lao PDR particularly in forested areas.

Typically Acrisols are acid to very acid, have low base saturation and low available plant nutrient content. They have high aluminium saturation percent and high phosphate fixing capacity. They also have low water holding capacity and are easily compacted and eroded. In addition stable organo-mineral complexes are absent and effective root growth is usually limited to the top 15-25 cm of the profile, or in the case of undisturbed rainforest, to the horizon containing the decaying organic matter.

The process of clearing exposes the organic layer, resulting in rapid degradation of the organic material containing the nutrient store for the ecosystem, resulting in a disastrous effect on productivity.

It is therefore easy to understand why these soils have not been widely used except for plantation agriculture, which is a managed substitute for the original forest cover. This substitution allows for a long recovery period after the damage caused by clearing, before the cycle begins again. In the case of rubber plantations the period is for 30 years or more and when intercropping occurs for the first 3-4 years after clearing and undercropped with legumes the Land Use Factor is usually 10 or greater (compare this with Table 1 and Okigbo, 1984).

In the case of shifting cultivation as practiced in the absence of population pressure (Nye and Greenland 1960, 1964), land was allowed a "resting period" of about the same length (30 years) and this also resulted in a "conservative" system of agriculture, as land cleared and cropped to annual crops was abandoned to regrowth for up to about 30 years, thus allowing for complete recovery as far as productivity is concerned.

The problem arises when due to population pressure or other economic factors, the recovery period is shortened to the point at which the process by which soil returns to normal after the disturbance of clearing and cultivation becomes too short. At this point the system becomes "exploitive' as the potential yield obtainable from the systems declines (Evenson et al. 1970). This is clearly shown in Fig 2.

Okigbo (1984) has described a method of defining land use in shifting cultivation using a Land Use Factor as follows:

Land Use Factor (L) = C+F/C

C = length of cropping cycle

F = length of fallow period

Table I includes a selection of the data given by Nye and Greenland (1960) giving typical values for C and F. These values suggest that L = 5-10 is a normal for any soil and that this value changes with soil type, depth and slope, falling to L = 3-5 on deeper Ultisols under short term recurrent cultivation.

In order to understand these differences it is necessary to examine the processes which occur during a total cycle of clearing cropping and fallow.

2. The effects of shifting cultivation on soil nutrients and physical properties

It is argued by von Uexkull (1966, 1984) that to maintain fertility in soils in the humid tropics the soil should be kept under some cover; either forest canopy, paddy rice (cover of water) or a dead mulch.

The reasons for this are seen in Fig 3, which shows how direct exposure of the soil under dryland crops results in wide extremes of temperature being experienced and run off made worse because of reduction of percolation.

In Tables 3 & 4 the adverse effects of clearing and burning on the chemical and physical attributes of tropical rain forest soils is shown. The decline in yield under continuous cultivation is presented in Fig 5 as a function of soil, climate and vegetation.

The use of machinery to clear land that has been under slash and burn agriculture to produce farms of a more permanent nature, has resulted in many problems. One that is rarely referred to arises in areas where there is a large density of termite mounds. Traditionally slash and burn farmers have left the mounds intact and grown crops like papaya, chilies and tamarind on them, as these plants grow better in the higher soil pH of the termite mound. Often farmers slowly incorporate the mound into the surrounding soil. When mounds interfere with mechanized agriculture they are usually levelled with bulldozers. In Thailand it has been observed by Evenson (unpublished) that this creates circular patches of soil of high alkalinity and low permeability and that little will grow in these areas for at least 12 years following clearing. If levelling is contemplated an economic analysis should be carried out using the method developed by De Boer (1975).

In many large plantations in southern Thailand termite mounds are not levelled. The plant spacing is adjusted around the trees.

Andriesse (1987), after studying the effects of slash and burn practices at two different locations in Asia (Sri Lanka, Sarawak), concluded that they were not the same under all conditions and that they were dependant on the combined effect of climate, soil type, time after burning and on the local leaching regime which was important in redistributing the minerals released from the burned biomass down the soil profile. He showed that:

1. Soil pH always increases following burning. The degree of change depending on the total amount of biomass burned, the effectiveness of the burn and the amount of rainfall (causing leaching).
2. Soil organic matter was only slightly affected by the burn itself.
3. That with intensely hot fires there is considerable loss of N in the 0-5 cm layer of topsoil.
4. That change in available phosphorus in the topsoil is the most dramatically affected by the burn. There was a direct relationship between the increase in available P and the amount of burned biomass. This increase is shortlived, largely disappearing 4 years after the burn.
5. That sulphur is lost to the ecosystem in the long term as a result of burning. Initially large amounts of soluble sulphur are released to the soil upon burning but this is rapidly leached depending on the amount of rainfall.
6. With burning, base saturation increases in direct proportion to the amount of biomass burned, this increase disappears over time, presumably taken up by the increasing biomass or through loss by leaching.

In relation to 3 and 5 above it is interesting to note that in upland agriculture in northern Thailand (Anon 1985) on Acrisols, the only nutrients found to be consistently deficient were nitrogen and sulphur.

3. Nutrient budgets in forest, plantations and slash and burn agriculture

A simple systems framework for nutrient cycling through an ecosystem is presented in Fig.4. Using a framework like this allows the processes involved in nutrient cycling to be visualized.

A quantitative example of nutrient cycling through a stable forest system in India, demonstrates the complexity of the nitrogen flows and pools (Fig.6). It can be seen that by cutting and burning such a system the total amount of N lost from the system is 676 kg N per ha., a loss which cannot economically be replaced by fertilizers.

Nutrient budgets have been presented for forests by Kawana (1981) who has shown that litter fall and decomposition vary from 1.0 to 10.9 tones per ha. per year and from 1 to 50% respectively with the higher rate being experienced at higher temperatures. The accumulation of N in the topsoil is similarly affected and ranges from 4 to 11.5 tones per ha. being lowest in the humid

tropics. He concluded that interruption of the N cycle by clearing is likely to result in rapid degradation, except in very dry or flooded areas.

Andriesse (1987) estimated that 100-150 kg. N per ha. would be lost if a forest system in northern Thailand were to be cut and burnt or removed.

In Fig.7 N-cycling in an oil palm plantation is presented and this clearly demonstrates the beneficial effect on the nitrogen cycle in the system of having a leguminous cover crop as an understorey.

4. Amelioration of the effects of clearing in slash and burn systems

Andriesse (1987) recommended the following ways to ameliorate the effect of clearing:

1. At the clearing stage, equal spreading of biomass before the burn is advocated on soils with low buffering capacity (sandy soils) to prevent increase in alkalinity.
2. Clear felling without burning, particularly in the humid equatorial tropics may have a beneficial effect, but fertilization with P and K may then be necessary to boost the slower release of nutrients thus obtained. Burning serves only to rapidly release nutrients trapped in the biomass.
3. On poorly buffered sandy soils, sulphur deficiency is likely to occur after burning due to loss of mobile sulphur compounds.
4. Rapid immobilization of active P in soils with Al- and Fe- compounds needs the presence of active root systems to keep surplus P, K and S in the ecosystem via uptake into the biomass. In clay soils in the wet tropics, these should be recycled through the roots in the surface 25 cm of soil, but in more arid areas with sandy soil, leaching losses can only be prevented by maintaining a good root system deeper than 25 cm. In this context agro-forestry or plantation cropping can play an important role as the deeper root systems can trap and recycle nutrients that have leached below normal rooting depth of annual crops.

5. Changes occurring during the cropping phase following burning

Changes that occur during each cropping phase of shifting cultivation include:

1. pest and disease and weed multiplication.
2. erosion of topsoil.
3. deterioration in soil physical and nutrient conditions.
4. decrease in number and composition of soil organisms. (Nye and Greenland 1960; Ahn, 1974).

6. Development of alternative systems to replace traditional slash and burn agriculture

The objective of modified systems is to improve productivity per unit area by decreasing the "Land Use Factor" without creating an exploitive system as defined by Evenson et al. (1970).

Okigbo (1984) has listed alternatives to shifting cultivation and bush fallow systems. Some later additions and modifications have been included from other sources. (Table 5.)

All these options exist, but have varying degrees of ecological and social acceptability and economic viability.

O'Sullivan (1985) described a large number of land use options available in the Philippines, and concluded that until the various species of legumes that could be used for cover cropping in various environments have been fully determined, the best option was alley cropping with Leucaena leucocephala. However the advent of serious problems with Psyllid attacks on Leucaena has made the alley cropping option less acceptable, and in a study of relative susceptibility to erosion, it was found that companion cropping with a dense ground cover of Desmodium heterophyllum dramatically reduced erosion. A technique for cutting a swathe

through the legume sward and planting crops without tillage was providing yields comparable to alley cropping.

In Papua New Guinea the use of Casuarina oligodon as the principal three in the fallow phase has been practiced since the 1930's (Bourke pers.comm.). The Casuarina fixes atmospheric N and releases it into the system. Thiagalingam and Famy (1981) have shown that the soil N and C content under Casuarina oligodon were twice as high as under Albizia or Crotalaria. Other nitrogen fixing tree species are also available. These can be selected for their value as human food (e.g. Parkia speciosa), animal browse (e.g. Leucaena) or firewood (e.g. Acacia).

In a variant of the "jhum" system in north-eastern India, the lower branches of Pinus kesiya are pruned, the undergrowth is also slashed and then used to form ridges by being covered with soil and then burnt (Mishra and Ramakrishnan 1984).

Von Uexkull (1984) has recommended the following sequence of land clearing:

- Burning should be avoided. Underbrushing should be done at the start of the rainy season and stacked to allow better access to land.
- Cover cropping should begin while the big trees are still -standing using large seeded types of legumes. Mucuna chinensis is an example (but Calopogonium mucunoides and Centrosema pubescens and Pigeon Pea (Cajanus cajan) will do if available; authors note) Psophocarpus letragonolobus can also be used as a cover crop that can also yield food. The use of 100-200 kg per ha. of rock phosphate in the rows where the cover crop is planted is also recommended.
- Large trees are then ring barked or poisoned, then felled once the canopy is dead.
- The cover crop, having established itself before removal of the big trees, takes over the function of the forest canopy in protecting the soil and maintaining productivity. If well established, it is capable of fixing up to 350 kg per ha. per year of N, acting as a smother crop thus keeping the area free of weeds, stimulating the activity of micro-organisms and worms, helping to maintain cation exchange capacity and reduce leaching losses.
- Once this transition phase in which forest is converted to agricultural use by substituting leguminous cover crops for forest trees is completed cropping can begin using a system which alternates food crops with cover crops.

Von Uexkull (1984) advocates the use of cheap herbicides to prepare the land for planting so as to maintain a minimal tillage system and reduce labour inputs where this is a problem. In addition P and K fertilizer would need to be applied along crop rows.

The cropping pattern envisaged has 50% of the family farm area being under cash crops (tree crops), while the remaining area is divided equally into cover cropped land and food crops. Under such a system, von Uexkull suggests that soil fertility would actually improve over time.

Such a system would require a major demonstration and extension effort backed up by the provision of suitable marketing arrangements for the cash crops and provision of fertilizers and possibly herbicides. In the highlands of Cameroon, Prinz and Rauch (1987) have described a sustainable land use system which is based on the return of crop residues and animal manure, and on erosion control. It avoids turning the soil in ploughing by using a chisel plough pulled by oxen to split the ridges of the previous crop on to organic matter laid in the furrows, so that the next years ridges lie over the previous years furrows. In addition, this system involves the raising of draught animals which provide power for the ridging operation. The whole system is integrated with economic bush and tree crops, and requires the use of inorganic fertilizer inputs.

7. Discussion

The information provided demonstrates quite clearly that the problems that have been encountered in many parts of the world when attempts have been made to intensify traditional slash and burn agriculture, have resulted from the loss of nutrients and organic matter from the system following the burn and during the cultivation phase. When a long fallow phase or a

plantation crop is used, the system has time to recover by replacing lost nutrients from those released during soil genesis and in the case of plantation crops by the addition of fertilizer.

This then raises the question why addition of fertilizer alone cannot be used to replace the nutrients returned to the system during the fallow cycle. In general this approach has not been successful for the reasons shown in Table 2, 3 and 4, where it can be seen that attempts to increase production result in intensification of soil losses and increases in runoff of rainfall, both of which downgrade the capability of the land to be cropped. Much of this decline is due to the rapid loss of organic matter from the exposed soil.

In the "jhum" system in India a reduction of the cropping plus fallow cycle has been shown to be feasible in a system in which a range of crops are grown that are largely annuals or biennials and with use of animal manure, however it has been found uneconomic to reduce the total cycle to 5 years and a 10 year crop + fallow cycle is recommended. This has probably been due to the failure to maintain soil organic matter and soil cover with an appropriate leguminous cover crop.

Selection of crops that are perennial and can be grown under the cover of shade, browse trees or economic tree crops, is one way of providing a stable system. Another is to include a leguminous cover crop phase or an economic leguminous pasture phase with return of animal manure. These options will be looked at in the context of the upland cropping situation in Laos, in Part II.

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Table 1: length of the crop and fallo periods under shifting cultivation observed in different parts of the world

No.	Place	Annual rainfall (mm)	Crop	Fallow	Periods in years			
					Normal		Excessive	
					C	F	C	F
				Moist evergreen forest zone				
1.	Sarawak	c. 3 800	Hill rice	Forest	1	>12	2	-12
2.	Gustemala	3 400	Maize	Forest	1	>4		
3.	Liberla	2 00 – 4500	Rice, manloc	Forest	1-2	8-15		
4.	Slerra Leone	2300 – 3300	Rice, manloc	Forest	1-5	8	1.5	5
5.	Assam	2500	Rice/millet, malze, rice	Forest	2	10-12	2	<7
6.	Sumatra	c. 2300	Rice, root crops	Forest	2	10-16		
7.	Philippines	2500	Rice, root crops, maize	Forest	2-4	8-10		
8.	Nigeria (a) Umuhia	c. 2300	Yams, maize, manloc	Acioa barteri	1-5	4-7	1.5	2.5
	(b) Alayl	c. 2300	Yams, maize manloc	Macrolobium sp.	1.5	7		
9.	Central congo Zaire	1800	Rice, maize manloc	Forest	2-3	10-15		
				Moist semi-deciduous and dry forest zone				
				(Including humid zone of derived savanna)				
10.	West Africa	1500 – 2000	Maize, manloc	Moist semi – deciduous forest	2-14	6-12		
11.	N. Burma	1300 – 1800	Hill rice	Grassland and pine forest			5	10
12.	West Nile Uganda	1400	Eleusine, sorghum, simsim,	Grass, mainly	2-3	8-15	3	3

			maize	Setaria sp.				
13.	Abeokuta, Nigeria	c. 1300		Thicket			2	4-5
14.	I lesha, Nigeria	c. 1300		Thicket	2	6-7		
15.	Central Uganda	c. 1300		Elephant grass	3	8	1	2
16.	Ivory Coast	c. 1300		Elephant grass	3	3	9	6
17.	N. Rhodesia	c. 1300		Thicket	6-12	6-12		

Source: Nye and Greenland, 1960

Land Use Factor (L) = C+F / C ,where C = length of cropping cycle and F = length of fallow period

Table 2: changes in soil properties following clearing, burning and cultivation of soils in tropical forest regions

A. Changes in chemical properties

		Site	Before	Immed.	1 year	2 years	3 years
pH		1	5.2	8.1	6.8	6.6	-
		2	6.6	9.0	-	-	-
		3	4.0	4.5	4.5	4.1	4.4
Exch. Ca (meq/100 g)		1	7.2	21.2	20.5	14.5	-
		2	9.4	33.5	-	-	-
		3	0.2	0.9	0.8	0.8	0.5
Exch. K (meq/100 g)		1	0.5	2.5	0.6	0.3	-
		2	0.5	11.8	-	-	-
		3	0.1	0.3	0.1	0.1	0.1
Total N (%)		1	0.26	0.25	0.24	0.19	-
		2	0.35	0.41	-	-	-
		3	0.12	0.14	0.09	-	-
Readily	(Truog)	1	10	30	-	-	-
Estimated	(Bray 1)	2	5	-	-	-	-

	P (qg/g)	(Olsen)	3	5	16	11	15	5
B.	Changes in physical properties							
							After	
				Site	Before	Immed.	1 year	2 years
	Bulk density	Hand	2	(0-3 cm)	0.63	0.94		
	g/cm3	Clearing		(3-5 cm)	0.80	1.17		
		Bull - dozer	2	(3-5 cm)	0.91	1.46		
	Infiltration	Hand	2	Capacity	88	44		
	Cm/hr	Clearing		Rate	21	-	21	22*
		Bull – dozer	2	Capacity	115	17		
		Clearing Hand		Rate				
		Clearing	3	Rate	(210)	10		
		Bull - dozer						
		Clearing	3	Rate	(210)	0.5		

Site 1 = Kade, Ghana (Nye and Greenland, 1960,)

Site 2 = IITA, Ibadan, Nigeria (Lai 1979)

Site 3 = Yurimaguas, Peru (Sanchez, /979)

- Capacity refers to eater entry when lateral flow above B horizon prevented.

Rate refers to water entry when lateral flow above B horizon prevented.

Source: Greenland, 1980.

Table 3: loss of nitrogen (kg ha) through burning in a slash & burn system ("jhum") in India

FALLOW PERIOD YEARS	PRE-BURN SOIL POOL (x10)	ADDITION IN SLASH (x10)	TOTAL SOIL POOL PRE-BURNING (x10)	SOIL POOL AFTER BURN (x10)	TOTAL CYCLE LOSS
	a	b	a+b	c	(a+b-c)
15	7.68	43.6	7.73	7.22	510.2
10	7.74	38.6	7.78	7.32	462.1
5	6.40	29.3	6.43	6.17	262.8

Source: Mishra & Ramakrishnan (1984)

Table 4: land clearing: effects of method of deforestation and tillage methods on soil and water loss, grain yield and tonnes of soil lost per tonne of grain

CULTIVATION METHODS	SOIL LOST BY EROSION t ha	WATER LOSS mm	GRAIN YIELD t ha	SOIL LOSS PER TONNE OF GRAIN
TRADITIONAL				
Manual clearing;	0.01	2.6	0.5	0.02
no tillage,	0.37	15.5	1.6	0.23
Conventional tillage.	4.46	54.3	1.6	2.90
CRAWLER TRACTOR				
shear blade	3.82	65.6	2.0	1.91
• tree pusher & root rake	15.36	153.0	1.4	10.97
• tree pusher, root rake & conventional tillage	19.70	250.3	1.8	10.87

Source: Okigbo B. (1984).

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Table 5: alternatives to shifting cultivation

1. Plantation Agriculture.

   Sole crop (oil palm, rubber, tea etc.)

   Mixed crops (e.g. crop + cover trees, banana + coffee, coconut coffee)

   Tree crops (e.g. rubber) undercropped with pineapples, upland rice, maize, mung beans, peanuts, pigeon pea, until canopy closure (Paisan Laosat.an pers. comm.) or cassava.

2. Agroforestry.

   Tree crop/arable crop combinations.

   until canopy closure.

   Continuous (e.g. alley cropping systems described by O'Sullivan 1985).

   Shade tree/perennial crop systems e.g Trees + Vanilla or cardamoms or pepper.

   Tree/forage intercrops + livestock.

3. Planted fallow systems.

   Tree and shrub fallows + arable crop sequence.

   Short-term legume + grass fallows + acable crop sequence.

4. Livestock production systems.

   Poultry.

   Large or small ruminants on improved pasture and brose plants. Small ruminants on improved pasture under plantation crops (Chee, Y.K., and C. Devendra (1981); Mahadevan P. and C. Devendra. (1985).

5. Annual arable crops.

   Mixed or relay crop system + short term fallow.

   Mixed or relay cropping without fallow.

   Sole crop and short duration fallows.

   Sole crop continuous.

6. Special commercial horticulture.

   Fruit trees

   Vegetable crops, especially close to urban centres or in highland tropics.

   Ornamentals.

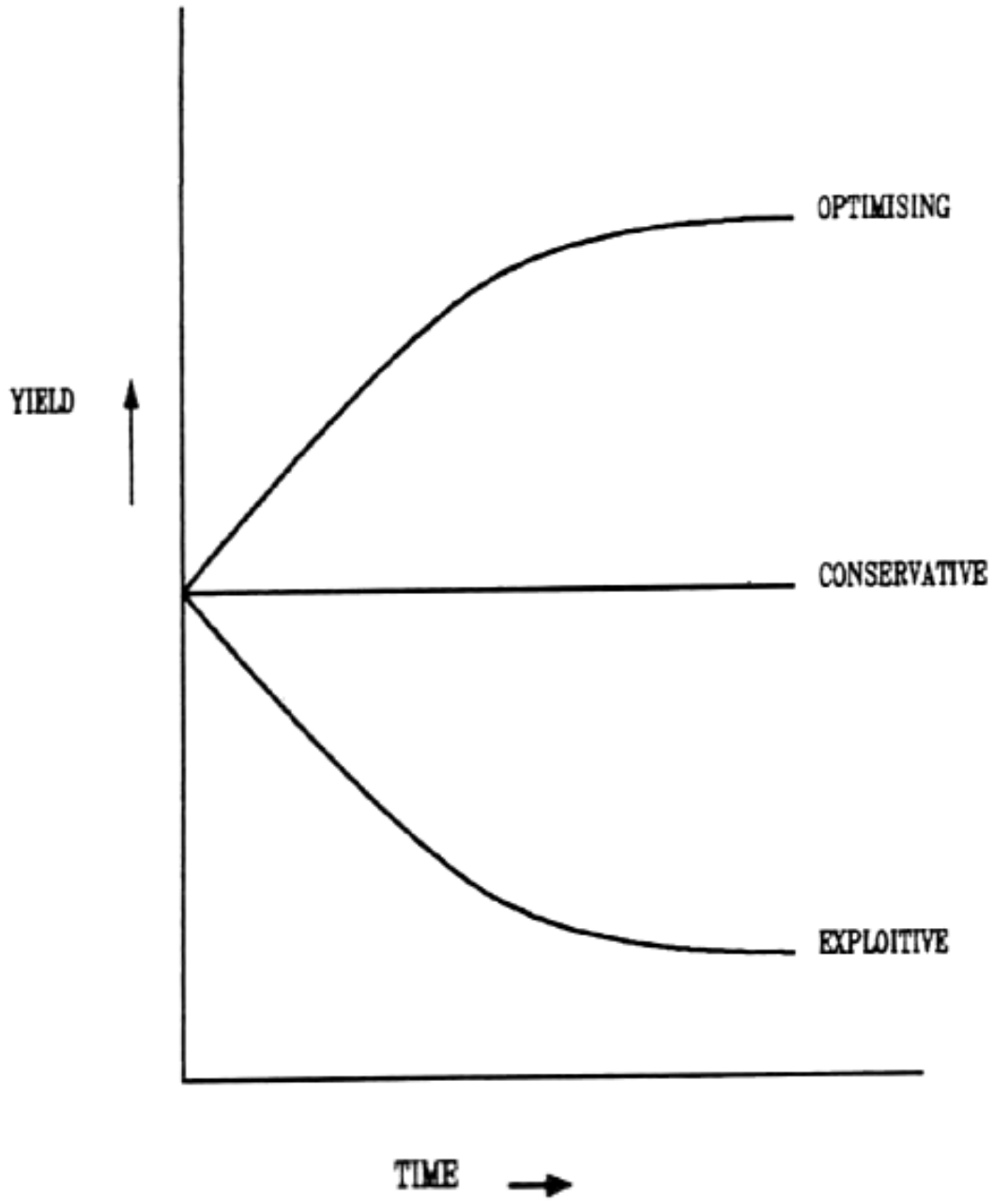
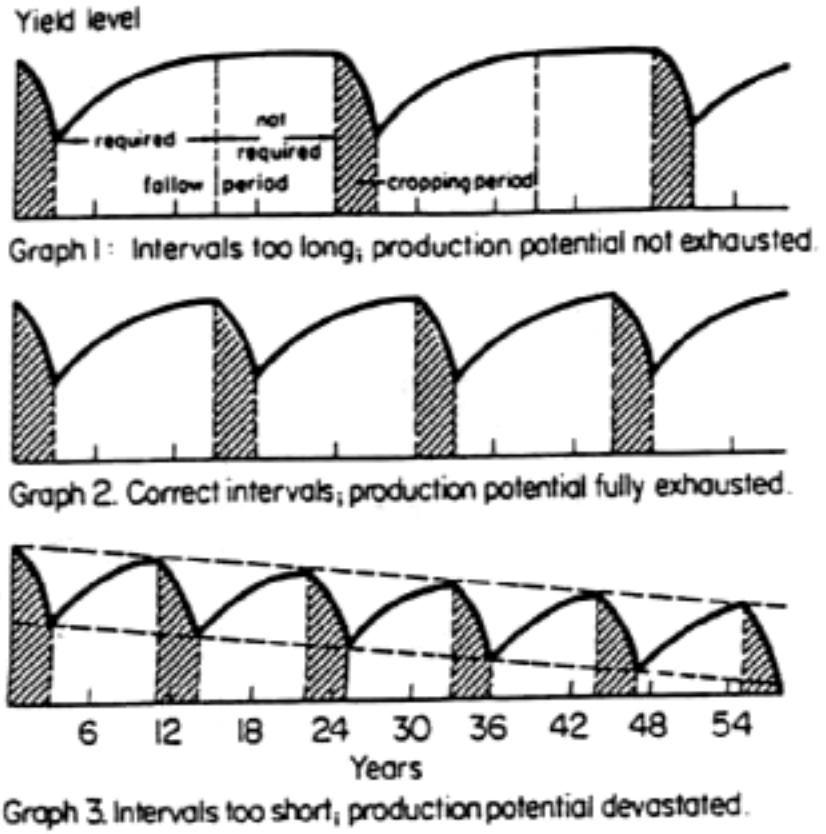


Figure 1: a simple definition of agricultural systems

Source: Evenson, Plucknett & Horton (1970)



Graph 3. Intervals too short; production potential devastated

Figure 2: crop yields after shifting cultivation in relation to the cropping interval (Ruthenburg 1965)

source: Okigbo, 1984

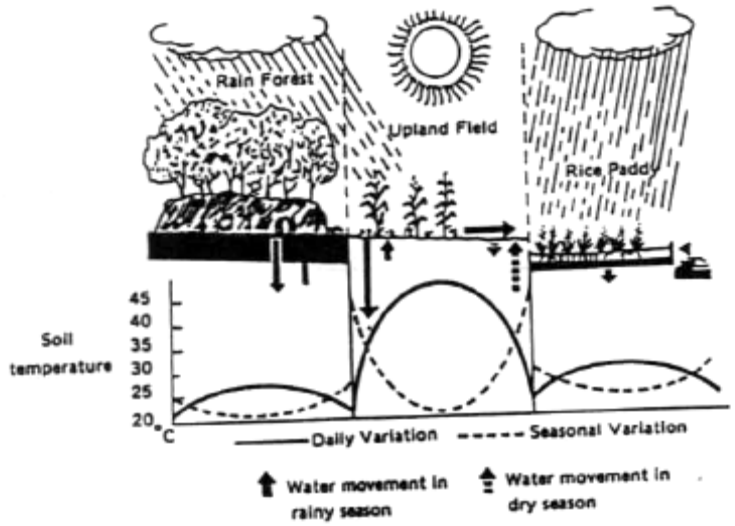


Figure 3: soil cover and soil fertility in the tropics

source: von Uexkull, 1984

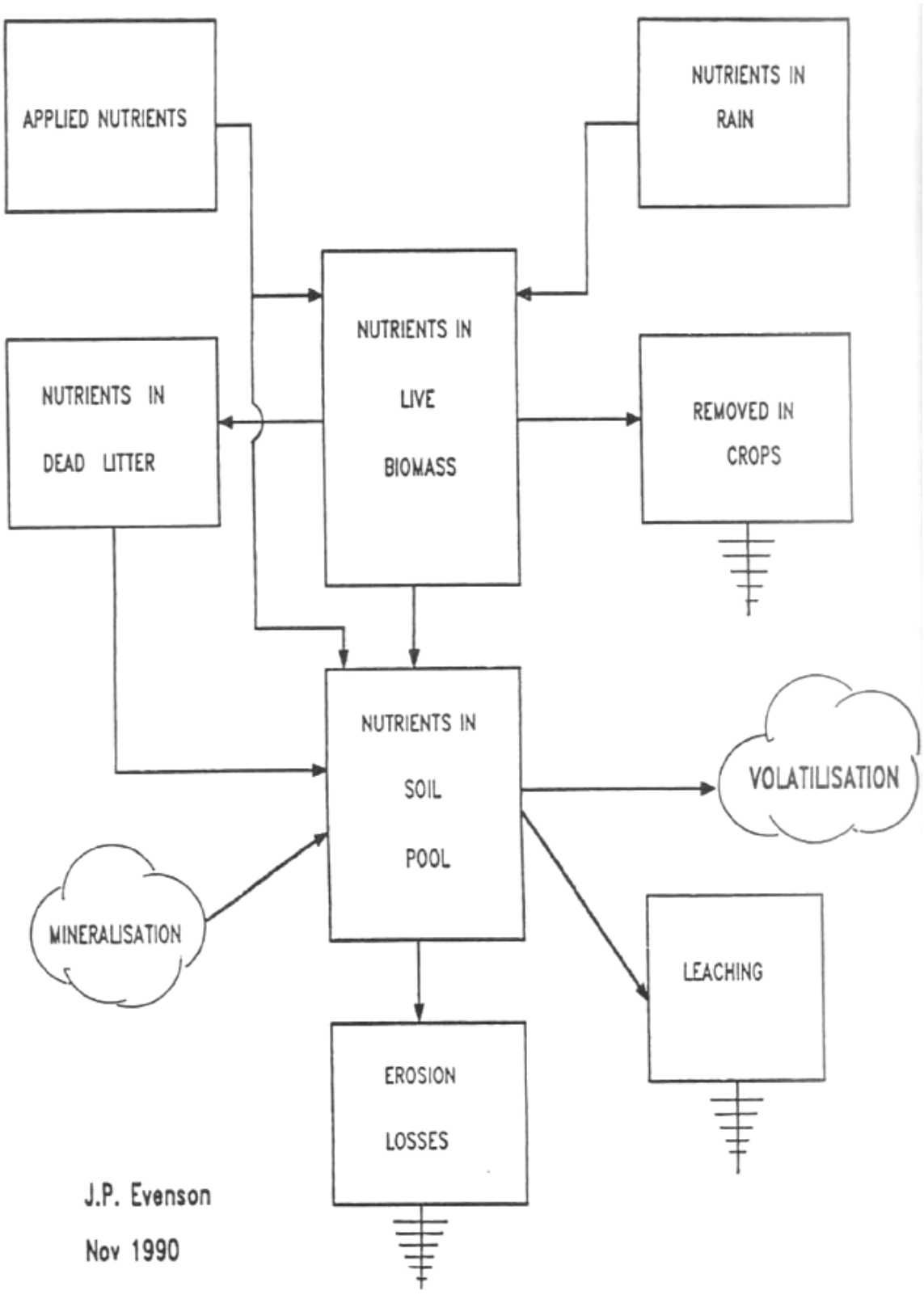


Figure 4: nutrient flows in an agro-ecosystem

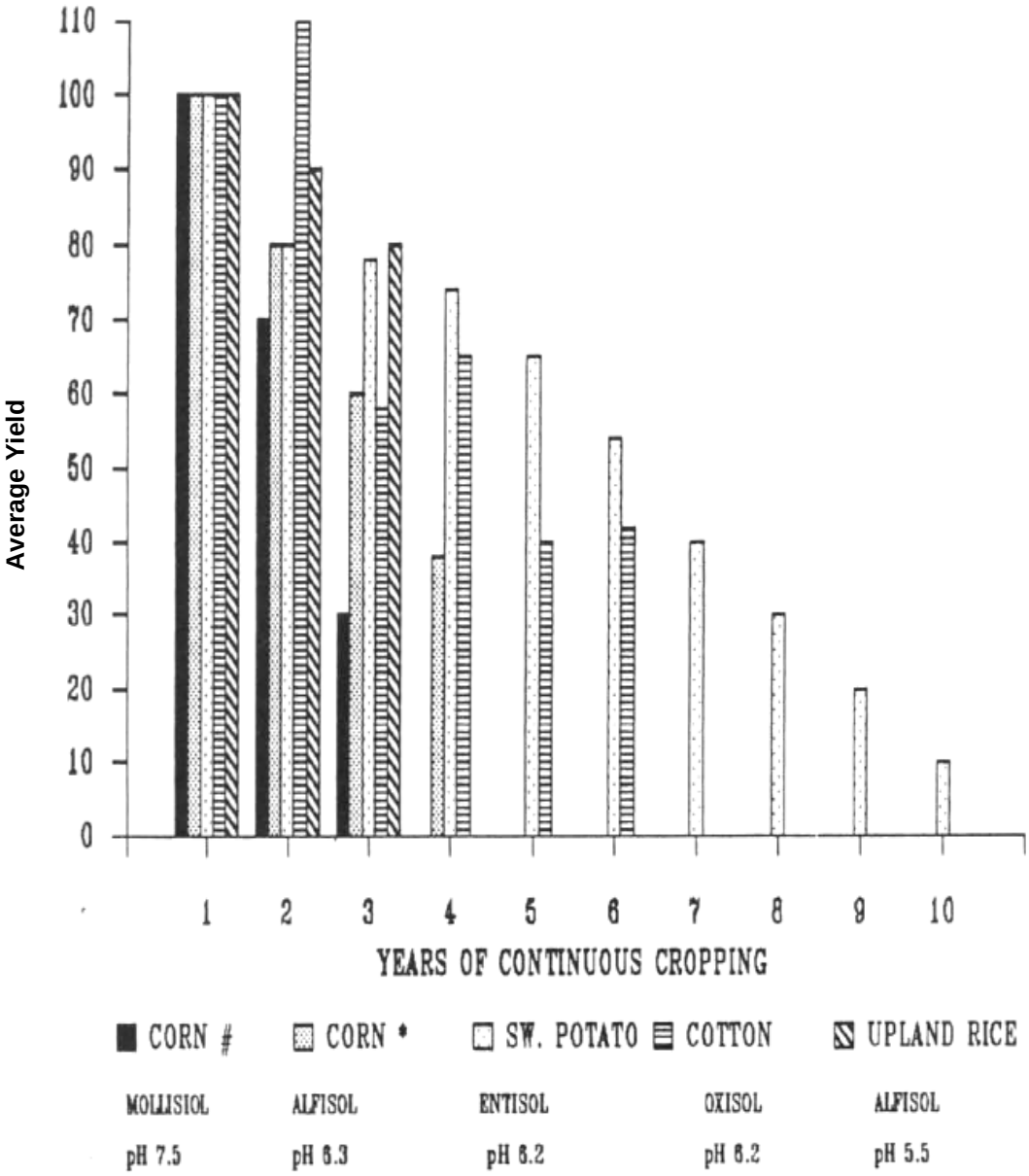
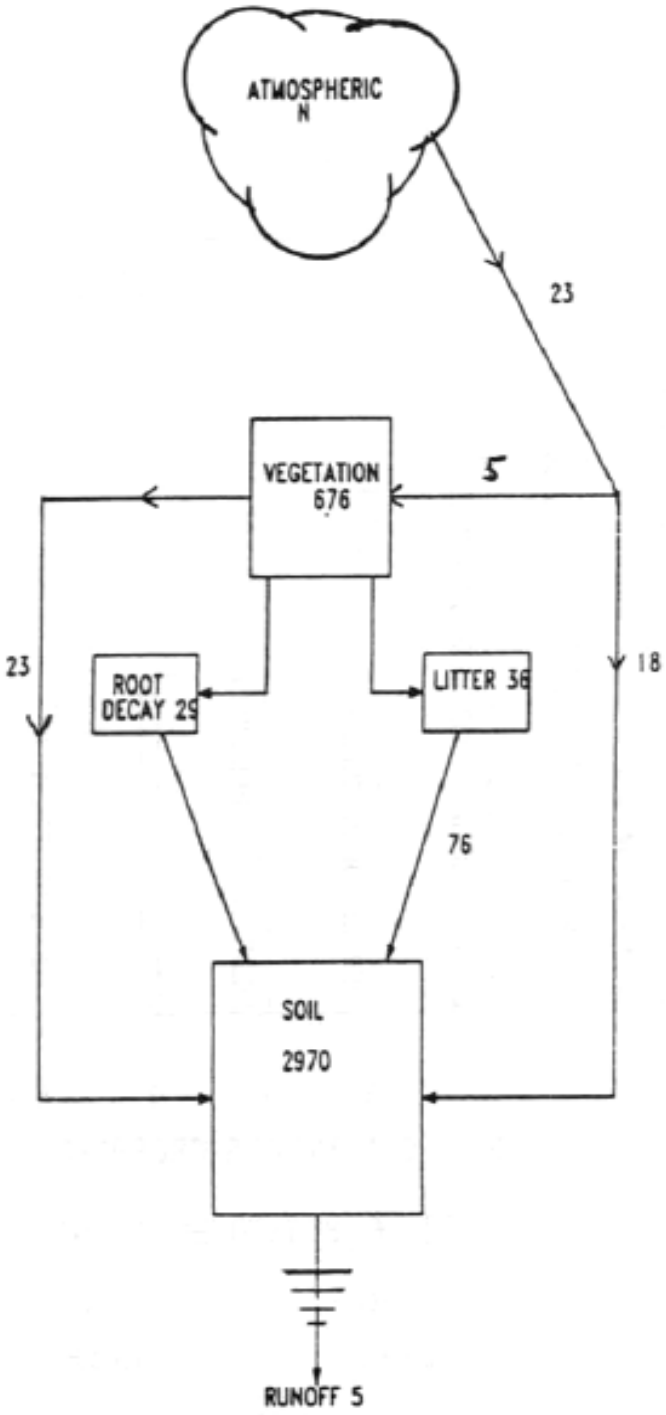


Figure 5: yield decline under continuous cropping

source: Sanchez, 1976



Values within boxes represent N kg ha-‘ within the system at maximum growth. Other values are annual fluxes.

Figure 6: cycling of N in a tropical deciduous rain forest

Source: Singh and Pandey, 1981

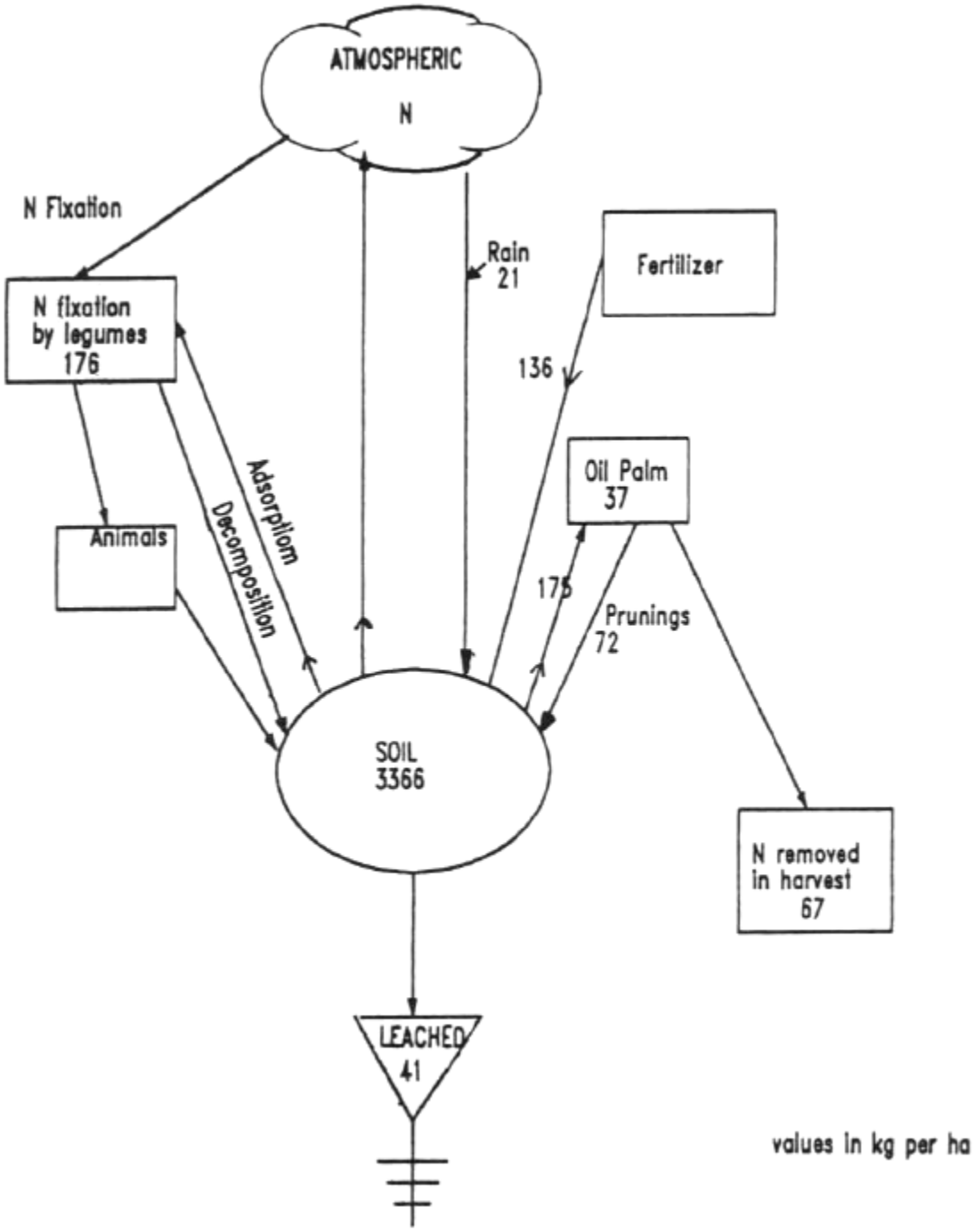


Figure 7: N cycling within a developing oil palm ecosystem

source: Agamuthu and Broughton, 1981

APPROACHES TO SLASH AND BURN LIMITATION

(continued)

PART 2 BASED ON REPLACEMENT OF RICE WITH HIGH VALUE CROPS.

1. Introduction

In Part 1 the effects of forest clearing under slash and burn agriculture was examined. There can be no doubt that the practice results in "swift and drastic" changes (Norman 1979) to the ecosystem. However, as shown in that paper, the system is essentially conservative and not exploitive, unless it is driven too hard. Under natural conditions it may take a century or more to re-establish itself. In West Africa, under a 2 year crop + 10 year fallow, soil organic matter content stabilized at the end of the cycle at 75% of the level of primary forest (Reed 1951), so that the system was not inherently exploitive. The problem arises when population pressure forces a reduction in the recovery time without any compensatory measures being taken. At this point in time there is little land use pressure in some of the upland areas of Laos and so it is very opportune to consider the development of ecologically acceptable cropping patterns and methods of rehabilitating areas that have already deteriorated as a result of over-exploitation.

In Part 1, techniques designed to speed up the rate of recovery of the fallow phase by the use of leguminous trees and cover crops were discussed. The use of legumes is already practiced among the Karen and Lahu people on the border of Thailand and Burma where pigeon pea is planted into upland rice stubble before abandoning the field. Another technique for maintaining fertility is the use of leguminous cover crops during the cropping cycle in a form of mini strip cropping (von Uexkull 1984; O'Sullivan 1985).

It has been estimated that to maintain fertility, 10t ha. per yr. of dry matter residues from crops and green manures need to be returned to the soil (Anon 1985).

The problem to be addressed here is that of how the techniques discussed can be utilized in combination with changes in the crops grown, to improve the economic status of upland farmers in the Lao PDR.

2. Ways of improving the productivity in upland farms

One of the problems of the upland farmer is that the value of the rice he produces is per kilogram only half that of farmers on the lowland, and the farmers in the upland areas are at a subsistence level. There is little incentive for them to sell rice. Several options are available to improve this situation, which involve the development of semi-intensive systems of production.

These include:

1. to provide crops and cropping systems that can efficiently give a significantly better cash return while maintaining productivity, thus enabling the farmer to buy rice produced more efficiently elsewhere.

2. to provide crops and cropping systems that can efficiently give a significant cash return, and maintain productivity while still enabling the farmer to supply all or at least most of the family's needs of rice.

Table 7 contains the hypothetical options for the evolution of upland agroecosystems.

In view of the fact that the production of cash crops for the subsequent purchase of staple crops is seldom carried out in semi-subsistence agriculture (Fisk and Shand, 1969) the second option, a mix of subsistence plus cash cropping is probably the most feasible option, and is in fact the most common form of agriculture in many parts of south east Asia. It is one which secures the food supply for the farmer and his family, while providing them with a cash income. In many countries where other food crops are grown for sale, up to 40% of the consumable energy produced is retained for family use (Norman 1979). Evenson and De Boer (1978) pointed out that once the productivity of the staple crops was improved sufficiently, the released resources can then be channelled towards improvement of cash cropping. This type of system once operating efficiently can lead to further stages of intensification of cropping as more cash becomes available to purchase necessary inputs.

The options on crops to be grown in any improved system is large. The first option is exemplified by smallholder rubber, oil palm and coffee plantations, in which the farmer grows most if not all his own food, and obtains his income from crops that are essentially high value low volume crops. In the case of rubber there is an additional advantage that the sheet rubber can be stored on farm to be marketed when prices are acceptable to the farmer.

In Indonesia the ratio of food crop area to rubber in smallholder rubber farms is 1.43:1 (Suratnaya Effendi, 1985). In Malaysia the ratio is closerto 1:1 (Abdul Ghafar Wahab 1985). This clearly indicates the likelihood that farmers will opt to maintain secure supplies of food from their own farm and not rely on buying the main staples elsewhere.

3. Strategies for cropping

Plantation agriculture.

In Laos, fruit trees already being grown that are capable of further development are durian, mango, mangosteen, lychees and bananas. Other fruits also worthy of consideration are custard apple, sweet apple, wax apple, milk apple and jack fruit. It is also quite likely that cashews and macadamias will have potential in some areas, as they have already been recognized as having potential in northern Thailand and the nuts in shell have the advantage of being easy to transport and store (Anon, 1985).

Reference to the "Dictionary of Lao Foods" by Wyndham James. in a cyclostyled copy and available at a few libraries in Vientiane, Vidal (1962) which is not very easy to find. and the `Lao Food Compendium' (Nabong Agriculture College, 1993) will provide exhaustive lists of fruits already available in the Lao PDR. New genetic material would need to be obtained for most fruits, so as to take advantage of more recent breeding progress.

Development of fruit tree cropping will need to go hand in hand with a need for fresh fruit in urban centers or the development of an export industry. Export industries however require guaranteed supplies of high quality produce.

In northern Thailand for example it is reported (Anon 1985) that mangoes can provide a new yearly income of 7000-14000 Baht per rai from 25 trees (Anon, 1985). New varieties of Sweet Tamarind are also proving to be very profitable.

Following clearing, the land must be cover cropped as quickly as possible and an economic tree crop or tree cover (see Part 1) crop planted. If the economic tree crop planted requires a number of years to come into production then food crops or cash crops need to be planted to provide a cash flow. Examples of dual purpose cover food crops are winged bean and pigeon pea, both of which can smother weeds while providing food.

In Malaysia, in newly planted rubber, smallholder growers have found that cassava following groundnuts and maize produced economic returns (Pushparajah, 1985) as did bananas. In

Thailand (Paisan Laosawan pers. comm.) bananas and pineapples have also been found to give economic returns when used in the first 3-4 years after planting rubber, and certainly these crops need to be considered for use with other economic tree crops where climatic conditions are suitable.

If there is no immediate requirement to grow food or cash crops, the land to be planted with trees should be sown to a suitable legume. In southern Thailand Stylosanthes species have been found to be very suitable as they do not twine. Twining legumes frequently used in rubber need to be cleared away from young trees regularly. In southern Thailand, pigeon peas were found to provide a good cover crop under young rubber, aggressively smothering weeds and providing green pods for eating (Paisan Laosawan, pers. comm.).

4. Perennial crops grown under tree cover

Pepper (Piper nigrum), cardamom (Elettaria cardamomum), Cambodian cardamom (,Amomum krervahn), as well as coffee and to a lesser extent tea, are all worthy of consideration, and the need at this point is to develop some information on potential gross margins for these crops. Crops such as coffee, tea and cardamom are already being grown and so economic data should be available.

5. Tree crops and animals

Where economic tree crops are being grown it is often possible to consider grazing of small ruminants so as to provide income. Under rubber in Thailand and Malaysia for example, once the rubber has reached an age when light penetration,through the canopy falls to below 50% of available photosynthetically active radiation (approx 3 yrs), undercropping with crops and particularly grain legumes is not possible but suitable forage legumes and grasses and ferns can grow and provide a feed source for animals. In Malaysia sheep farming has been shown to be compatible with rubber production (Pushparajah, 1985). Some legumes. particularly Desmodium ovalifolium and the Desmodium heterocarpon group can establish and grow quite well under low light intensity.

Bishop (1978) has discussed strategies for animal production on legume/fuelwood fallows, which could possibly be adapted for use under other economic tree crops such as fruit, nuts and coffee.

Falvey (undated) has reviewed sheep production in North Thailand, and has cited marketing and the extension barriers as the main problems.

Once again, in the case of all these options it is essential to collect sufficient economic data to allow some suitable assessments to be prepared.

6. Permanent or semi-permanent pastures for animal production

The immediate development of legume based pastures following clearing from forest is another option for the farmer. This can be done for two main reasons:

1. to cover crop land until it is needed for crop production: semi-permanent pasture.
2. to provide permanent pasture.

Forage crops, particularly legumes, can often be integrated into the rice cropping system so as to enhance the usage of stubble left after harvest. In both cases the benefits in terms of both N and organic carbon accumulation will be considerable (Humphreys, 1985).

The problem is the choice of grasses and legumes to be used. More research on the local adaptation and productivity will be needed.

In southern Thailand the grasses of Brachiaria genus were found to be the most successful. B. mutica was most successful for wet areas, while B. decumbens, B. Ruziziensis and B. humidicola (cv Tully) were found to give the most consistent grass cover in upland areas (see Appendix 1). This group also performs well under Lao conditions.

The best legumes for cover are those already recommended for use in rubber plantations elsewhere, namely Centrosema and Calopogonium spp. Non-twining fairly low growing legumes

are also needed, Stylos and in particular cv 'Graham', 'Cook' and Nerano' were found to be very aggressive if managed properly, and have also proved to be the most promising legume cover crops in north Thailand (Anon 1985).

Recent work (Evenson, unpublished) suggests that Aeschynomene americana, A. hystrix and Cassia rotundifolia are worthy of more intensive testing in the Lao environment.

If a system including native pasture is to be used, it is necessary to discover the nutrient value and productivity of that pasture. In southern Thailand on a savannah grassland, Apinan Kamnalrut, Evenson and Kritsenapong Laksanapokin (unpublished) found that on a Dystric Gleysol that was deficient in N, P, K, Ca S and Cu the grass components of the pasture had concentrations of N, P, Ca, S and Zn well below those usually considered as critical for normal maintenance of cattle. The net primary productivity of the pasture in the absence of annual burning was 12 tones per ha. per yr. but the limit to animal productivity would obviously be pasture quality and not quantity. Annual burning to obtain a green pick of higher quality seriously affected subsequent productivity, which fell to 7 tones per ha. per yr. after two consecutive annual bums.

7. Annual arable crops

Maintenance of yield in continuous cropping systems in northern Thailand has been based on a need to maintain soil organic carbon levels at 1.7 % which is equivalent to the level found in newly cleared areas.

Experience in northern Thailand (Anon 1985) has shown that conservation farming combined with appropriate land development methods designed to minimize erosion have produced much better yields than traditional methods (Figs. 8 and 9), and that various options are available. The option chosen will affect cash returns (Fig. 10).

Cash crops that are grown include ginger, onion. garlic and vegetables together with mung bean, peanut and maize. However marketing the crop is the problem because this is done via middlemen.

It must always be remembered that the main aim of most farmers is to grow rice, and as it is the staple crop, the objective is to be self-sustaining for food.

Other possibilities for cash cropping include flowers and ornamental plants. However such systems rely on the presence of suitable transportation systems and markets for the produce.

8. Tree crops and trees suitable as covers

Leguminous tree crops suitable as covers include Leucaena, Glyricidia, and Cassia sp. Other trees include Casuarina, which fixes atmospheric N. Another legume widely used in tropical America is Inga edulis which also provides food and firewood. This tree should be introduced for testing.

Pinus kesiya which grows in upland areas of the Lao PDR (Vidal 1956) has been used in the "jhum" system already mentioned (see Appendix 2). Many other trees have been listed for their potential in multipurpose agroforestry (Nair and Fernandes, 1984), and for firewood (Anon.1980).

9. Soil fertility

It is important that the main soil nutritional problems should be defined to determine whether increases in productivity can be achieved economically. Extensive work in the northern regions of Thailand (Anon 1985) has shown that in the case of upland rice response to fertilizers is often unpredictable and even negative. Currently the recommendations for crops grown in the Upper North is limited to 40 kg ammonium sulphate per rai for maize only, and 20 kg gypsum per rai for peanuts.

Only on highly eroded soils and particularly oxisols was phosphorus deficiency observed on maize and peanuts. It is recommended that the legume phase of the rotation should receive low rates of rock phosphate and gypsum as a prudent maintenance measure.

No significant responses to micronutrients have been detected in glasshouse trials.

10. Economic viability

It is necessary to collect as much information as possible on potential yields and cropping patterns for the range of options to be considered. Where local yield data is not obtainable then as a start information from elsewhere should be used. In Tables 6a & b a list of average crop yields is given for a variety of crops already mentioned. Needed to go with this table is information on market value and demand for the crops and likely return to the farmer in the form of gross margins.

Land development costs will have as marked an effect on economic viability, as the method of land development will have on the future fertility and stability of the soils. This is particularly so in the case of the tropical Acrisols.

Von Uexkull (1984), discussing land clearing methods, stated: "In the worst cases, the tree trunks and stumps are removed by heavy bulldozers which then disc plough the (dead) soil, thereby further disturbing the topsoil and compacting a subsoil that is already, in its natural condition, often poorly aerated.".

Currently commercial costs of D65 Bulldozers (or those of similar size) are at least $35 per hour or US$300 per ha and the damage their use can cause is rarely mentioned.

Von Uexkull (1984) concluded that the safest and cheapest way was to maintain a constant cover of organic mulch and keep soil disturbance to a minimum.

11. Conclusion

An attempt has been made to summarize the possibilities that exist for providing an economically more rewarding and ecologically acceptable series of cropping options for upland farmers in Laos. It becomes obvious that more information is needed before even simple economic assessments can be made, for many of the options.

Actual cropping systems, such as those that have already been tested for 10 or more years (Anon 1985) elsewhere, have reached a stage that the best of them are worthy of introduction into Laos on a supervised basis.

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APPENDIX 1

More recent work in the Lao PDR has identified Aeshynomene americana, A. hystrix and Cassia rotundifolia as having great potential.

APPENDIX 2

Pinus kesiya (syn. P. khasya), which forms the basis for the 4jhum' system in India and also grows at altitudes of 800m and above in the highlands of the Lao PDR is therefore worthy of study as a cover tree.

Table 3. hypothetical evolution of upland ecosystems

	PRODUCTIVITY	STABILITY	SUSTAINABILITY	EQUITABILITY
TRADITIONAL CULTIVATION low population	low	medium	high	high
TRADITIONAL CULTIVATION high population	very low	very low	low	medium
REAFFORESTATION	low	high	high	low
CASH CROPPING	high	low	low	low
TREE GARDENS & CASH CROPPING	medium	medium	medium	medium
INTEGRATED TREE HOME GARDENS	high	medium	medium	high

SOURCE: KEPAS (1985). The upland agroecosystems of East Java. Kelompok Penelitian Agro-Ekosy3tem, Agency for Agricultural Research and Development.

DEFINITIONS:

PRODUCTIVITY- The net output of the system, crop yield or economic return

STABILITY- Constant productivity In the face of environmental variability, measured by the coefficient of variation of yield or net income.

SUSTAINABILITY- System persistence in the face of repeated stress or major perturbation such as pollution, deteriorating soil structure, or the appearance of new pests or diseases

EQUITABILITY- The pattern of distribution of the products of the system among the human beings contained in that agro-ecosystem

Table 4: ultimate farmer's yields under average production conditions (t/ha)

Ultimate farmer's yields under average production conditions (t/ha)

		Rain-ted	Irrigated
Cereal crops (grain)	Rice (paddy)[a]	1.5-2.5	4.0-5.0
	Wheat	1.3-2.0	3.0-5.0
	Maize	1.5-3.0	4.0-5.0
	Sorghum	1.3-2.0	4.0-5.0
	Millet	1.0-2.0	
	Barley	1.3-2.0	2.0-3.0
Root crops (roots/tubers)	Cassava	15.0-20.0	25.0-35.0
	Potatoes (tropics)	8.0-12.0	12.0-18.0
	Sweet potatoes	5.0-10.0	12.0-18.0
	Yam	12.0-25.0	12.0-18.0
Oil and protein crops (seeds)	Soya beans (12-20% oil)	0.8-1.3	1.5-2.0
	Chick peas (grain)	0.5-1.0	1.0-1.5
	Beans (seeds)	0.5-1.0	1.0-1.5
	Cowpeas (seeds)	0.5-1.0	1.0-1.5
	Pigeon peas (seeds)	0.8-1.5	
	Groundnuts (50% oil)	1.0-2.0	1.5-2.0
	Sunflower (40% oil)	1.0-1.5	1.5-2.0
	Safflower	0.8-1.3	1.5-2.0
	Sesame (40% oil)	0.5-0.8	1.2-1.5
	Brassica (42% oil)	0.8-1.3	1.3-1.8
	Oil palm [b](bunches 20% oil)	10.0-20.0	-
	(pericarp oil)	2.0-4.0	-
	(kernels 47% oil)	0.5-1.0	-
	Coconut [b](copra 60-65% oil)	1.5-2.5	-
	Olive [b](fruit 18% oil)	2.0-2.5	3.0-4.0 (annually)

Sugar-producing crops	Sugar-cane [b](10% sugar)	40.0-60.0	100.0-120.0
	Sugar-beet (15% sugar)	20.0-30.0	40.0-45.0
Fruit crops	Banana [b](1.500 trees)	15.0-25.0	35.0-50.0
	Orange [b](180 trees)	10.0-20.0	20.0-30.0
	Grapefruit [b](100 trees)	8.0-15.0	15.0-25.0
	Mandarine [b](230 trees)	8.0-15.0	15.0-25.0
	Mango [b](75 trees)	7.0-15.0	15.0-30.0
	Papaya [b](1,000 trees)	10.0-20.0	20.0-30.0
	Date palm (100 trees)	-	8.0-12.0
	Grape [b](2,000 trees)	3.0-5.0	5.0-10.0
	Cashew [b](120 trees)	1.0-1.5	-
	Pineapple (40.000 plants)	25	40
Vegetables	Onions, lettuce, spinach, radish, cucumber, melon, squash	5.0-10.0	10.0-20.0
	Tomato, eggplant, cabbage, cauliflower, carrots, watermelon	10.0-20.0	20.0-40.0
	Sweet peppers	3.0-6.0	6.0-12.0
Fibre-producing crops	Seed cotton (34-38% lint)	1.0-1.5	2.0-3.0
	Jute (dry-processed fibre)	1.0-1.5	1.5-2.5
	Kenaf (dry processed fibre)	1.0-1.5	1.5-2.5
	Rosella (dry-processed fibre)	1.0-1.5	1.5-2.5
	Sisal [b](dry-processed fibre)	1.5-2.0	-
	Kapok [b](seedless fibre)	1.5-2.0	-
Beverage crops	Cococa [b](dried beans)	0.8-1.5	-
	Coffee [b](dried beans)	1.0-2.0	-
	Tea [b](dried beans)	1.0-2.0	-
Industrial crops	Rubber [b](latex)	1.0-1.5	-
	Pyrethrum (dried blossom)	0.5-1.2	-
	Castor bean (45% oil)	1.0-1.5	1.5-2.0
Stimulant crops	Tobacco: flue-cured leaf	0.5-1.0	1.5-2.0

	Air-cured leaf	1.0-1.5	1.5-3.0
Fodder crops (fresh weight)	Alfalfa [b](20% dry matter)	30.0-40.0	80.0-100.0
	Berseem [b](15% dry matter)	20.0-30.0	60.0-80.0
	Maize [b](15% dry matter)	15.0-25.0	50.0-60.0
	Sorghum [b](20% dry matter)	15.0-25.0	50.0-60.0

. a Paddy is unhusked grain.

. b Perennial crops: low figure indicates yields from smallholdings, high figure those from estates.

SOURCE: Euroconsult (1989), Agricultural Compendium, Elsevier.

Table 5: crop yields

SOURCE	1	1	1	2	3	4
YIELD LEVEL CROP	average	tow	high	average	average	average
Mango	3250	2500				
Cashew	1650				850	
Tamarind	4493					
Mangosteen	6937					
Langsat	4368					
Durian	2806					
Rambutan	8800					
Custard Apple	6006					
Wax Apple	3550					
Guava	4881					
Santol	2968					
Tangerine	11600					
Pomelo	4337					
Banana	1837					
Paddy Rice	2275		3793	2441		2660

Irrig. Rice						2997
Upland Rice	1770	875#	2250#			1230
Maize	1875			1430		1440
Sorghum	1300					
Soybean	1418	687	1337	960		750
Peanut	1575	712	1575	1000		850
Cotton	1250	562				700
Mungbean	512	412	512	490		650
Pigeon Pea						
Cowpea						
Pepper					100	
Sweet Potato						7120
Coffee						370
Tea						1870
Tobacco						4230

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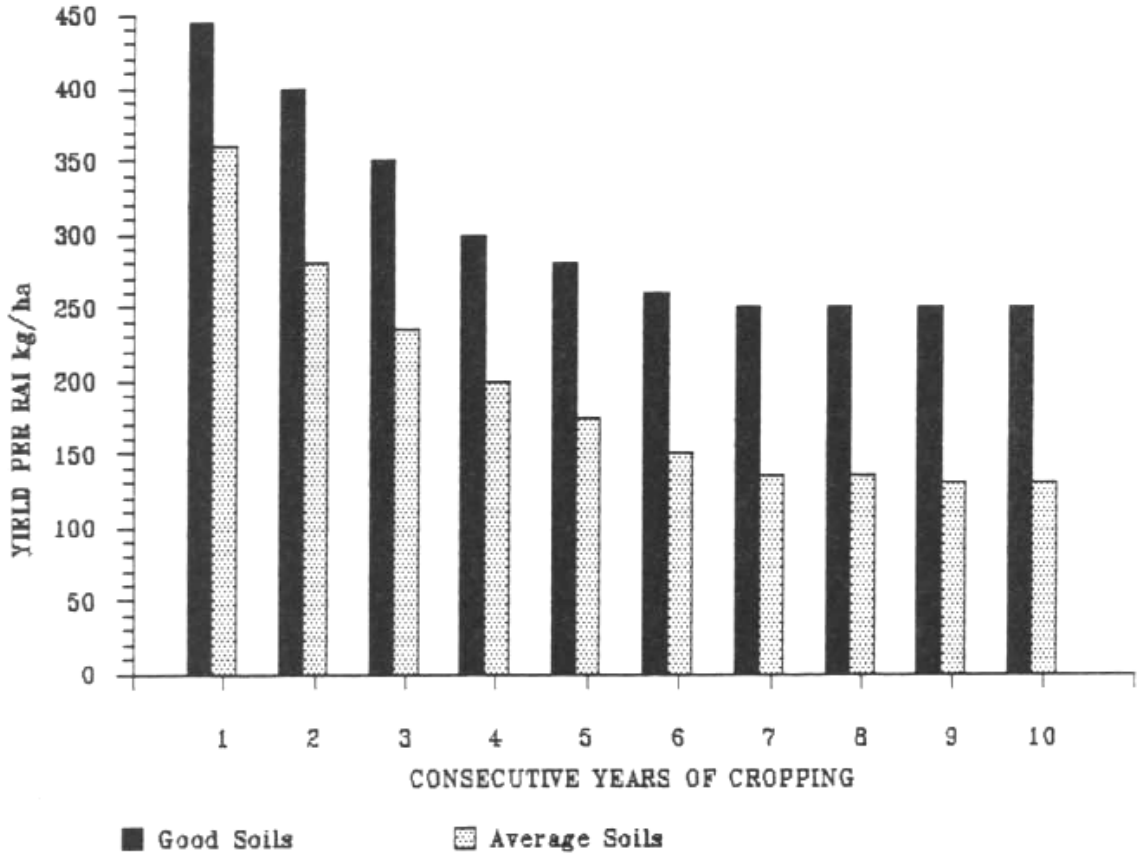
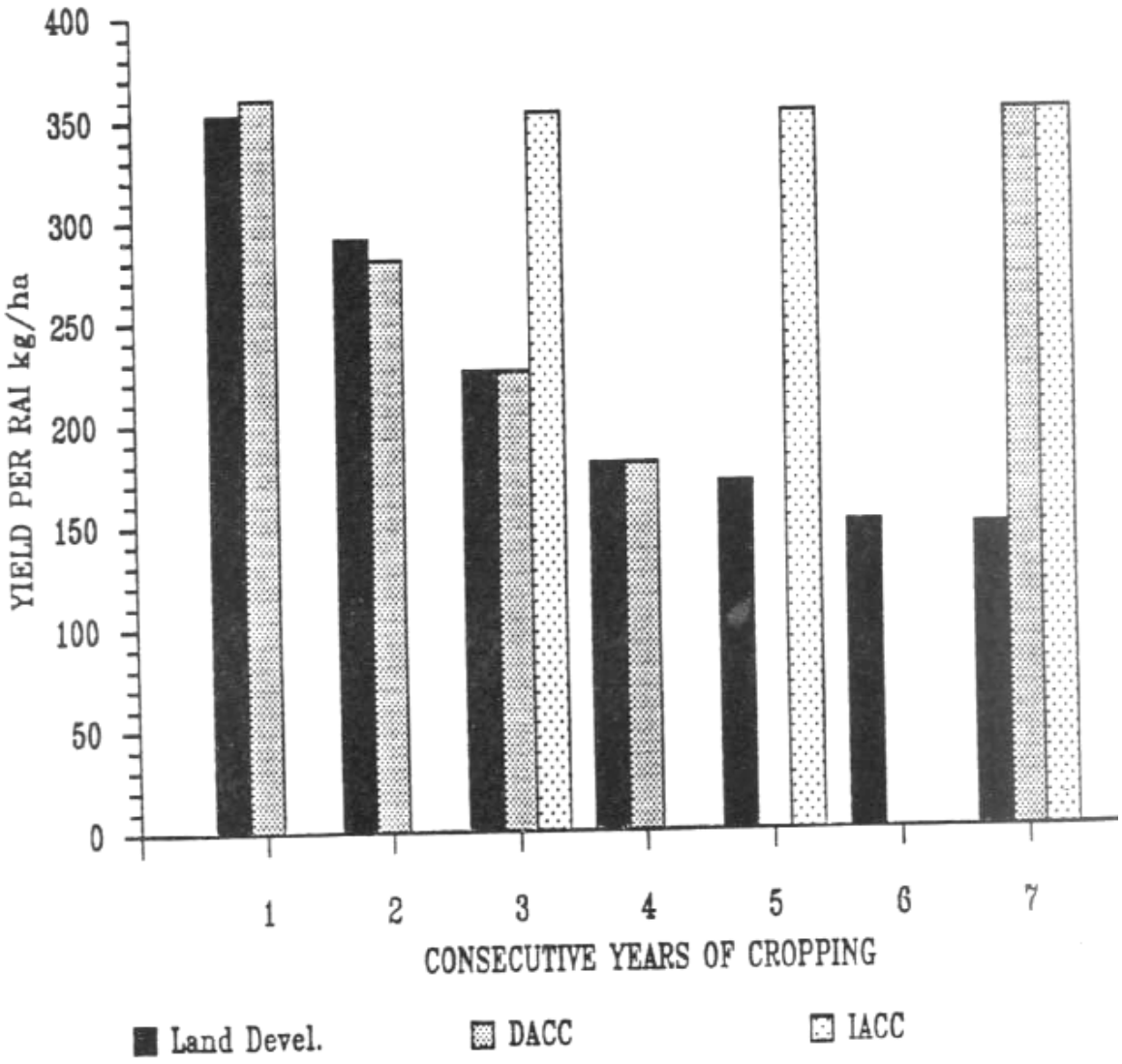


Figure 8: estimated upland rice yields over 10 years monocropping (kg/rai)

source: Anon., 1985



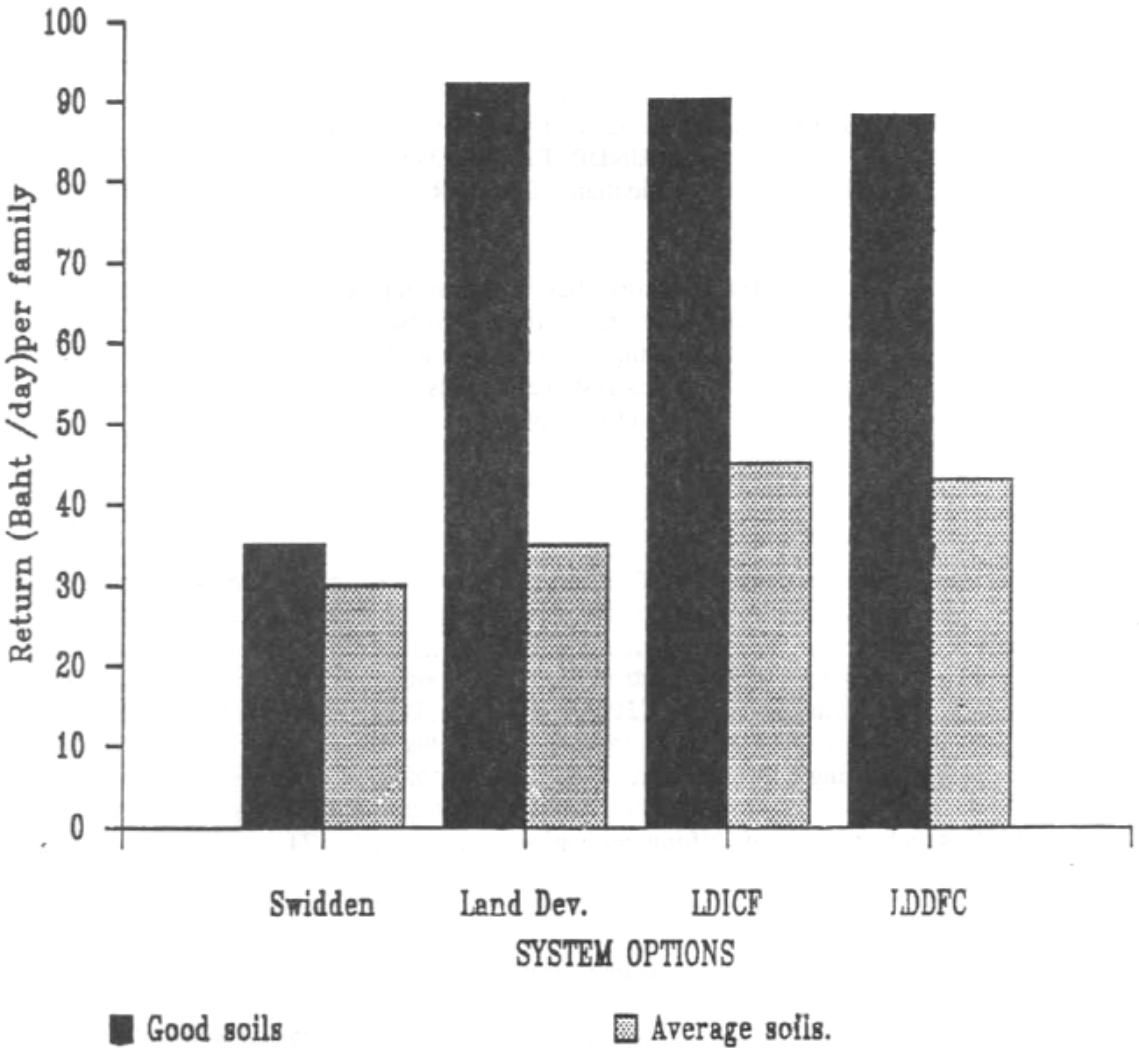
Land Development only

Land Development with delayed acceptance of conservation cropping

Land Development with acceptance of conservation cropping

Figure 9: estimated upland rice yields from multicropping (kg/ha)

Source: Anon., 1985



ICF = IMMEDIATE ACCEPTANCE OF CONSERVATION CROPPING

DFC = DELAYED ACCEPTANCE OF CONSERVATION CROPPING

Figure 10: returns per family per daywith different options (in baht)

source: Anon., 198

SHIFTING CULTIVATION PRACTICES IN LAOS

- present systems and their future -

Laurent CHAZEE

CTA

Projects of Small Scale Irrigation

in Oudomsay and Luang Namtha

UNDP/OPS/LAO/89/029 and UNDCP/OPS/LAO/89/CO3

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Vientiane, Lao PDR

Translated by Dirk Van Gansberghe

from the French original version

" Les pratiques d'essartage au Laos

Les systemes actuels

et leur avenir"

SUMMARY

Reducing poverty by at least insuring food self-sufficiency and protecting the national environment in the context of a growing population represents a big challenge.

The challenge is particularly big if we consider the natural dynamics of the three variables POVERTY - ENVIRONMENT - DEMOGRAPHY which have antagonistic effects between them. It is thus necessary to guide the overall dynamics towards a compromise, where the technical solutions will become economically interesting and ecologically desirable for the Government and socially acceptable for the population.

The natural and traditional means to improve the socio-economic conditions of the rural communities practicing shifting cultivation for their subsistence consist of having access to a large exploitable territory, which means to have access to a maximum of natural plant resources (biomass) to clear. The population growth will naturally restrict the access to the resources and technical adaptations will then become unavoidable, unless a rigorous birth control programme is established.

For the Government, the protection of the environment entails an unavoidable policy to restrict the exploitation of the rural areas, a balanced policy of rural development and/or a policy of birth control. These policies are going in the opposite direction of the natural inclinations of the peoples. Every country is confronted with the same dilemma.

What are thus, in the conditions of Laos, the consensus-based solutions which would enable Laos to reach the optimum stage of a well-balanced situation, taking into account the long term objectives of everyone?

From a general point of view, Laos has the chance of being able to preserve important natural resources, and the environmental problems have not yet reached a stage requiring urgent measures as experienced in numerous countries. But it is urgent to undertake, with the rural population, the most appropriate actions to conserve the natural resources, and to exploit them in the best possible manner.

The first solution is a demographic one. It would consist of establishing a rigorous national birth control policy. This would allow Laos to save several years in order to be able to progressively improve the policies for development and for environmental protection. Is this achievable and

recommendable in the Lao context? Will it affect the population of shifting cultivators who are often isolated?

The second solution is directly connected to the production systems of the shifting cultivators (management of space and modes of exploitation). There are hundreds of technical solutions in the world, they have proved to be useful, but in different specific historical, geographical, demographic, economic, social and cultural contexts. Which are the already known solutions or the new ones resolving the problems of the shifting cultivators in the highland villages of Laos, and above all, the solutions enabling them to reach their long term objectives in a sustainable manner? Very few.

There are two strategies for introducing solutions:

- one consists of testing them first, and then waiting for the results. Have they been accepted? Did the populations adapt themselves? Considering the range of possible solutions, the risk of failure is generally higher than the chance of success, especially in the long term or after the end of an assistance. The resulting negative effects are often difficult to bear for the populations and the Government.
- the second strategy consists of knowing the populations of shifting cultivators and their differences, and, according to the present situation and their long term objectives, defining with them the most appropriate solutions and the prior conditions to attain these objectives. These solutions must be consistent with the economic and ecological objectives of the Government.

The second strategy requires a preliminary phase of long duration study, which leads to the establishment of a strategy for micro-regional development (at the district level for example). Conversely to the first strategy, solutions are not imposed, they are formulated with the communities to respond to their immediate problems, and they are oriented from the start in a way allowing them to reach their long term objectives. It is this strategy which has been used at the provincial level by the project assisted by UNDP and UNCDF in Oudomsay and Luang Namtha.

This strategy has allowed the collection of the following information at the district level:

- which were the groups of shifting cultivators willing to produce rice in irrigated plains and under which conditions.
- which were the groups preferring to stay in the highlands, but which would be ready to develop cattle production in order to buy the rice they would not produce anymore on the slopes.
- which part of the population was interested in constructing and maintaining terraces and under which conditions.
- etc.

The conditions are now in place to launch a development programme while protecting the environment.

Introduction

General characteristics of slash-and-burn practices

The practice of slash-and-burn is an ancient technique, which has been used on all continents. It is still practiced in many countries and it allows to feed a numerous population, often isolated from communication networks and markets without access to education and new techniques.

This production system, close to proto-agriculture, situated between gathering-hunting and sedentary agriculture, has allowed, from generation to generation, to establish close links between nature and mankind. These linkages have been formalised through experiences and empirical observations, where different technical, social, religious and traditional values were mixed. Indigenous shifting cultivation societies have established relatively well balanced relations

with the natural environment in which they live. They have organized themselves to exploit natural resources, through not very perfect production modes, but in a way, sufficiently sustainable to be able to maintain the system until now. These societies have adapted their life, centering it on that particular type of production system. The human settlement is in the forest, the spirit of the forest flies over the "hay" field, gathering and hunting are daily activities and production is thought of in terms of forest regeneration.

A traditional shifting cultivator, if one takes the time to listen to him, would inform us about the complexity of the system. Rules are not written. but he knows exactly how to operate that system "ecologically" and extracts his food from this well known and indispensable equilibrium: natural resources - demography. At the moment he is out of the equilibrium he looses his references, and his capacities will then depend on the possibility of access to new techniques. This equilibrium has already been broken in many countries, as a sign of adaptation for the production system, or of progressive degradation of the environment. This equilibrium has often been broken naturally through demographic pressure on the resources which were not sufficient anymore for the same production modes. This equilibrium has also been broken when policies on environmental protection were not adequately complemented with compensation measures for the groups of shifting cultivators. In this case, the forest has been temporarily saved, but:

- the population was not self-sufficient anymore;
- the soil became infertile with short-fallow policies;
- rural exodus became unavoidable, creating important problems in urban environments.

These consequences have been particularly noticeable in countries like Madagascar and Brazil.

Practicing shifting cultivation has never been positively perceived neither by sedentary populations of the plains and forest societies interested in their profits, nor by the Governments concerned with environmental protection.

Nowadays this extensive system does not have any promising future, but it has been denounced and most often described by sedentary populations who did not always consider the history, the evolution of the technique and their significant advantages. One must note that this technique has allowed scattered populations to renew their production system thus their future, from one generation to another, without depending on any sophisticated tools, draft animals and external inputs. The products harvested after slash-and-burn from a land with a crumb structure covered by ashes, have a particular flavour not found with the other cultural practices in the plain. The concept of palatability, often underestimated, yet consists of one of the main criteria for seed selection by shifting cultivators. In fact, even the lowland populations are always ready to pay for these luxurious goods (rice, vegetables, papaya,etc.) in order to be able to eat them during the season.

The highland forest often provides the population, through its by-products, with a better nutrition balance than the plains. The orientation of the slopes determines the choice of crops, according to the orientation to the South or to the North. The altitude favours a better health protection (better water quality, less dust, no malaria, etc.) and its variations enable the staggering of the different crops (effect of climate), and thus of manpower.

Shifting cultivation practices have thus numerous advantages and have been practised by populations of "ecologists" who have been able to rationally exploit the natural resources by conserving the environment, vital condition for their future.

Confronted with demographic growth and with a relative decrease of natural resources the Governments are legitimately taking all the possible measures to protect the environment in general as a whole. This objective has also always been pursued by the shifting cultivators. Important technological breakthroughs are thus unavoidable resources and the demography is broken. But, if these breakthroughs are provoked without any prior assessment of the social and cultural costs, without pre-evaluation of the consequences for the whole system and of the disappearance of the precedent equilibrium, they can lead to acculturating consequences with

negative and costly effects (poverty increase, rural exodus, social destructuring, loss of knowledge on traditional regulation means).

For the success and continuity of a production system modification programme based on shifting cultivation practices, it is therefore important to study with the population, in harmony with their long term objectives, which are the acceptable socio- economic technical solutions that could be envisaged. The modalities and the pace of implementation of the activities will be compatible with the human capacity of the corresponding rural communities.

Shifting cultivation in Laos

About 300,000 families in Laos could be considered as farmers of the forests, based on the fact that their production systems are based on forest and soil regeneration cycles rather than on regular crop rotations. These families live in the forests or nearby the forests. They practice the technique of shifting cultivation (slash-and-burn) by tradition, but also because of a lack of access to land in the plains.

The most important areas are planted to rice, in monocropping or in mixed cropping. The area of wet season rice under shifting cultivation covers 34 % of the national rice area and 20 % of the annual production (National statistics, 1992). The other slash and burn areas are planted to maize, cassava, vegetables, fruit-trees, oil crops, cotton, cucurbits, indigo, aromatic plants, etc.

In addition to this number of families, we can add about 100,000 families who regularly use the forested slopes, but in a more restricted way. One part of these families use them annually for food crops, barter crops and cash crops, which thrive better on drained slopes than in the plain (pineapple, bananas, sesame, cotton, opium poppy, etc...). The other group of families, in addition to the described crops, are obliged to consider the slopes for rice production. They do it annually if their lowland rice area (in the plain) cannot insure the family's self-sufficiency. If the family's area in the plain is hardly sufficient to meet the requirements of the family, the slopes might anyway be periodically used for rice production in the following cases:

- For security reason, in anticipation of an unfavourable year (climate, crop pests, etc..) which would be responsible for the yield decrease in the plain.
- In case of a lack of manpower for lowland cropping (no draft buffalo, sick ploughman).
- If rice is considered as a cash crop or barter product for the family.

It is estimated that every year (since the last 5 years) about 310,000 ha of vegetation is cleared for the different annual crops grown on sloping land. Out of the average repartition by crops, the following:

- 235,000 ha for upland rice
- 30,000 ha for maize
- 45,000 for the other crops (cotton, cassava, soybean, groundnut, beans tobacco, sugar cane, vegetables, sesame, etc..)

The burnt area is somewhat exceeding the cleared area, the difference coming from the burning of pastures (Xieng Khouang, Houaphanh, Phongsaly and from the forest fires).

Considering an average fallow period of 4.5 years, 1,400,000 ha are used in Laos in shifting cultivation systems, which means 6% of the national territory.

Based on my studies at village and provincial levels from 1989 to 1993 (109 villages) within the context of the UNDP/UNCDF projects, this figure seems underestimated for crops other than rice and for the average area of fallow. The total annual cultivated area is estimated at 380,000 ha, and the average fallow period is 5.5 year. The total area used in shifting cultivation on the whole of the system is estimated to be 2,090,000 ha. If the forest fires and the burnt but not cultivated

areas are added, the total burnt area within the whole of the cycle would reach approximately 2;300,000 ha which means 9.7 % of the national territory.

From records established through aerial photographs of the Forest Inventory and Management Office with the assistance of the SIDA, the total area under shifting cultivation is increasing in Lao P.D.R. The aerial photographs of 1981-82 and the Spot pictures of 1988-89 show 73 % of increase in the annually cropped area under slash and burn (352,500 ha against 610,700 ha). However, the fallow areas have increased by 5.7 % only, passing from 4,024,100 ha to 4,254,000 ha. This trend is confirmed by field observations in Oudomsay and Luang Namtha provinces where the annual slash-and-burn areas increase while the fallow periods decrease.

Based on these data, an estimated 4,864,000 ha were used in shifting cultivation systems for the year 1989 with an average fallow period of 8 years (against 12 in 1981-82), which represents 20.5 % of the national territory.

Official statistics are thus generally inaccurate and it is estimated that the total annually cultivated slash-and-burn area in Laos ranges between 310,000 ha and 600,000 ha, with a trend toward the reduction of fallow periods.

Based on the studies and observations made in the Naphok-Nabong region (Dirk Van Gansberghe) and the Namtha, Sing and Xay plains (UNDP/UNCDF LAO189/029- LA0/89/CO3), the rays'area have increased in the last three years. These sloping areas are often cultivated by new families arriving without access to lowlands and by young and new couples without rice fields in the plains or disinherited by their parents.

These general figures give an estimate which hides a great diversity of situations in the territory of the Lao PDR. Indeed, there are several techniques of slash-and-burn, different seasons, following the fallow cycles, or according to the shifting systems.

The farmer of the forest whose main activity is generally based on production of upland rice, benefits also from numerous resources which are not available for the lowland sedentary farmer. Indeed, itineraries in the upland field on hills or mountains are also opportunities for activities such as gathering, hunting, trapping, wood and honey collection. These forestry plant or animal by-products are not only serving for self-consumption, but also as local money for exchanges between villages or on the markets (bamboo shoots, mushrooms, spices, tubers, etc....) or even offer possibilities for cash crops (cardamom, benzoin, rattan, damar gum, resin, traditional dye, areca nut, etc...).

The natural population growth and the national policy of forest protection contribute, since many years, to the awareness of hilltribes of the necessity to modify their production system. Several examples have already been seen, some happier than others. One can note among the success:

- The "race" towards irrigable land, especially in the North of the country, where the tradition and the techniques of irrigation exist. Any kind of irrigable land area is looked for and developed.
- Rural communities reinforce their activities related to crop intensification and the diversity of family activities, as far as the processing of products. These actions are mainly recognised in the perpheric urban zones or where the demographic pressure requires it, for example around Luang Prabang, on the Boliven Plateau, around the cities of Vientiane, Savannakhet, Pakse and Saravane.
- Improved management of the village land designated by the local authorities for slash-and-bum practices. Some villages are reinforcing their animal husbandry activities to finance the gap in rice production, particularly in Phongsaly, Luang Namtha, Houaphanh, Oudomxay, Xieng Khouang and on the Boliven Plateau.

Some sadder examples could be cited:

- The anarchic migration of population groups, mostly Lao Theung, looking for new territories, because those which are presently authorized for use are too restricted to insure food self-

ufficiency. Without access to land in the plains or to new techniques, the only reaction for survival known consists of splitting up the village and seeking new land.

One can note these migration flows from Luang Prabang, Houaphanh and Xieng Khouang and Phongsaly towards Luang Namtha (districts of Sing a,nd of Long), Oudomxay and the province of Vientiane (region of Kasi - Phone Hong). These groups try their chance in town as a last solution, becoming then forced to begging. Another flow also exists from the mountains to Saravane (district of Tahoy) and from Champassack towards the Boliven Plateau and the cities of Saravane and Pakse.

- Production from sloping land is becoming insufficient to insure food self-sufficiency, so the families look for temporary jobs in agriculture, which is experienced as a degrading situation.

In case of emergency, they are obliged to accept underpaid jobs and also to send children to work. Psychologically hurt, these families know that they have entered a dangerous cycle of dependence, where any concept of security, future of capitalisation and social amelioration (education in particular) must be forgotten, at least temporarily. The extreme stage observed in Oudomxay and in Luang Namtha is when they have to sell a parcel of lowland for a low price, sell the poultry, and then start to smoke opium, and to sell the children.

The process of poverty eradication initiated by the Lao Government and the policy of environmental protection represent a difficult challenge when faced with the population growth. The overall approach adopted by the Lao Government is appropriate, and it seems important to pursue in this direction, looking for technical solutions, socially acceptable for the communities involved, economically interesting and ecologically acceptable for the Lao Government.

1. Principles of shifting cultivation

Shifting cultivation, which is often called under the name "slash-and-burn" or swiddening" and in French "essartage", "agricultue itindrante", "defriche-brillis" in Laos, consists of cutting the natural vegetation, leaving it to dry and burning it for cropping the land.

This forestry agriculture is generally practised in Asia in a biogeographic environment composed of tropical dense forest, often evergreen, on naturally drained crumb soils.

The sedentary population uses the forest plots with a fallow cycle traditionally over 10 years, but which necessarily decreases with the population increase and the diminishing village territories. The fallow system allows the forest regeneration.

It is accompanied by the reconstitution of the soil structure, of humus and soil biology. A fallow which is long enough gives an arborescent plant cover which limits the herbaceous storey, synonymous of constraining weeding for the family.

The shifting population groups move when the forests around the village have been exploited and when the time necessary to reach the remote forests is justifying a change of location for the village. Traditionally, the village was replaced every 10-30 years, depending on the number of people in the village and the quality of the soil.

This extension technique, if well managed, allows with simple tools, a diversified production with steady potential yields. The plant takes nutrients from the soil mineralized thanks to burning, and structured by the roots and the biological activities linked to the preceding natural vegetation.

The yields are yet irregular, since they are highly depending on the climate and crop pests, in particular rats and insects.

2. The calendars and the practices of shifting cultivation

2.1 The cropping calendars

The cropping calendars depend on:

- the latitude (time-lag of the wet season)
- the cultivated plant
- the micro-climatic effects
- the ethnic group

In general, one could distinguish 3 main types of cropping calendar in Laos:

- The calendar of the wet season
- The calendar of the dry season
- The crop - pasture calendar

Within these categories, one can distinguish the mono-cropping systems, the annual multiple cropping systems and the animal - perennial multiple cropping systems.

The most widespread system in Laos is the wet season rice cropping, in mono-cropping or with some associated plants. For the regions of Northern Laos, the calendar of activities is described in the following table (see table 1).

It is difficult to separate the calendar of activities for rice cropping and the associated crops, from activities of hunting and gathering. Indeed, the benefits of the crop are easy to see at harvesting, but the intermediary benefits between the preparation of the plot and the harvest are far from being negligible. These activities are conducted concurrently, often in the same field and are mostly meant for food purposes for the family that stays in the field.

2.2 Practices for the wet season crop

The fallow

Some slash-and-bum societies prefer shifting cultivation rather than sedentarisation of the village and the cropping in a fallow system.

Traditionally, the Hmong and the Yao use this technique in Northern Laos, whereas some Lao Theung groups of the south (Lave and Katou) use it in Attapeu and Sekong. The system consists of exploiting the forests around the village on a given radius. When the distance to cover beyond that radius is found too constraining, the village moves towards the new slash¬and-burn territory.

The origin of shifting cultivation is linked with ethnic traditions, but also with soil fertility problems. The villages can afford a bigger size than is allowed by the fallow system.

For the societies of "sedentary" shifting cultivators, if the population pressure stays low, a long fallow period insures yields which are in many cases higher than those of lowland production. For instance, in Laos, in Vietnam and in Cambodia, the traditional fallow periods are generally more than 10 years, going up to 20 years for the Mon-khmer of the Kamu, Lawai and Lamet ethnic group.

These long fallow periods require thus a considerable area of village land for slash-and-burn, each family using between 10-30 ha during the whole cycle. This explains why the forest population utilizing that technique has to be scattered. The villages consist of rarely more than 25 families, to benefit from an acceptable distance to the field for movements and transport. This is still often the case in the low populated regions such as Attapeu, Sekong, Phongsaly and the South of Oudomxay and Luang Namtha.
Table 1: Calendar of Activities in upland fields for Northern Laos

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
• Tool preparation												
• Decision to slash												
• Slashing												
• Burning												
• Unloading												
• Sowing												
• Fencing												
• Bamboo shoots												
• Insects cicads												
• Weeding												
• Frogs												
• Rats bird												
• Harvesting												
• Threshing												
• Transport												

When the population pressure increases, the village land decreases, the fallow cycles decrease until the soil, too often cultivated, is being degraded progressively with the effect of erosion, if no compensation measure is taken. For instance, in Luang Prabang, with a population density higher than 25 inhabitants/km2 around the city, an awareness has raised since a few years due to the necessity to improve the technique of slash-and-burn. The province of Phongsaly, with a low population but quite denuded from its primary forests because of the shifting nature of most of the population, is the only province where traditional sedentary agriculture using irrigated terraces on mountains exists (Phongsaly and Ho ethnic groups).

In general, the land is utilized for one year and abandoned in fallow. Yet, when the soil is rich and clayey, it is exploited 2 or 3 years before resting. One notes for example this practice in the Kham district of Xieng Khouang, in the districts of Bounma, Bountay and Gnot-ou in Phongsaly and on the Bolovens Plateau.

THE CROPS

Rice represents 75 % of the sloping area used every year for annual cropping. The other main crops include the following:

- maize
- cotton
- cassava
- soybean, kidney bean, groundnut

b. sugar cane

- sesame
- vegetables (cucumber, gourd, sweet potato)
- fruits (watermelon, melon, banana)
- spices (basilic, chilies)
- Job's tears
- indigo

These crops could either be associated in the same plot, cultivated in different locations in adjacent plots or grown in separate fields. They can be grown in association with perennial plants, such as papaya, banana or castor bean in the South and banana or benzoin in the North.

SLASHING

Slashing the vegetation is a village community activity, mostly performed by men. This system of assistance exists all over Laos. The duration of slashing operations depends on the biomass to be cut. It varies from 100 hours per hectare for an herbaceous to bushy fallow (fallow period of 2-3 years) to 500 hours per hectare for an arborescent fallow of 10 years. Slashing is done with a small traditional axe and a manual saw for the big trees.

DRYING

The organic matter is left on the soil to dry for 3 to 4 weeks in general. This technique presents the advantage of completely covering the soil, constituting a humic natural mulch protecting the soil against sun drying and the impact of violent tropical rains. The structure of the soil is not only preserved but its microbial fauna is stimulated by the organic matter being degraded. The combination of these effects is agronomically excellent for the germination of the seeds.

BURNING

The month and the moment of the day are generally carefully chosen for burning since it is a delicate activity. The whole family field must be burnt the same day and as quick as possible to insure the maximum consumption of the organic matter. A poor burning could be responsible for a tiring unloading of trunks and a decreased soil fertility. As a result yield and labour productivity will be affected.

In Oudomsay, burning activities are concentrated in the period between end of March -beginning of April, in the afternoon or in the night when the wind starts to blow. Burning is a family activity (husband and wife) but the village will intervene in case of uncontrolled fire.

UNLOADING AND SECOND BURNING

Unloading trunks (= "debardage" in French) is generally a family activity (husband and wife), but the systems of mutual assistance or labour exchange will prevail if volumes to be removed are important. This activity requires between 50 and 250 hours depending on the volume of organic matter to be reburnt or to be removed from the field. At this occasion the remaining litter is subject to a second burning in some places (= "ecobuage" in French) where preferably vegetables, fruits and spices will be sown.

One must note that, for the families without sufficient manpower or those cropping a land with a fallow period of only two years, the second burning is a very important activity. Rice and its associated crops are sown where the organic matter has been regrouped and burnt.

LAND PREPARATION AND WEEDING

Some ethnic groups (the Kamu, the Pou Noy, the Ho and the Iko) weed the swidden field before sowing, using a small hoe. The crust of the top soil is thus broken with the advantage of drying some weed roots and also favoring the infiltration of rain water in the soil. This is a long -and

xhausting family activity mostly executed by women. One land preparation/weeding with handtools (= "sarclage" in French) requires a minimum of 100 hours of work per hectare.

The majority of shifting cultivators only conduct a simple weeding without land preparation (= "deserbage" in French) before sowing.

SOWING

Sowing is certainly the master activity in the shifting cultivation system, from a religious, traditional and social point of view. Sowing is generally preceded, for Buddists as well as for animists, chamanists or taoists, by feasts, prayers, songs and dances to wish for a good rice year. With the Iko, nobody is allowed to start sowing operations before the male community feast of the "Gnisholo" during which they welcome and celebrate the spirit of the forest, guard of the swidden fields.

Sowing is a happy festival regrouping the family in the rays. It is also the occasion for a copious pic-nic. Songs are heard from one valley to another. The Iko of the Long district even use noisy sowing tools (bamboo strips).

Sowing, as well as burning, must be achieved in one day by women, men and children. If the field is too big, the family will ask for help from friends. Each worker sows a quantity of seeds on an area he is able to weed. In a system with a short herbaceous fallow period of 2 years, the maximum is 15 kg of seeds per labour (0.2 ha). For a medium fallow period of 7 years, the maximum is 25 kg of seeds (0.35 ha). For a long fallow period of 20 years, the maximum amount of seeds per labour is 35 kg (0.5 ha).

Men are making holes every 18 to 25 centimeters using a dibble stick made of wood or rattan with a stronger or iron pointed end. Women with a seed bag attached to their waist come after, throwing 8 to 20 seeds per hole. With this operation being generally quick, 15 to 30 % of the seeds stay out of the holes.

Afterwards, rice seeds are not covered with earth, which increases the risk of loss by predators (ants, birds and rodents) or by the effect of climate (drying or expulsion from the hole under the pressure of raindrops). One can also wonder if the number of seeds sown per hole is not calculated according to these losses. The labour constraint for covering the seeds seems to be more important for shifting cultivators, than the constraint of losing half of their seeds which is generally the case.

The time required for sowing varies from 70 to 150 hours per hectare, according to the experience of the team. An average of 100 hours of work per hectare has been observed in Oudomsay.

With a density of 15 hills per square-meter and an average of 12 seeds per hole, the quantity of seeds is between 68 and 75 kg per ha with a maximum of 90 kg.

Rice is often mixed with maize in Northern Laos. Vegetables (gourds, cucumber), fruits (watermelon), spices (chillies, basilic) and tobacco are also seen in the same field with the Lao Theung but generally on spots where ashes are accumulated and on termite mounds. Cotton, cassava, indigo, groundnut, soybean and sesame are generally sown along the boundaries of the rice plots.

In the region of Vientiane, crops are often mixed in genuine associations (rice, groundnut, maize, beans), delineated with survival crops (cassava, tubers, bananas). In the South, in Champassack and Saravane, one can see associations between rice, maize, chillies, papaya and bananas. There is a great diversity in the different types of associations.

FENCING

Fencing is taking place before or after sowing, using non burnt wood and bamboo or by digging trenches or holes around the swidden field. The fence protects the field against buffaloes, cattle, horses, goats and also large wild mammals (sambar deer and wild boar in particular).

The time required for fencing is highly variable according to its quality. The minimum recorded is 50 hours/ha while 120 hrs/ha is considered as a maximum. It is an activity generally reserved for men.

WEEDING

Weeding represents the most labour consuming and the most tedious activity of the cropping cycle as well as the most limiting for production.

Indeed, the size of the family's swidden field is more often calculated according to the family labour available to maintain the corresponding area (weeding from May to August) than on the basis of the area needed for given target production figure. The target production comprises the self-consumption requirements and also the excess which will serve as means of exchange.

Thus it is easy to understand that large families without important proportion of manpower are disadvantaged and chronically deficient (with a negative consumption/production ratio). This deficit is aggravated when the fallow periods become shorter for two reasons:

- The soil fertility decreases steadily, from 2 tons/ha in forest of 15 years, to 1.5 tons/ha in forest of 8-10 years, to 1 ton/ha in forest of 5-6 years and 600¬800 kg/ha in forest of 3 years.
- When the fallow period shortens, the arborescent storey is replaced by a bushy storey and finally by a herbaceous storey. In this way, the shorter the fallow period the longer the time required for weeding.

As a conclusion, the shortening of the fallow period brings the shifting cultivator into a rapid process of poverty if he does not have access to other sources of production or income. The shorter the fallow period, the lower the yield per unit area, the longer the weeding operations and thus... the smaller the. family's swidden field. This process does not even allow the extensification of the system because of the limiting factor to production represented by weeding.

Weeding is an activity generally reserved for women and children. If the village is distant. they will often stay in the fields from May to October, with the head of the family insuring the contacts with the village and insuring the food. The fields are weeded at least two times. In Oudomsay, the time for weeding per hectare in 1992 fluctuated between 400 hours and 1,000 hours for fields cropped after a three-year fallow period.

In the provinces of Oudomsay and Luang Namtha, the studies on family production in 15 villages (750 families) have resulted in the following conclusions:

a. For a soil with potential yield of 1 t/ha in a normal year with a fallow period of 4 years

   Family with ratio manpower/family members = 1 Production largely self-sufficient

   (+ sales of surpluses)

   Family with ratio manpower/family members = 3/4

   Production hardly covering the requirements for self-consumption.

   Family with ratio manpower/family members = 1/2

   Family not self-sufficient except if family members who are not considered as manpower are less than 5 year-old.

   Family with ratio manpower/family members = 1/3 Chronic rice deficit in all cases.

b. For a same soil with a potential of 1.5 t/ha in a normal year with a fallow period of 7 years

   Family with ratio manpower/family members = 1/2-1 Production largely covering the self-consumption (+ sale of surpluses).

   Family with ratio manpower/family members = 1/3

   Production hardly covering the requirements for self-consumption.

ACTIVITIES CONNECTED WITH THE RAY

The activities of the wet season ray take place from February to November. It is the occasion for the shifting cultivators to do the following:

- Hunting in February-March during the return of the migrating birds.
- Collecting insects during the first rains in April in the cleared rays (crickets, cicades and carabs).
- Collecting bamboo shoots, growing after burning and mushrooms from May to June.
- Collecting the non burnt wood for family use, or for sale along the road.
- Collecting frogs during weeding and also bamboo shoots and other forest plants from June to September.
- Trapping birds and rodents at grain maturity in August-September.

HARVESTING

The harvest of early upland rice ("khao dor") starts at the beginning of August, but most of the work is taking place between 15 September and 15 October. In some humid and cool valleys a few fields are harvested in December.

Harvesting is a female and male activity. It is a family activity when the manpower is sufficient, but it is generally conducted with exchange of labour within the village. The duration varies according to the method in use. It takes more than 150 hours/hectare for the stripping method and about 100 hours/ha by cutting stems or panicles.

The Lao Loum and the Lao Soung cut the rice stems, let them dry for 3 to 5 days (sheaves are spread in the fields). If threshing has to wait for several days, until the end of the harvest, the sheaves are then put together in stacks, with the ears towards the inside, before threshing them in the field.

Some Lao Theung use this technique, but the majority of them harvest by stripping the panicles. This technique requires the grain to be well dry since it will be put in bags immediately. The harvest is generally conducted 8 to 10 days later than for the same variety harvested by cutting and collecting sheaves. The grain falls in a satchel or a basket attached to the belt, and is then transferred into a jute sack. Many Lao Theung (for example the Kamu Lu, the Kamu Rok and the Ka Bid), also put a satchel on their bag in order to select on the spot the bigger seeds they will use for the next season. This technique has certainly allowed, from generations after generations, a mass selection for each variety used.

THRESHING

This family activity takes place in the fields after harvesting by reaping the rice crop. When harvesting is done by stripping, threshing is avoided.

The Lao Houay of the provinces of Luang Namtha and Oudomsay (Miao-Yao linguistic family) are the only ones who harvest rice by reaping without threshing. The rice sheaves are directly stored in the rice barns and the houses.

TRANSPORTATION AND STORAGE

Transportation is generally a male activity. It is restricted when the granaries are built in the fields but it represents a tedious task when the granaries are in the far-away village. The Lao Soung may use horses for transportation, some Lao Loum use the buffalo or an oxcart if the relief allows it.

Each rice barn is generally belonging to one family but it can regroup several families when the settlement units are plurinuclear (Lao Houay, Yao, Iko). They can be located in or under the house (some Lao Loum and some Lao Soung), in bamboo jars sealed off with cattle dung (Lao Loum, Thai Dam, Thai Deng, Thai Khao), in bamboo or wooden granaries on stilts (Lao, Kamu,

Lamet, Ka Bid, Samtao, etc.) and in sophisticated wooden granaries (Lao Theung Hoy and Tchieng in the province of Attapeu).

Bags are emptied in rice barns located in the fields for the traditional Lao Theung populations (Katou, Atak, Lavai, Sadang of Sekong and Attapeu and some Lao Soung ethnic groups).

With the Kamu, the rice granaries are often regrouped outside the village fence to protect them against an accidental village fire.

With the Lao Loum, the granaries are mostly found in the village.

2.3 Practices for the dry season

From September to April, some of the sloping land is used in rotation after the wet-season crop:

- opium poppy after maize (October-March in the North);
- melon and watermelon after rice;
- pasture after rice (Phonsaly, Houaphanh, Xieng Khouang)
- thatched roof grass after rice (North of the country)
- vegetables near the village when irrigation water is available.

One can notice that the land is harrowed for opium poppy cultivation and that some villagers collect the cattle in the villages to increase the yields (Hmong villages in the Nam Bak, province of Luang Prabang). The field is then generally used for a minimum of 3 years to grow opium poppy.

2.4 Organisation of the activities

Regarding the way slash-and-burn activities are organised, each village has its own formula and it is difficult to give an average description of this organisation. One can simply note a general trend from a community-based organisation of the works towards a more family- or individual-based system.

Traditionally the Lao Theung and the Lao Soung villages were divided into groups of shifting cultivators (8 to 15 families per group) and all the activities except weeding, threshing and transporting were communal within each group.

Presently, the groups are still existing but only clearing and sowing are compulsory community activities. For the rest, the families try to rely on themselves otherwise they request assistance to the group to which they belong. Burning, weeding, fencing, threshing and transporting are most often family activities.

With the Lao Theung Kamu Rok of Houn district, the groups of swiddeners are formed in February by the head of the village according to their geographic desire for swiddening. At the end of February the head of the village gives the greenlight to each group for delineating the family plots on the land previously negotiated between the groups and himself.

Each group of swiddeners will report the partitioning to the head of the village in order to be able to start clearing operations.

The means of regulation for the land tenure system are difficult because the exploited area is naturally limited by the capacity of the family manpower. The only possibility is to ask for manpower assistance which in fact is rather a kind of labour exchange.

3. The different production systems

3.1 The diversity criteria for the production systems

The different village studies conducted from 1989 to 1993 in 10 provinces of Laos (Oudomsay, Luang Namtha, Phongsaly, Xieng Khouang, Sayaboury, Luang Prabang, Saravane, Champassack, Sekong and Attapeu) have allowed to set the criteria for hierarchy which explain the practices of slash-and-burn and its diversity:

a. The ethnic group

Swiddening is a production mode linked with an ethnic tradition, mainly kept by the Lao Theung populations (Austro-Asiatic linguistic family, sub-family Mon-Khmer) and the Lao Soung populations (linguistic families Miao-yao and Chinese-Tibetan). The minorities of the linguistic family Thai, originating from North Vietnam and China, also maintain that practice but to a lesser extent. Differences of practices are linked to their traditional ethnic habits. Those practices could have been modified through mixing of ethnic groups (migrations) and exchanges of knowledge.

b. The policy of protecting forests

The policy pursued by the Government is now becoming the second factor explaining the diversity of the practices. This phenomenon is relatively new (last 10 years). It has had the effect of reducing the swiddening village territory at levels calculated differently according to the provinces.

The village territories as authorised in Luang Prabang, Xieng Khouang or Houaphanh allow a maximum fallow cycle of 4 years. In Oudomsay, Luang Namtha and Phongsaly, fallow cycles of 6 to 8 years are still tolerated. In Sekong and Attapeu some remote ethnic groups are left with fallow cycles of more than 15 years.

The policy of protecting the forests is known in all the visited villages and the villagers have changed their attitude towards the forest. The behaviour has been modified in more than 60 % of the studied cases, by reducing the fallow cycle, by looking for land in the plains, by progressively changing their farming activities (coffee, pineapple, small trade, livestock, service activities, etc.), or by seeking rural seasonal jobs, but also by splitting villages or migrating to find new territories for swiddening.

For example, since two years a migration flow of Hmong and Kamu communities has been observed from Xieng Khouang and Houaphanh towards Luang Namtha and Oudomsay where the provincial fallow policy is more flexible. These migrations are survival reactions with some communities going to the point of selling their cattle to finance their trip.

The Kamu also move from the Northeast of the country towards the North of Vientiane province and settle-in along the roads in the hope of finding a job or organising some small trade.

c. The population density

The more the population density increases, the more the relative natural resources connected to the territory decreases per village. When other swiddening territories are available the traditional swiddening system persists. It is estimated that the maximum density for swiddeners in Laos in average soil conditions is 12 persons per square kilometer of forest. In these conditions the fallow periods are long enough to insure good yields, without significant degradation of the soil and with a permanent regrowth of the forest cover. These conditions still exist in Sekong, Attapeu, in the North of Phongsaly and to the East of Luang Namtha.

If the density exceeds 15 inhabitants per square kilometer of forest the fallow cycles decrease. With 20 inhabitants per square kilometer, some villages are looking for other less populated territories, and some other villages try to find local solutions of regulation (gathering, vegetable gardening, temporary jobs, small business, small animal husbandry, etc.)

If the density is higher than 25 inhabitants per square kilometer of forest and there is no more territory, as around Luang Prabang, the reconversion of the production system must be very quick: searching for irrigable land to produce lowland rice in the plains with double cropping if

possible, searching for jobs, intensification of production and processing of farm products, in connection with the market demand (jam, weaving, sugar bread, etc.). The modification of the production system is recommended to avoid the degradation of the rural socioeconomic and physical environment.

d. Marketing possibilities

Rural communities rapidly adapt their production systems to the new demands of the market. This criterion is presently affecting only a minority of shifting cultivators who have access to the market. The others are far from the markets and used to inter-villages exchange systems.

It is yet interesting to see the rapid evolution of the production systems due to the opening of a border, to the establishment or the rehabilitation of an access way, to the creation of a local market, to the access to local marketing information through television, etc...

Sooner or later, the swiddening populations of Laos which are not yet affected by the demand of the market will be confronted with that. The economic attraction sometimes occurs at the expense of the natural resources, and is often accompanied by an increase of the socio¬economic differences between the rural groups.

e. The quality of the soil and the biomass.

For a same ethnic group and the same overall production system, swiddening practices and the work calendar could be different according to the quality of the soil and the vegetation.

For instance, some Hmong of the Nonghet district, in Xieng Khouang province, on clayey and fertile soils, exploit the same plot for 2 to 3 years before leaving it to fallow. If the topography allows it, draft buffalo will have been used for plowing before sowing, especially for opium poppy. The clay proportion of the soil is a condition inciting the swiddeners to build some terraces to retain water and cultivate rice.

On the other hand, the families of the same village after coming to Oudomsay have had to modify their practices according to the soil, less fertile and more sandy. The land is only used for one year before being fallowed. Ploughing and weeding are of very little use on sandy soils, especially if the yields stay low. On sandy soils, it is preferable to favor varieties with a short cropping cycle to decrease the risks in case of drought at the beginning or the end of the cropping cycle. Building terraces would only bring additional tasks without yield increase. With the annual change of plots, the family territory of exploitation is wide and time required for walking and transporting is more constraining for the working calendar.

f. The micro-climatic conditions

The combination of the altitude, the topography, the orientation of the slopes and the geomorphology of the swiddening territory is contributing to the specific micro-climatic conditions for production (called the "station effect"). These particular conditions often explain differences in practices and differences in plants or cultivated species.

3.2 The different shifting cultivation practices in the family production systems

As we have seen, the swiddening practices are conditioned by the ethnic group and the evolving environmental conditions. The combination of these conditions or criteria of differentiation define different farming systems. These farming systems could be classified in categories at the provincial or at the national level.

Several entry points could be envisaged. For example table 2 gives some possibilities of categories for cropping systems based on slash-and-bum practices.

The diversity of shifting cultivation is unknown in Laos and yet there exist very specific systems:

- In the province of Phonsaly, in the districts of Khoua and Samphan, the Kamu have been associating the rays and the benzoin trees from which they collect the resin since a long time. These trees are inherited although the owner of the trees does not own the land where they grow.

- The swiddening systems of the Lao Theung Rok in the South of Oudomsay are examples of ecology. They combine a small wood system, with a wind break and anti-erosion hedges. Clearing is neither done on the summits, nor on the accidental steep slopes. The trees of more than 30-40 cm of diameter are solely pruned and saved from the fire to allow their regrowth. After the emergence of the rice seedlings, the weeds are cut and put in small piles in the field, constituting shelters and thus traps prepared by manpower for frogs, lizards and small rodents. These small animals are collected every day. In August and September, bamboo fences are set in the rice field, with an opening every 5 to 10 meters. Each mouse or rat passing through to eat the rice is caught in a striking trap. All these animals are contributing to the nutritional improvement especially in proteins for the family.

4. Advantages and disadvantages of the swiddening systems compared to sedentary practices in the plains

4.1 The advantages

a. The quality of the harvested products.

The criterion of palatability is often the main one for the choice of a variety by a farmer from the forest. In general they find the varieties cultivated in the plain rather tasteless. The most surprising thing is that many lowland dwellers and city dwellers also find them tasteless. Each one attributes this particular flavour to the practice of burning and thus to the ashy earth. It is very clear that in the markets, the products from the rays (vegetables and fruits in particular) are highly praised. Even if they are more expensive the quality is recognised.

Table 6: Cropping systems

CROPPIN SYSTEMS	WET SEASON SWIDDENING						DRY SEASON SWIDDENING			
CHARACTERISTICS OF THE COMMUNITY	RICE		OTHER CROPS				Food crop	Cash crop	Survival crop	Opium
1. SWIDDENING PRODUCTION/ TOTAL PLANT PRODUCTION (family or village) - > 80% swiddening - > 50% and <80% swiddening - > 20% and <50% swiddening - > 20% swiddening 2. CROPPING SYSTEMS BY ETHNIC GROUP - Lao Loum system - Lao theung system - Lao Soung system 3. CROPPING SYSTEM/ DEMOGRAGHY - < 12 inhab. /km2 of forest - < 20 inhab. And > 12 inhab. /km2 of forest - < 25 inhab. And > 20 inhab. /km2 of forest - < 25 inhab. /km2 of forest 4. CROPPING SYSTEM/MARKET										

- Daily market										
- Market 1 to 2 per week										
- Market 1 to 2 per month										
- Market 1 to 2 per year										
5. CROPPING SYSTEM/LANDFORM										
- Slope & warm plain 150-400 m										
- Slope & half-warm plain 400-700 m										
- Slope & cool plateau 700-1,000 m										
- cold slopes > 1,000 m										

b. The low requirement in equipment and capital

One must recognise the knowledge and the capacity of the swiddeners who are able to make their living out of an environment not very advantageous, sometimes even hostile, by using simple means affordable for anyone.

The tools consist of a knife or a chopping knife forged in the village (possibly a big saw for the big trees) for clearing, the same tools for fencing, a dibbling stick for sowing and sometimes a small hoe for weeding if the knife is not used. If harvesting is done by reaping a traditional sickle is used.

2In the plain farmers use the plough, the harrow, the leveller, the hoe, the shovel, the knife and the sickle.

c. The low financial charges per hectare.

Swiddening is an extensive practice which only requires seeds and manual labour as charges. This advantage is significant in the context of a local economy with very little trade if compared to a lowland system where it is necessary to finance community work for water supply, the annual maintenance of a draft buffalo, the most sophisticated tools, without speaking about fertilisers, insecticides, as well as herbicides and fungicides which will ultimately be used even in small quantity.

d. The nutritional quality of life in the forest

The nutrition studies conducted in more than two hundred families growing crops only under shifting cultivation (Oudomsay and Luang Namtha in 1992 and 1993) show that the rate of malnutrition does not exceed the 4 %.

The diet is generally more varied than for the rural populations in the plains. Indeed, the nearly daily hunting products (birds, rodents, insects, batrachians, reptiles and molluscs) together with products from gathering are filling the gap in terms of energy and vitamin deficiencies. The studies show that the low rate of malnutrition are often due to sanitary problems weakening the organism.

The forest is thus not only serving as a safety valve in case of food shortage but also a permanent food reserve with various products (more than 200 animal and forest plant products were identified in the market of Oudomsay in 1993).

e. The health in the highlands

The farmers of the forest very rarely go to modern health services which they very often ignore. In any case the recovery is a matter of spirits complemented with traditional medical care.

The animist ceremonies for recovery, even if they are not always efficient, have at least the advantage of being the occasion for having a meal accompanied by meat. These different ceremonies thus contribute to the improvement of nutrition. The sacrifices of animals are becoming less frequent in Northern Laos but they are still important for the Lao Theung in Sekong and Attapeu (Laval, Lave, Alak, Katou, Sadang, Talieng, Tahoy, Hoy, etc.).

The populations of the lower slopes are as sensitive as the populations of the plains to malaria, diarrhoea and respiratory infections, but they suffer more of it because access to health services is more difficult. The highland populations avoid these diseases more and benefit from generally safer water.

f. Maximum exploitation of the territory

In forest settlements natural resources, if not degraded, offer possibilities which are incomparable with those of the plains. Bamboo, wood, palms and rattan are the materials for houses, barns and fences. Hunting and gathering insure nutritional complements which are varying with the seasons and represent a food security stock. Bamboo shoots and limestone are used for bamboo paper production. The plant biomass and the humus are at the foundations of the production system. The orientation of the slopes, North or South, and the elevation scale represent the natural means for crop diversification and for spacing out the activities.

All the resources put together insure the autonomy of functioning for the populations of the forests and the maintenance of the diverse family activities.

g. The maintenance of a community spirit

It is generally recognised that foresters and woodcutters are much less individualistic than ordinary farmers. This fact is partially explained by the differences in terms preoccupations between these two groups (annual for the farmer and connected to the wood cycle for the forester).

For the farmer of the forest, the concern for production is a daily one, but it could not be envisaged without a minimum of community work difficult to avoid. The expression " Unity ,makes strength" is really becoming important in this case. Indeed, the swiddening system is so extensive and the labour productivity for rice production is so low that the condition for changing from hunting and gathering towards agricultural production requires a vital mutual aid. The individual who would try to step away would quickly return to the stage of hunting and gathering.

This community spirit is thus insuring the necessary cohesion and mutual aid to pursue and improve the production system by swiddening.

4.2 The disadvantages

a. Ecological

- The atmospheric pollution by release of important quantities of carbon dioxide (acidity and greenhouse effect).
- The erosion and the destruction of the soil structure if the fallow periods are short. The soil loses its arable layer by the combined effect of physical factors (run-off and gravity effect) and, to a lesser extent, of climatic and chemical factors.
- The simplification of the natural ecosystems by the reduction of plant and animal biodiversity, called biocenosis. The ecosystem, considered as the ecological unit, consists of a complex equilibrium between the climatic conditions, the associations of animals and plants and the mineral substratum on which they feed. A simplification of the biocenosis through swiddening results in a new equilibrium generally less stable and less protected from external aggressions (man, climate, pests, etc.)

- The uncontrolled fires.

b. Human

- It is an extensive system with a low labour productivity (without considering the products from hunting and gathering). In Oudomsay, the studies of the UNDP small scale irrigation projects (LAO/89/029 and LA0/89/CO3) have led to the estimate of 1,600 hours of work, equivalent to 200 man.days, per hectare of upland rice (in 5 % association with maize) on a three-year fallow. With an average production of 1.4 t/ha, the labour productivity is 7 kg of paddy per day of labour, which is 3.5 times lower than the productivity of an irrigated lowland system in the same region. In this case, it is becoming preferable to look for a salaried job insuring a daily income of 10 kg of paddy. The estimated labour productivity from the above-mentioned studies ranges from 2 to 11 kg of paddy per day of labour.
- The difficulty to insure family food self-sufficiency because of the low productivity of labour and the bottlenecks for production represented by the short fallow period and weeding. When a family has a low proportion of work force it brings the family to chronic food shortages.
- The low capacity and weak motivation for capitalisation and access to new techniques because of isolation, to improve the socio-economic situation of the family.
- Very limited access to education and health services (because of the distance, the lack of cash and also by ignorance). Education would often allow to provide the useful information to solve some problems. Health would solve several problems in connection with reproduction aspects of women. The improvement of health care against malaria and diarrhoea would significantly increase the labour availability. Education, on the other hand could lead to a reverse situation, by the poverty awareness and the subsequent decision for migration and reconversion. The population increase due to health care must be compensated by an increase of production at least equivalent to the requirements.

c. Natural

- The climatic conditions and, in particular, the drought spells. With a minimum of 15 days without rain during the vegetative stage of the rice cycle, yield losses are becoming considerable.
- Predation by animals is common, but it is controlled by fences, traps, guns, crossbows, catapults and an almost continuous surveillance of the swidden fields. One can generally observe more than 5 trapping systems in a field which are installed at precise different periods. The regular predators are rats, field mice, grasshoppers and caterpillars. In the case of still wild areas, wild boars, porcupines, barking deers, monkeys and sometimes elephants are causing damage. But among the mammals, buffaloes, cattle, horses and goats are the ones causing the most important damages. Birds could intervene at the beginning of the migrations, in September and October, at harvesting time.

d. Economic

The loss of the arborescent biomass when it is not burnt nor taken over after clearing is an economic loss in terms of wood with commercial value. In ecological terms the loss is not evident. It is estimated that during the clearings, no more than 30 % of the trunks of more than 20 cm of diameter are mineralised during the burning (trunks not dried and insufficient fire).

5. Natural evolution of the shifting cultivation production systems in Laos

The swiddening systems of Laos are continuously evolving especially because the farmers are constrained by the decrease of the natural resources and the necessity to feed themselves. The solutions are unfortunately not always sustainable thus provoking socioeconomic and environmental degradations.

The natural evolution of the swiddening systems, in fact rather conditioned by the overall national dynamics (natural resources, policy, demography, economy) are summarised in table 3.

6. Conditions for accelerated modification production systems of the slopes

As shown in table 3, some solutions have already been found by the farmers of the forest to offset the decreasing resources and village territories. Sometimes they were assisted by projects under national or international assistance.

It is interesting to note that the access to lowland paddy fields, to markets (cities or borders), to new techniques (information, training, demonstrations, examples) and to particular micro-regional modifications have induced some modifications of attitudes and behaviour.

The catalyst of modification seems to be less the technique in itself than the insurance of favorable conditions for adoption of the new technique.

It is clear that the rehabilitation of an access road to a market could activate a commercial flow which could not be induced by any assistance without considering that access.

Table 3: Evolution of shifting cultivation systems in Laos, Laurent Chazee

Table 7: Evolution of shifting cultivation systems in Laos, Laurent Chazée

CAUSES OF EVOLUTION	EFFECTS ON THE SUYSTEM	RESULTS	GEOGRAPHIC ZONES
ENOUGH NATURAL RESOURCES – SPACE IN NOT RESTRICTED	TRADITIONAL SWIDDENING LONG FALLOWS OR SHIFTING SYSTEMS (10-20 YEAR FALLOW)	- Food self-sufficiency - Conservation of soils and of forest regeneration	Attapeu, East-Sekong East of Saravane, of Savannakhet of Khammouane, South of Luang Namtha
SPACE LIMITATION (policy effect or population growth)	REDUCTION OF FALLOW PERIOD WITHOUT MODIFICATION OF SYSTEM (8-12 YEAR FALLOW)	- Decrease of production compensated by other family activities - Traditional activities of hunting fishing, gathering and temporary jobs are increased	Oudomsay, Luang Namtha, Phongsaly, Bokeo, North of Luang Prabang, Champassack, Saravane, Khammouane Sayaboury
	IMPORTANT REDUCTION OF SPACE (3-8 YEAR FALLOW)	- The village splits and look for new land - Migration to cities or along roads - Insufficient traditional regulating activities – increased diversification of activities - Serious food problems	Xieng Khoung, Houaphanh, Phongsaly, Sayaboury
FREQUENT OR CHRONIC FOOD DEFICIT WITH THE SWIDDENING SYSTEM	FOOD CONSTRAINT IMPOSES A MODIFICATION OF THE PRODUCTION SYSTEM		
1 NO SUSTAINABLE SOLUTION	---------->	- Impoverishment ---> search for temporary jobs ---> increased diversification of activities ---> sale of	Especially in Xieng Khouang and Houaphanh. Some in Luang Namtha, Vientiane, Luang

		capital ---> exodus ----> social destructuration ---> misery or reconversion	Prabang
2. ACCESS TO MARKETS AND NEW TECHNIQUES	---------->	- Production centered on market intensification on sloping land with associations and seasonal management of the crops - Cash crops on slopes-coffee-wood-fruits… - Reconversion in trade, livestock, handicraft….	Sub-urban zones and frontier zones Champassack, Saravane, Suburbs, borders, pastures
3. ACCESS TO LOWLAND AND WATER	---------->	- Modification of production system into a sedentary lowland system	Wherever possible
4. ACCESS TO PARTICULAR CONDITIONS	---------->	- Clayey mountainous paddy fields or terraces with irrigation possibility - External assistance	Phongsaly, Houaphanh, Xieng Khouang. Everywhere

Examples of spontaneous modifications of the production system without any direct technical assistance are numerous in Laos and are linked to conditions which have become favorable (at least in the medium term). Here are some examples:

- the example of coffee on the Bolovens, with the migration of the populations coming from Sekong, Attapeu and the district of Tahoy after the rehabilitation of the road in 1990 between Saravane and the Thai border. The access to the market became permanent, main-condition which has motivated the mountain dwellers to abandon their rays.
- the example of the rehabilitation of the road Vientiane - Kasi which attracts the Lao Theung populations and stimulates them to produce products for the Vientiane market (peanut, maize, soybean, improved pigs, etc.).
- the rehabilitation of road 7 between Kasi and Phonsavanh will certainly become the key factor for the development of cattle and buffalo raising in the province of Xieng Khouang.
- the example of Thailand and its markets in the border areas which have originated numerous modification of the production systems, with for example the production of vegetable seeds, the drying of agricultural products, weaving, etc.
- a project of paddy land or irrigation development attracts spontaneously some swiddening villagers persuaded by the efficiency of a sedentary lowland agricultural system in which they see the sole possibility to change their production system and to become self-sufficient in food.

One can thus note that the reaction of a farmer to a technique or to a new production system is conditioned by its usefulness in the local socio-economic environment. Thus, a Lao farmer of the Lao-Thai frontier zone has a lot of interest, taking into account the terms of exchanges, to adapt himself to the demand, since the profit will justify any sacrifice. The same Lao farmer at The Lao-Chinese border will have more interest in keeping his subsistence production system because the Chinese products are 25 % less expensive and the terms of exchanges are not favorable.

On the other hand, several examples of assistance have shown that the proposed techniques have not been, or have only partially been adopted by the target groups although the same technique has been accepted in Thailand, in Phillipines or elsewhere. Yet, they were not acceptable for the Lao farmer in the local conditions which were often not even studied.

How to explain that at just a few kilometers of distance, a village of swiddeners does not want to settle in the plain, whereas another is requesting it?

It is necessary to study it before proposing a new technique or a new system otherwise, if one begins in the two villages:

- The first village will have a passive attitude, the assistance will have to demonstrate everything, will be long and costly and the results will be uncertain. The assistance will be experienced as a constraint.
- The second village will show a participation and a quick response to any new proposal, the objectives of the assistance being consistent with the village objectives.

The big difference between the two villages is that the first perceives the new system as having a rather negative socio-economic impact (no insurance in terms of land tenure, water and health, linguistic problems, loss of forested land, loss of traditions, etc., which are not compensated by the possible economic gain), leading to a psychological blockade to modify the system (he does not believe in it), whereas the second perceives the socio-economic balance of the new system as advantageous (access to markets, to health care, to education and above all to food security).

These examples are sufficiently showing that the quickest and most economic development changes in Laos will be undertaken by the populations themselves. It is just necessary to create the appropriate conditions to launch the development in the good direction. The technique must only come to support the dynamics of development which has already started and which is convenient to assist.

SOME EXAMPLES OF CONDITIONS TO RESPECT BEFORE INTRODUCING ANY AMELIORATION OR MODIFICATION IN A SWIDDENING SYSTEM

/1/ If the farmer goes from sloping land production to lowland production.

- Insure his access to land (and to water in case of irrigable land).
- Insure the information and sufficient health care for a minimum of 3 years if he moves his house from the mountain to the plain.
- Insure a credit service for the purchase of a vaccinated buffalo for animal draft.
- Insure the access to a technique and integrate him in the community water management system, techniques management system, etc.
- Insure a literacy programme and a Lao language training programme if the farmer does not speak Lao and wishes to be able to read and to write; this will avoid communication problems.

/2/ If the idea is to improve the cropping system of the sloping land

e. By the introduction of cash crops (coffee, tea, castor, etc.)

- Which villages or which families are interested?
- Are the soils, the territory and the climate suitable?
- Are the markets and the access reliable? Are the prices sufficiently attractive with the cost of transportation and according to the quality of the demanded products?
- Which are the other conditions concerning the villagers (credit, equipment, pre-financing of the crop, access to production and processing techniques?

f. By a system less degrading for the environment.

- What is the efficient indigenous knowledge? and what are the conditions for its functioning?
- In case of prior assistance, what is still there and why?
- What are the opinions of the villagers and their objectives in the long run?
    - If the idea is to try the establishment of terraced paddy fields, the essential conditions seem to be: soil with more than 40 % of clay, fertile and possibility of irrigation by canal or lateral run-off, to insure the renewal of the fertility and a yield higher than 3 Uha in order to compensate for the constraint of establishment and maintenance of the terraces.
    - If the idea is to develop the sloping land to grow annual cash crops alone or with associated food crops the response will be facilitated if the access to the market is insured.
    - If the idea is to improve free-grazing animal production (cattle and buffalo), it must correspond to a desire from the population and to the development potentials of pasture and forage crop resources. In this case, a permanent access suitable for vehicles is essential to initiate the dynamics which must be assisted by a veterinary service and credit services.
    - If the village is isolated, not integrated in the monetised economy, without access to Lao language, a minimum of education and to new techniques, a technical tentative of development will have very little chance of impact. A communication network, a market and access to education are prerequisites for stimulating the adoption of a new technique.

7. Actions undertaken by the small scale irrigation project in Oudomsay and Luang Namtha to reduce shifting cultivation practices

The objectives of the project are the following:

1. Reduce slash-and-burn practices through the development of irrigation schemes for the population who want it and to whom irrigable land has been allocated.
6. Insure food self-sufficiency and increase the income for these population groups in a sustainable manner by assisting them to organise the management of the new systems.
7. Assist the population according to the other priorities in order to generate more income which in turn may serve to finance the social ameliorations.
8. Train the local authorities {province, district, village) and the design and construction companies in planning, managing and implementing development programmes.

The project is thus working with people that have decided to change their production systems and produce rice from irrigated paddy fields only. The long technical and socio-economic studies have permitted to establish contracts for the development and the utilisation of the new schemes to be constructed. The contracts between the village community, the local authorities and the project are specifying the respective responsibilities of each partner, the modalities of execution and functioning and the overall strategy for development. In the contracts it is also planned to protect the watersheds of each stream used for irrigation.

The criteria used to allocate the new land allow to insure food self-sufficiency for at least each family in the scheme. The self-sufficiency is attained either by having enough land or through a better yield by unit area (improved variety, introduction of compost, better water management, maintenance of the system).

The increase of incomes is insured through the development of parallel economic activities.

The entire development plan thus insures a progressive but total transfer of the rice production from the slopes to the plains (the other secondary crops could be maintained, like maize, cotton, sesame, etc.). As a matter of fact, the availability of manpower becomes a necessity to intensify the systems in the plains and the social and economic benefits, if they are positive, do not incite the villagers to come back to the slopes.

The project, by creating 300 new hectares and increasing yields in 250 old paddy fields indirectly allows to save 120 hectares of forests per year, and 600 hectares considering the swidden/fallow cycle. The same level of production would be reached by cultivating 900 hectares per year, which means by clearing 5,000 hectares in a swidden/fallow cycle.

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THE DIVERSITY OF SHIFTING CULTIVATION IN LAOS

Preliminary field observations from the Nabong area

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INTRODUCTION

This brief paper is based on observations made in different provinces of the Lao PDR with emphasis on upland cropping systems found in the Nabong area, Vientiane prefecture. The article is also based on a slide presentation I presented during the Nabong technical meeting. Because it was difficult to reproduce the slides for this report, only a selection of black-and¬white photos taken in the Nabong-Naphok area are presented to illustrate the observations.

THE DIVERSITY OF SHIFTING CULTIVATION SYSTEMS IN LAOS

In Laos, shifting cultivation systems show a lot of diversity at different levels:

- at the regional level (i.e., agrarian system, agro-ecosystem. farming system)
- at the village level (i.e., village production system)
- at the farm unit level (i.e., farm production system)
- cultivated plot level (cropping system)
- herd, flock or pond level (animal husbandry system)
- tree level (agro-forestry system, silvicultural system)
- farm products level (marketing & processing system, post-production system)
- wildlife level (natural resources management system)
- family level (socio-economic system)

These levels of agricultural systems are based on a very simple approach that I have developed at the Nabong Agriculture College for government civil servants who are being trained to become either cropping systems specialists (or "agronomists") or animal husbandry systems specialists (or "zootechnicians"). The curriculum is centered on the general concepts of agro-ecosystems analysis which I have adapted .to the Lao context and have used in teaching a new integrative course of general agronomy. Systems approaches in agriculture have the advantage of facilitating the integration of education, research and development activities.

My observations on shifting cultivation systems have been collected over 8 years in the provinces of Vientiane, Houaphanh, Xieng Khouang, Oudomsay, Luang Namtha, Phongsaly, Savannakhet, Luang Prabang and Champassack as well as in the prefecture of Vientiane. The diversity of systems is great, due to topography, soil resources, forest resources, altitude, latitude, population density, ethnic group, local policy and market accessibility. For example, shifting cultivation systems observed in the mountainous Hmong villages of the northern provinces are quite different from those practiced by the lowland Lao or the resettled Hmong in the Vientiane plain.

CROPPING SYSTEMS IN SWIDDEN FIELDS OF THE NABONG AREA

Preliminary field observations were made in swidden fields around Nabong. One of the most interesting periods for visiting cultivated plots is at the beginning of the cropping cycle when plants do not yet cover the soil, which makes it easier to conduct field observations on crop¬soil-climate interrelationships. The diversity at the plot level, the crops grown, and farmers management of the field were observed.

Intra-plot diversity

One of the most important characteristics of swidden fields is the micro-site diversity within each field. Two contributing factors are topographic variations from one point to another and soil (texture and structure). Burning also results in micro-site heterogeneity due to uneven distribution of ashes. Stumps and trunks add to the variability as well as the presence or proximity of natural forest trees. Termite mounds are common in swidden fields (also in paddy fields) of the Vientiane plain and dramatically increase the heterogeneity of the plots. Lateritic outcrops are also often seen in upland fields of the Nabong area. Sometimes not visible at the surface, laterite can easily be observed in the soil profile. It was visible at 40¬100 cm depth in many places of the Nabong college farm.

Crops

A wide range of crops are grown in the swidden fields of the Nabong area. These swidden cropping systems of the Nabong-Naphok area should be considered as mixed cropping systems even if upland rice is the most important component of the system. The systems can be defined as "upland rice-based mixed cropping systems". The following crops were observed either in the same or in separate fields: upland rice (Oryza sativa), maize (Zea mays), cassava (Manihot esculenta), groundnut (Arachis hypogea), cotton (Gossypium hirsutum, G. arboreum), Job's tears (Coix lachryma-jobi), sesame (Sesamum indicum), rice bean (Vigna umbellata), yam bean (Pachyrrhizus erosus), yardlong bean (Vigna sesquipedalis), amaranth (Amaranthus sp.), sorghum (Sorghum bicolor), watermelon (Citrullus lanatus), squash gourd (Cucurbita maxima), cucumber (Cucumis sativus), sweet melon (Cucumis melo), pumpkin (Cucurbita moschata), several other cucurbits, sweet potato (Ipomoea batatas), yam (Dioscorea sp.), Amorphophallus sp., banana (Banana sp.), pigeon pea (Cajanus cajan), roselle (Hibiscus sabdariffa), taro (Alocasia sp.) and other less common crops. Farmers also grow crops around their houses or in other fields including rainfed lowland rice, fruit-trees (mango, guava, jujube, papaya, tamarind, coconut, star apple and citrus) kapok, vegetables and spices.

Farmer's management of the fields

Even without interviewing the farmers, it is possible to see that the apparent disorder of a swidden field is actually a management system adapted to the high level of heterogeneity encountered in the field. For example, termite mounds are used for planting cotton, Job's tears, papaya, cucurbits, roselle and even upland rice. Cassava and maize, although commonly seen in upland rice fields, were never observed on termite mounds, reflecting the logical way farmers place their crops in a field. Cassava is often planted along the borders of the field, sometimes with maize, beans and Job's tears. In some upland rice fields, maize plant density was higher in lower micro-sites where an accumulation of good soil was caused by water run-off. Cucurbits are grown in association with upland rice in most fields, and preferably sown in micro-sites where ashes are concentrated.

Weeds

As in many other parts of the country, weeds often force shifting cultivators to abandon a field after one or two years. Chromolaena odorata is common but is not necessarily the most significant weed. It is very common along the road, in shrubland near Nabong college, and in field fallows. Weeds were not systematically observed in farmers fields but they were recorded in the fields of the Nabong college. In the upland fields of the college farm, I have observed the following species: Aeschynomene americana. Ageratum conyzoides. Ludwigia octovalvis, Axonopus compressus, Borreria repens, Cassia tora. Chrysopogon aciculatus, Crotalaria pallida, C. goreensis, Digitaria sp., Echinochloa colona. Eleusine indica, Hyptis suaveolens, Ischaemum rugosum, Imperata cylindrica, Mimosa pudica, Panicum walense, Pennisetum polystachyon. P. pedicellatum, Sacciolepis indica and Sida acuta. It appears that Hyptis suaveolens is a new and aggressive weed in some places. Some farmers have serious problems with bamboo and use strong metallic tools to remove them from the fields. Mimosa invisa also occurs in some places. Weeding is most often done by women and children.

ANIMAL HUSBANDRY SYSTEMS OF THE NABONG AREA

Animal husbandry is an important activity for most shifting cultivators. In the Nabong area, farmers raise cattle, buffalo, pigs, goats, chickens, ducks and turkeys. Communal free grazing is widely practiced. There are heavily grazed areas between the college and the Burapha farm where the vegetation is now composed of Axonopus compressus and Chrysopogon aciculatus with Chromolaena odorata, sometimes Imperata cylindrica, in association with different shrubs including a bamboo commonly eaten by the cattle. Upland fields are always well protected with different types of fences. There are a few fishponds in the villages of the area. Small fish are caught in streams (Nam Ngum river and tributaries) during the wet season. The practice of cut-and-carry has been observed as an animal feeding practice. In the dry season, after the rice harvest, lowland paddy fields are commonly used as grazing areas. Natural pasture species include Axonopus compressus, Bothriochloa sp. Chrysopogon aciculatus, Hymenachne sp., Imperata cylindrica, Sacciolepis indica, Desmodium sp., Pennisetum polystachyon and Sacciolepis myosuroides. There are also many different local unidentified legume trees and shrubs.

ILLUSTRATIONS

The photograghs of the following pages were taken in the Nabong-Naphok area a few weeks before the Nabong meeting, (end of June - beginning of July 1993). The pictures focus on the cropping systems at the level of the cultivated plot. Explanations are given with each photo.

CONCLUSIONS

These preliminary observations on shifting cultivation systems in the Nabong area support the following conclusions:

- shifting cultivation is practiced by all the major ethnic groups of Laos in a wide range of conditions;
- there is great diversity in the shifting cultivation systems of Laos, and therefore using a flexible systems approach is required when attempting to propose and test innovations;
- as a result of population increase, shifting cultivation is increasingly practiced in the Vientiane prefecture just a few kilometers from the capital; every year there is more land under shifting cultivation in the Nabong-Naphok area.
- in the Nabong area, although upland rice is the major upland crop, it is always grown in association with other crops such as maize, cassava, cotton and banana.
- the micro-site heterogeneity of the cultivated plots observed in swidden fields requires new on-farm research methodologies such as the so-called "agronomic diagnosis" being developed at the Nabong college with the assistance of the Lao-French/CCL project;
- the indigenous knowledge of shifting cultivators should be taken into account for any attempt to improve the performance of the systems they are managing;
- animal husbandry activities are important in the Nabong area and deserve more studies such as the evaluation of the local pastures and the traditional animal feeding systems;
- the Nabong Agriculture College should collect more information on shifting cultivation systems in nearby villages and study the evolution of these systems in collaboration with international organisations or NGOs.
- more information needs to be collected from the farmers of the Nabong area through interviews in order to complement the preliminary observations contained in this article.

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PHOTO 1: weeding a swidden field in the Nabong area. Photo by Dirk Van Gansberghe, July 1993.

PHOTO 2: tools for removing bamboo weeds in the Nabong area. Vientiane prefecture, D. Van Gansberghe, July 1993.

PHOTO 3: general view of a swidden field in the Nabong area. Photo by Dirk Van Gansberghe, July 1993.

PHOTO 4: rice, maize and termite mound in a swidden field, Nabong area. Vientiane prefecture, photo by D. Van Gansberghe, July 1993.

PHOTO 5: shifting cultivators weeding their field near Ban Naphok. Photo by Dirk Van Gansberghe, July 1993.

PHOTO 6: rice-maize mixed cropping in Ban Naphok. Vientiane prefecture, photo by D. Van Gansberghe, July 1993.

PHOTO 7: micro-site heterogeneity in swidden field near Ban Naphok. Photo by Dirk Van Gansberghe, July 1993.

PHOTO 8: rice-cotton-maize mixed cropping in the Nabong area. Vientiane prefecture, photo by D. Van Gansberghe, July 1993.

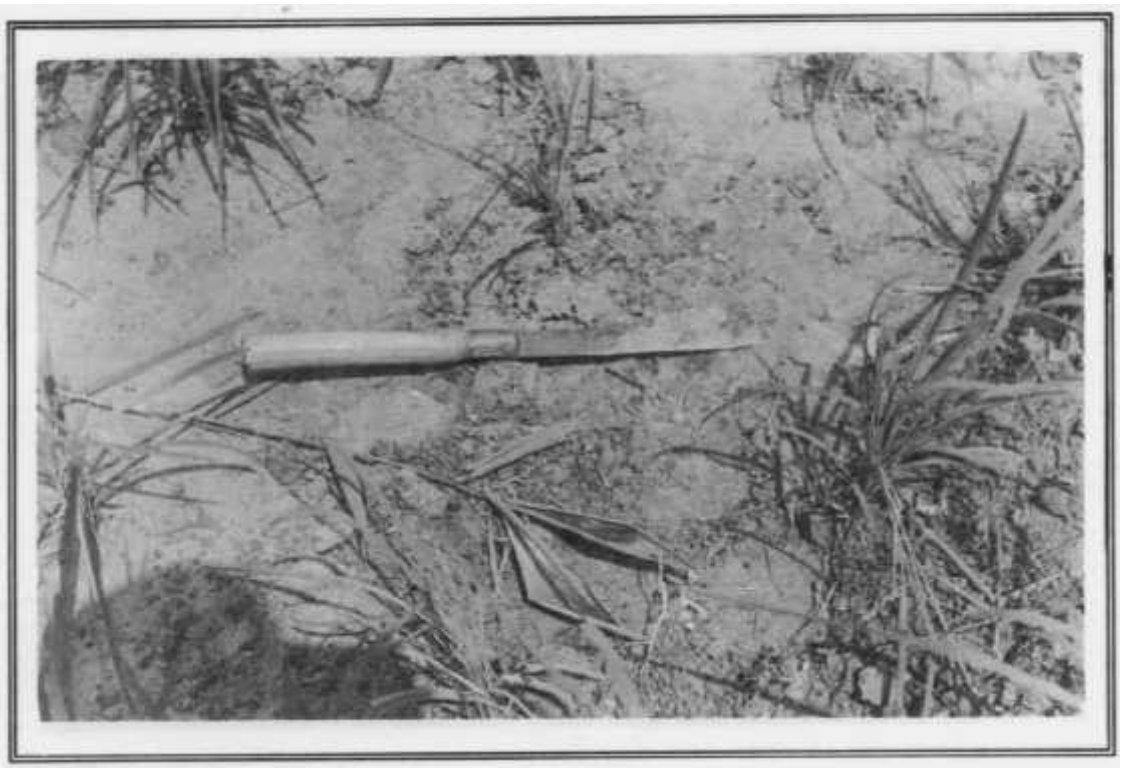

PHOTO 9: chopping knife for cutting and weeding, Nabong area. Photo by Dirk Van Gansberghe, July 1993.

PHOTO 10: rice-maize-cucurbit mixed cropping in the Nabong area. Vientiane prefecture, photo by D. Van Gansberghe, July 1993.

PHOTO 11: slaking earth in upland rice field, Nabong area. Photo by Dirk Van Gansberghe, July 1993.

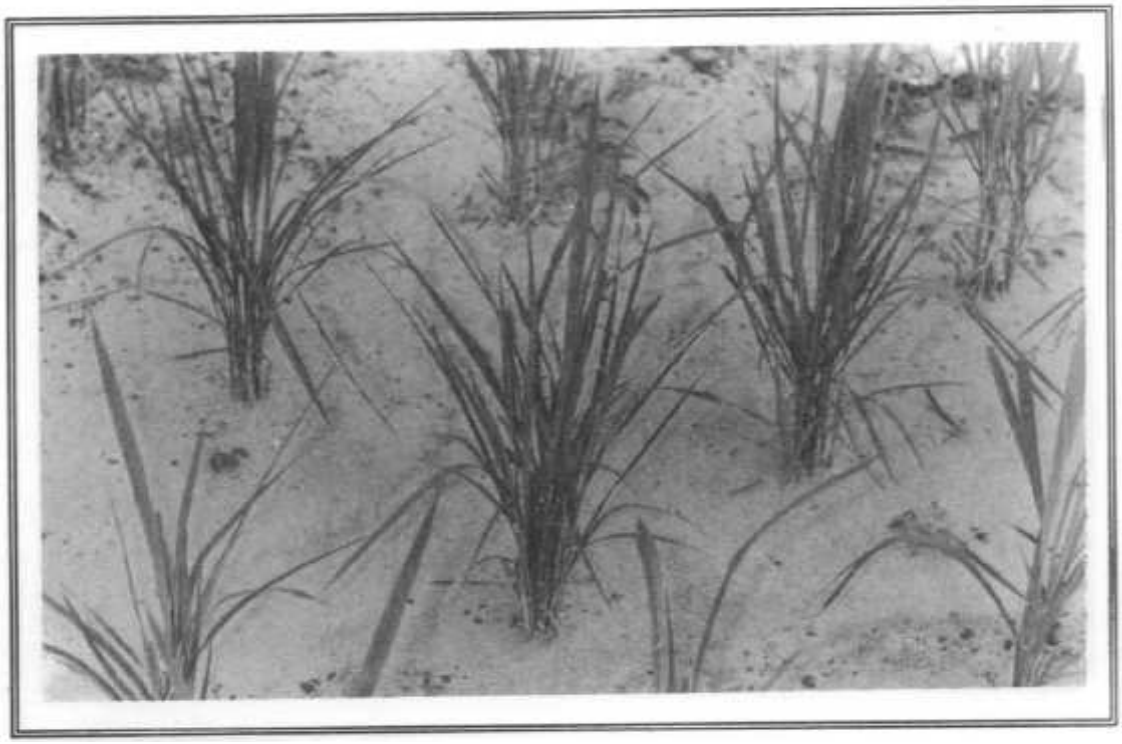

PHOTO 12: upland rice seedlings at tillering stage, Nabong area. Vientiane prefecture, photo by D. Van Gansberghe, July 1993.

PHOTO 13: upland rice, mai7P and cassava in the Nabong area. Photo by Dirk Van Gansberghe, July 1993.

PHOTO 14: heterogeneous conditions of a swidden field in the Naphok area. Photo by D. Van Gansberghe, July 1993.

AN OVERVIEW OF THE ROLE OF THE SUSTAINABLE AGRICULTURE FORUM (S.A.F) WITH REGARD TO SHIFTING CULTIVATION PRACTICES IN LAO PDR.

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What is SAF?

The Sustainable Agriculture Forum (SAF) is an autonomous coalition of international non¬governmental organizations (NGOs) and Lao development workers who are promoting sustainable agriculture, community forestry and other environmentally sound and participatory approaches to rural development in Lao PDR. SAF was founded in March 1991 by a group of Lao development workers employed by internatinal NGOs who have programs in rural development in Lao PDR. SAF is affiliated with the South-East Asian Sustainable Agriculture Network (SEASAN), and is informally connected to several other regional networks and coalitions.

Objectives of SAF

1) To support Lao people in their struggle to achieve food security by promoting low-cost, environmentally sound and participatory techniques and approaches to agriculture, forestry and rural development in general.
2) To provide a forum for Lao development workers to learn and share experiences about such approaches and techniques.
3) To facilitate coordination and information flows between individuals and organizations (both government and non-government) who are working in the field of sustainable agriculture and community forestry in Lao PDR.
4) To organize and coordinate workshops and other training activities on topics relevant to SAF objectives.
5) To cooperate with regional networks and organizations in other countries who have similar objectives in order to share experiences and information.

Working Methods

Forum Meetings are held monthly (usually on the second Monday of each month) and are an opportunity for members to discuss specific technical topics related to sustainable agriculture, as well as to plan and coordinate other SAF activities. Lao is the main language used at SAF meetings.

Workshops/Study Trips on various topics related to sustainable agriculture and community forestry are organized from time to time under the auspices of SAF. A working group of SAF members is usually established to organize each activity with one member organization taking a lead role. Participants include personnel from NGOs, government agencies and other international organizations.

Newsletter/Documentation SAF produces a regular newsletter on technical aspects of sustainable agriculture, as well as other documentation generated by SAF workshops and other activities. Most of this documentation is in Lao.

Regional Networking Through its affiliation with SEASAN and other regional networks, SAF facilitates linkages and information sharing between Lao development workers and organisations that are promoting sustainable agriculture in other countries in Asia. SAF is also able to nominate Lao participants for regional training activities, study trips etc. organized by SEASAN, as the

Workshop on Sustainable Upland Agriculture that took place in the Philippines last April and in which five Lao SAF members have participated.

Membership

SAF membership is open to any organization or individual who is directly involved in rural hay development activities in Lao PDR. Organizations wishing to participate in SAF activities should formally nominate one or two Lao staff members who will be responsible for being involved in SAF activities on a regular and on-going basis. It should be emphasized that the usefulness and success of SAF activities depends entirely on the active participation and contribution of all SAF members. Regular members of SAF are listed below.

Activities implemented by SAF

The following lists some of the projects and activities that have been organized under the auspices of SAF over the past years;

- Workshop on "Alley Cropping - the experience in Laos"
- Workshop on "Appropriate Technologies for Sustainable Rural Development"
- Workshop on "Botanical Pesticides" the)
- National workshop on "Community Forestry"
- A series of training workshops on "Participatory Action Research on Traditional

  Community Forest Systems in Lao PDR"
- Village Farmers Training Centre, Vientiane (RIFS)
- Development on Farmer Based Genetic Resources Conservation and Development (June 1993)

Funding

SAF has no organizational core budget at this time, and funding is sought on an activity-to¬activity basis. Organizations which have provided funding for SAF activities include CIDSE, Quaker Service Laos and CUSO/Canada Fund.

SAF and Shifting Cultivation

The systems of shifting cultivation or "swidden agriculture" that have traditionally been used by upland and highland communities in Lao PDR are complex, rational and sustainable forms land use if there is enough land to allow for long fallows and rotations. However, increased population pressure and movements of people have over recent decades led to more intense cultivation of marginal lands and shorter fallow periods. This has resulted in soil degradation, lower yields and increased pressure on forests.

Given this scenario, SAF members recognize that there is a critical need to develop stable and sustainable alternatives to shifting cultivation in Lao PDR. Many SAF member organizations are therefore working closely with relevant government agencies to develop and promote approaches and technologies which are socially and ecologically appropriate for the sloping and mountainous regions of the country. NGOs believe that progress towards more sustainable farming practices must not only involve identifying appropriate technical solutions, but must also focus on the process of developing and extending them. SAF believes that farming systems appropriate for upland and highland areas in Lao PDR should have the following characteristics;

- Address immediate, short-term needs such as food and income
- Be based on existing practices and traditional knowledge (i.e. build on and modify rather than replace)
- Promote diversification

- Minimize capital/resources requirements and the use of external inputs
- Provide acceptable economic returns
- Minimize tillage and discourage burning of crop residues
- Be appropriate given existing labour constraints

Specific techniques for upland and highland areas currently promoted and tested by NGOs in various parts of Lao PDR include alley cropping, cover crops, crop diversification and agro-forestry. In identifying and developing appropriate interventions, approaches such as farmer-based experimentation and farmer-to-farmer extension are especially valuable because they encourage the promotion of only those practices that are seen as appropriate by local people. To achieve sustainable land use in the upland areas, emphasis must be placed on practices which directly meet practical needs - especially that of food security. There is no point trying to "sell" sustainable farming practices on the grounds of conservation alone, if farmers themselves see their problems differently.

RAGULAR MEMBERS OF THE SUSTAINABLE AGRICULTURE FORUM (S.A.F) (June 1993)

Organization	Agriculture-related Project(s)	Location
CAA Community Aid Abroad P.O. Box 2927; Vientiane Tel. 16-9095	* Village Irrigation and Agriculture Programme - Rehabilitate Village Irrigation systems - Training & extension of villagers and gvnt officials in sustainable agricultural t echniques (botanical pesticides, rice-fish farming, natural rice farming, chicken raising, etc.) - Formation of Water User Groups - Rice Banks	Vtne P, SV, SE
CIDSE Cooperation Internationale pour le Developpement et la Solidarite P.O. Box 2795, Vientiane Tel. 16-9021 & 3653	* Integrated Sustainable Agriculture & Appropriate Technology (alley cropping, rice banks, natural rice farming, composting, botanical pesticides, green manure) * Irrigation & Support for Veterinary Network * In-Service Training of Provincial Agriculture * Support for Agricultural Services (training & extension)	National Level, SK, BL SY LP, Vtne P, SV, CH National Level
CONCERN P.O. Box 4374, Vientiane Tel. 2231	* Integration of Lao returnees and development of surrounding communities through rural development activities	BO, SK, CH, KM
CUSO Canadian University Service Overseas P.O. Box 3517, Vientiane Tel. 16-9511	* Support to Luang Prabang Rural Development Center * Community Forestry Workshops (1992-1993) * Community Forest Support Project * Native Pig Project * Sustainable Upland Agriculture Project (Networking, workshops, extension & on-farm trials)	LP National Level & 13 Prov. National Level Vtne M National Level & Vtne P

ESF Ecoles Sans Frontieres P.O. Box 3182, Vientiane Tel. 16-9096	* Development of education and productive activities in the field of primary and adult education	Country-wide
IUCN The World Conservation Union P.O. Box 4340, Vientiane Tel. 4600	* Forest Resources Conservation (Development of a protected area system and nature conservation capacity)	Country-wide
JVC Japan International Volunteer Center P.O Box 2940, Vientiane Tel. 5906	* Integrated Agricultural Pilot Farm	BL
	* Community forestry & Environment Project (Promotion of community forest conservation by villagers initiative)	KM
	* Community Development and Life Improvement Project (Seminar on sust. Agriculture, revolving funds for rice & chickent)	BL, KM, SV, SE, AT, CH
MCC Mennonite Central Committee P.O. Box 1118, Vientiane Tel. 3468	* Integrated Development Project (IDP) (Alley cropping, fish ponds, animal & rice banks, family gardens, veterinary services, etc.)	HP. PS
	* Sustainable Agriculture Projects (same activities as listed under IDP)	HP, PS, Vtne M
QSL Quaker Service Laos P.O. Box 1118, Vientiane Tel. 2383	* Small Scale Irrigation (Strengthen irrigation systems; agr. Extension, training & inputs)	LP, HP, XK, OU
	* Rice-based Integrated Farming Systems (RIFS)	LP, XK, OU, SK
	1. Promotion of sustainable development technologies and capacities (alley cropping, rice-fish farming, chicken raising, bio-intensive gardening, natural rice farming)	
	2. Organize training & produce extension materials	
	3. Networking	
	* Support Rural Development Center	LP
	* Veterinary Project (Vaccination campaign & training; animal banks)	LN, XK, HP, OU, PS
ZOA Refugee Care Netherlands P.O. Box 4224, Vientiane Tel. 4095	* Repatriation Assistance Programme (Agricultural support)	LN, BO, Vtne M

Coding Keys for Location: AT = Attopeu; BL = Bolikhamsai; BO = Bokeo; CH = Champassak; HP = HouaPhan; KM = Khammouane; LN = L. Namtha; LP = OU = Oudomsai; PS = Phongsaly; SE = Sekong; SK = Savannakhet; SV = Saravane; SY = Sayabouli; Vtne M = Vientiane Municipality; Vtne P = Vientiane Province; XK = XiengKhouang

S.A.F MEMBERS HAVING EXPERIENCE IN ALLEY CROPPING IN LAO PDR

Organization	Location	Acreage/ No. of farmers	Year started	Lessons learnt from alley cropping experiences
CIDSE	Savannakhet Prov. (2 villages in lowland areas)	2 site (Community-Managed)	1990	* Proper fencing during dry season to keep animals out * Benefits are long-term, therefore not an easy “entry point” * Erosion control is not as much of an issue in the lowlands and therefore farmers see it as a loss of planting area (about 10%) Future Plan CIDSE will continue to support the two villages in Savannakhet and plan to incorporate more fruit trees; CIDSE is also planning, depending on farmer willingness, to start alley cropping in upland areas where they are already working (Savannakhet, Sayabouli, Bolikhamsai).
MCC	HouaPhan * Phongsaly Provinces Vientiane Muni. (11 villages in total)	7.2 ha/25 sites all together (Some are community-managed and some are done on an individual basis)	From 1991 & on	* A strong fence is a prerequisite for the dry season * Should be done on an individual basis, not community-managed * Indigenous cover crop are more adapted to local conditions than imported sees * Regular follow-up and extension visits are a necessity Future Plan See Conclusion of the Paper “ Experiences of MCC in Alley Cropping in The Lao PDR”,
QSL/RIFS	Oudomsai, Vientiane, Luang Prabang, XiengKhouang & Bolikhamsai Provinces	7 ha/11 sites (All community-managed)	From 1990 & on	* Beniefits are long-term, therefore not an easy “entry point” * A strong fence is a prerequisite for the dry season * Regular follow-up and extension visits are a necessity * An integrated development approach has more chance of being successful * Secure land tenure is important Furture Plan See Conclusion of the Paper “ RIFS Experience on Alley Cropping”

THE SUSTAINABLE UPLAND AGRICULTURE PROJECT (S.U.A.P) AND HOW IT RELATES TO SHIFTING CULTIVATION

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Shifting cultivation practices, although remarkably sustainable and adapted to their environment in the past, have come under increasing stress in recent decades, and are now starting to be an major problem in Laos, causing widespread deforestation and watershed degradation. A priority for the Lao Ministry of Agriculture and Forestry (M.A.F) is to identify and promote alternatives to slash-and-burn agriculture that are both ecologically and economically sustainable and viable.

It is in that context that the Sustainable Upland Agriculture Projects (S.U.A.P), implemented by CUSO and the Agricultural Extension Agency of Salakham (D.A.E), is proposing to look at these alternatives that could contribute to develop more permanent farming systems and consequently decrease the extent of shifting cultivation practices in the uplands. In order to achieve this, SUAP is gathering information and experiences from various institutions and NGO-supported projects, which will help identify common themes, opportunities and constraints with regard to the development of sustainable upland agriculture practices.

A major rationale for this project is also to strengthen the coordination and information flows between the village and district level activities on one hand, and the central MAF institutions that formulate national policy and recommendations on the other. SUAP is starting to play a key role in that respect, in being an active member of the Sustainable Agriculture Forum (SAF) and therefore is helping to establish a better cooperation between all the relevant institutions and organizations.

SUAP also intends to carry out some direct agricultural extension, on-farm trials and trainings with farmers in a small number of target villages of Vientiane Province (Hinheup, and Vangvieng districts), and which are now in the process of being selected, in order to develop some working demonstration farms and to use farmer-to-farmer extension approaches. Examples of agricultural techniques that could contribute to develop more permanent farming systems, and which SUAP is interested in exploring included composting, botanical pesticides, use of green manure to improve fallow period, family garden, fish culture, natural rice farming, establishment of living fence and alley cropping.

Finally, although still in its initial phase, it is hoped that this small-scale project, by using the approach described above, will contribute to the long term process of developing appropriate solutions to the problem of shifting cultivation in Lao PDR.

Overview of the Objectives and Activities of The Sustainable Upland Agriculture Projects (S.U.A.P)

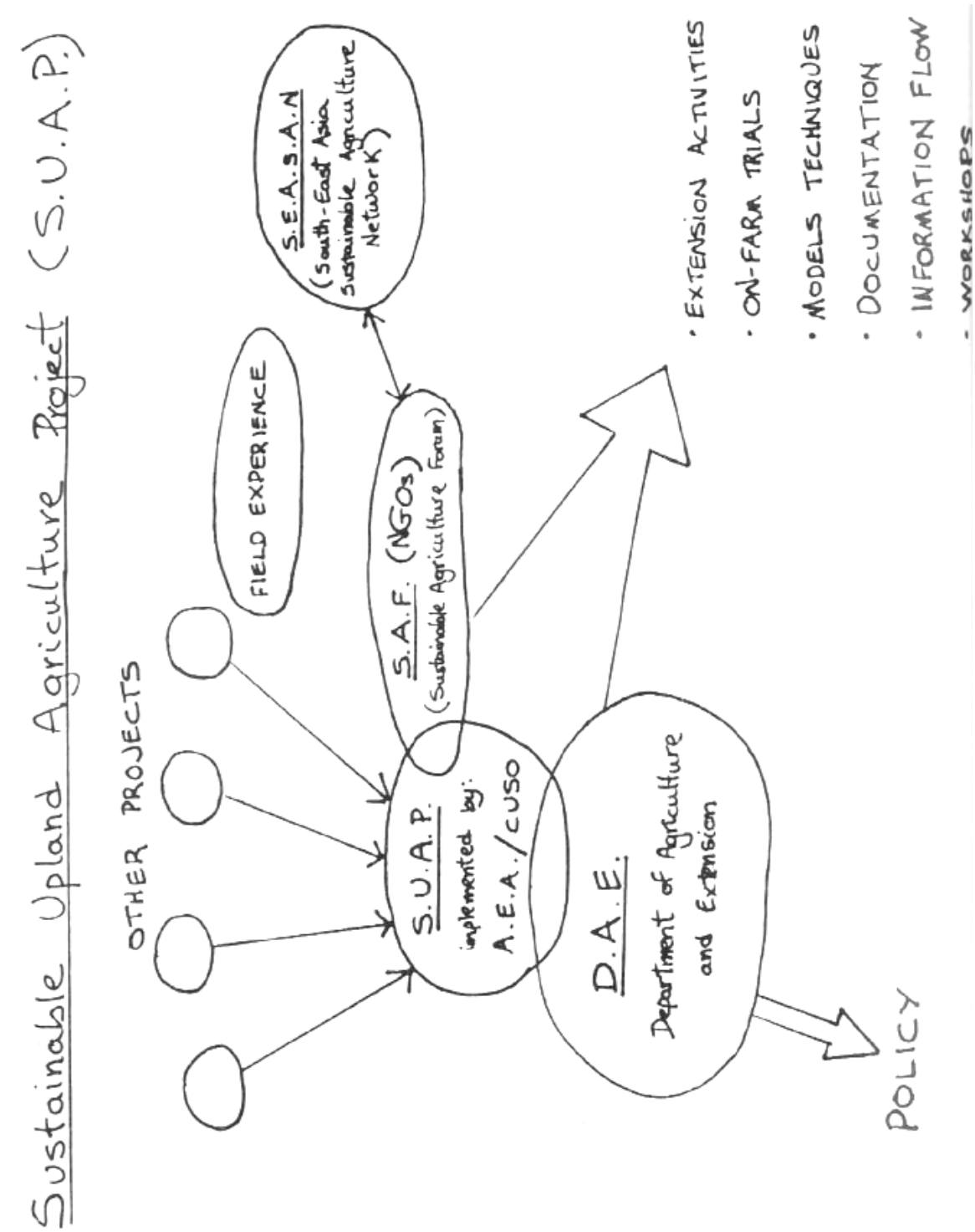
Implemented by CUSO and the Agricultural Extension Agency (M.A.F)

Its Objectives:

- Study, collate and document the experiences of various upland agriculture projects supported by NGOs and other organizations.
- Bring together key agencies and individuals working in the field of upland agriculture in Lao PDR to identify and discuss main opportunities and constraints to more widespread adoption of sustainable farming practices for the uplands, and from this develop more effective strategies for the future.
- Conduct agricultural extension and on-farm trials in a small number of villages in order to generate farmer experimentation and develop some "model farms" which can be used in study trips and farmer-to-farmer extension approaches.
- Strengthen information flows between field/village level activities and the institutions within the Ministry of Agriculture responsible for agricultural planning, policy and extension.

Its activities:

- Visit NGO projects as well as other organizations' projects in different provinces (upland areas) where activities relevant to SUAP are conducted.
- Participate and collaborate in SAF activities as well as other organizations presenting an interest in SUAP.
- Organize and facilitate workshops/trainings related to upland agriculture.
- Extension activities and on-farm trials in Vientiane Province.


Sustainable Upland Agriculture Project (S.U.A.P.)
OTHER PROJECTS
FIELD EXPERIENCE
S.E.A.S.A.N
(South-East Asia Sustainable Agriculture Network)
S.A.F. (NGOs)
(Sustainable Agriculture Forum)
S.U.A.P.
implemented by:
A.E.A./CUSO
D.A.E.
Department of Agriculture and Extension
POLICY
• EXTENSION ACTIVITIES
• ON-FARM TRIALS
• MODELS TECHNIQUES
• DOCUMENTATION
• INFORMATION FLOW
• WORKSHOPS

EXPERIENCES OF MENNONITE CENTRAL COMMITTEE IN ALLEY CROPPING IN THE LAO PDR KHAMHIENG and KHAMHOUNG

Mennonite Central Committee

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Paul OVERGOOR

Community Aid Abroad

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INTRODUCTION

MCC has been active in alley cropping in Houaphan and Phongsaly provinces and in the Vientiane Municipality since 1992. In total 25 alley cropping plots in 11 villages with a total area of 7.2 ha have been established. MCC's experiences include both lowland, midland and highland lao groups.

METHODOLOGY

Based on previous experiences, the following methodology has been used by MCC-staff in introducing alley cropping:

Village selection

The objective of alley cropping trials are discussed with provincial, district and agricultural staff and they are requested to identify villages with the following characteristics:

- mainly upland and little lowland rice production.
- no expansion of paddy possible.
- location near road.
- fixed settlement.

Village training

The selected village is visited and a village meeting is held in which alley cropping techniques are introduced. One or more volunteers are chosen per village on basis of labor availability and interest. Subsequently a workshop on alley cropping is held for the volunteers using teaching aids like: slides, posters and manuals.

Site selection

The trial plots should preferably be located close to the village, near paddy land, road and water sources in order to facilitate: easy follow up taking care of the crops, demonstration visit and growing of fruit trees.

Implementation alley cropping

Fencing: The site selection and the usual land preparation for upland crops (slashing and burning) is followed by properly fencing of the plots, in order to prevent cattle damage (especially goats).

Establishing hedgerows: Just before the rice planting season starts, contour lines are determined using an A - frame. The contours are located 4-6 m apart, depending on the slope and are marked with sticks. With the onset of the rains, two small rows each 50 cm apart, are dug on each contour line. Seed of the following species were sown in these double rows: Leucaena

leucocephala (80 kg/ha), pigeon pea or Cajanus cajan (80 kg/ha) and "wild ovaltine" (15-20 kg/ha). Also mixed pigeon pea / leucaena hedgerows (40/40 kg/ha), were established.

In mixed pigeon pea / leuceana hedgerows growth of leuceana was reduced. The final one year height was only 0,4 - 0.7 m compared to 1.8 - 2.0 m, when grown separately. The growth of pigeon pea both in pure and mixed rows was the same and was faster then that of L. Two loppings a year took place and the plants were pruned back to 40-60 cm height. The cutting material was used to mulch the crops grown between the rows.

Upland crops / Cover crops: Following the seeding of the hedgerows, planting of the upland rice took place in May. The rice was inter cropped with a local bean "tua sot". A spacing of 1.0 m x 1.0 m was used. From mid-september onwards the rice was relay cropped with black mungbean (tua dam), rice bean (tua deng) and lab-lab bean (tua bhep). The spacings were chosen by the farmers. The cover crops are grown to conserve moisture, suppress weeds and to add nitrogen to the soil. The cropping calendar for all the crops grown is shown in table 1.

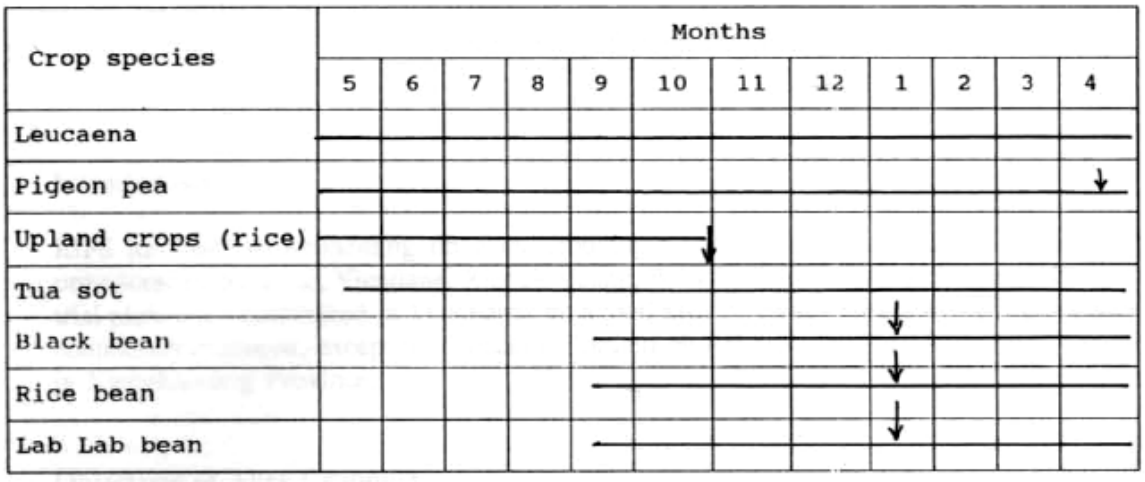
The performance of the cover crops depended on the location, In Phongsaly the black mung bean and "tua sot" grew well, but the lab-lab bean didn't. In Houaphan the situation was just the other way round. In some areas in Houaphan, all of the cover crops and the pigeon pea were damaged by fog and heavy dew in November / December. The germination of some of the cover crops was low.

FARMER OBSERVATION

A farmer in Houaphan Province who started alley cropping on 0.8 ha in 1992 and obtained a yield of 900 kg/ha observed that:

- half a meter around the hedgerows and in the areas where cover crops were planted, the soil quality improved.
- a 1.00 m spacing between two hedgerows of a double row would be preferable to a 50 cm spacing.
- the uniformity of rice in alley cropping plots is greater than in normal upland rice.

Table 8: Cropping calendar of species used in alley cropping



LESSONS LEARNT FROM ALLEY CROPPING EXPERIENCE

MCC - staff learned the following lessons from their alley cropping experiences:

- a strong fence is a prerequisite for successful alley cropping as the traditional fence isn't strong enough to prevent animals from entering the trial plots.

- alley cropping should be done on an individual basis; collective alley cropping plots haven't been successful.
- seed of indigenous cover crops that do well in local conditions should be looked for, as imported seeds often show poor adaptation and germination.
- regular follow-up and extension visits during the inplementation phases of alley cropping are a necessity; in order to do this properly, the number of sites should be limited.

CONCLUSIONS

Farmers in Houaphan and Phongsaly Provinces have shown interest in alley cropping and everybody who started experimenting has continued their activities. It'll need a couple of more years to evaluate if alley cropping is an appropriate technique for these farmers.

RIFS EXPERIENCE IN ALLEY CROPPING

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CUSO

Introduction

RIFS has been experimenting on alley cropping techniques since 1990 in five different provinces: Oudomdxai, Vientiane, Xiengkhouang, Bolikhamsai and Luang Prabang. In total, trial plots were established in 11 villages on a total area of about 7 hectares. All plots were community managed, except for 3 hectares located on RIFS Sustainable Agriculture Center in Xiengkhouang Province.

Objectives of Alley Cropping

1. Establish a more permanent farming system which would contribute to reducing shifting cultivation practices and deforestation.
2. Build up sustainable, regenerative and ecologically sound farming systems.
3. Diversify sources of on-farm income.
4. Increase total on-farm yields and cash income.
5. Increase the availability of firewood and fodder.

The Experience of Thaothan Village

This village located in Vangvieng District of Vientiane Province, tried alley cropping on two sloping areas of about one hectare each. The plots, established in 1991, were community managed by 10 farmers of the village. The three most important factors in implementing alley cropping were: fencing, contour hedgerows establishment and use of a cover crop.

Fencing

Fencing in most part of Laos are traditionally made of bamboo or dry wood. In upland areas these are habitually made every year by the farmers before the rainy season starts in order to protect their cultivated area from animals. During the dry season, a good secure fencing is even more critical for the plots under alley cropping as these are very attractive to animals that are then generally let free to eat everywhere. Traditional fencing is usually not sufficient for this purpose. Many organizations in Lao PDR, governmental as well as NOOs, that have tried alley cropping were not successful because of this problem. The establishment of a living fence, a contour hedgerow of perennials planted close together, could represent a suitable solution.

In Thaothan Village, Iatropha curcas ("Makniao" in lao language) was the species used for establishing a living fence. This species is well adapted to the Lao conditions and is also tolerant to acid soils. In May, two rows of cuttings/seeds were planted in staggered rows, 25 to 30 cm apart along the traditional fence. In the first few years, a combination of living and traditional fences must be used until the I. curcas gets dense enough to stop the animals.

Contour Hedgerows:

Along the contour lines two rows, 50 cm apart, of a mix of leguminous species (Leucaena 1/2; Cassia siamia 1/3; and Pigeon pea 1/6) were sown together. The hedgerows were planted in April. before sowing the rice or planting other crops.

Cover cropping

In October, two or three weeks before harvesting rice, a cover crop is planted; "Makthouange" known as rice bean in English (Vigna iimballatal. It is sown in holes at a distance of about 50 cm apart. This leguminous species is a good cover crop which spreads extensively and is used mainly to preserve soil moisture, improve fertility and act as a weed suppressor.

Results

Alley cropping in this village was not continued after two years. The main difficulty encountered was that villagers who had been practicing shifting cultivation in this area for several generations feel that it is impossible to farm a permanent area in the uplands; and therefore they abandoned the plot. The living fence, although promising, takes a long time to establish and therefore farmers decided to leave the land before the fence was sufficiently dense. Finally, lack of support from local extension workers has also contributed to the failure of establishing alley cropping in this village.

Basic Problems in Establishing Alley Cropping in Lao PDR

1. Alley cropping is a technique that is not an easy "entry point". It takes a long time to establish and to prove itself; farmers need to be patient.
2. Poverty and low income often force farmers to look for seasonal work elsewhere or search for food in the forest, and therefore they are not available to look after a new plot during the dry season.
3. Farmers are unexperienced and not confident about this new technology.
4. Adequate fencing for the dry season is difficult. Indeed, according to our experience, fencing during the dry season is critical and can often be the limiting factor, as the Thaothan Village experience has shown. The most successful plot where RIFS has tried alley cropping, located in Oudomsai, has been using barbed wire and was established on communal land to set up a rice bank. Barbed wire however is prohibitive for most farmers by its high cost.
5. Local technicians are often weak and unconvincing, and therefore cannot provide sufficient support to the farmers. Alley cropping also requires that extension workers spend a lot of time with the villagers, especially in the establishment period.

Lessons learnt from RIFS Experience in Alley Cropping:

6. An integrated development approach, supporting other types of activities such as revolving funds, income-generating initiatives, etc. has more chance of being successful.

Workplan should be established closely with the farmers and local technicians should provide regular and adequate follow-up to the farmers.

Secure land tenure is important; unless farmers feel that they have secure rights to the land they are farming they are unlikely to be wilting to invest in long-term techniques such as alley cropping.

For acid soil, a mix of Gliricidia sepiurn and pigeon pea is more suitable for the hedgerows.

Conclusion

Out of the villages where RIFS has tried alley cropping, only three are still pursuing it. They are located in Oudomsai and Luang Prabang Provinces. The RIFS Sustainable Agricultural Center in Xiengkhouang is also continuing its trials on alley cropping.

Rice Bank and Shifting Cultivation: The Experience of CIDSE

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with assistance of Denis Boutin

CUSO

The Objective

CIDSE's objective in supporting Rice Banks is to provide food security and reduce shifting cultivation practices in resource-poor villages through the enlargement and development of new paddy fields. Two Provinces, Savannakhet (20 villages) and Bolikhamsai (14 villages) are benefiting from CIDSE support to establish rice banks.

The rationale of this approach is that there are still several areas in these regions where paddy lands could be enlarged or established and this has become especially critical since the government is enforcing the policy to stop slash and burn agriculture. In the past, farmers used to complement their paddy yield by practicing shifting cultivation in the surroundings, but now they are increasingly forced to find alternatives in order to get enough food or income. CIDSE is therefore supporting them to increase the acreage under paddy land, so that in the long run they can produce enough rice for their own consumption.

The Process

A village Committee has first to be formed. It is usually composed of four villagers, of which at least one should be a woman. Their first task is to identify the farmers that are interested and willing to join a rice bank. Using a farmer-to-farmer approach, a study tour to a nearby village already using a rice bank would be organized. Then, if the villagers decide to start a rice bank, a communal rice storage barn should be constructed by them.

CIDSE is providing the initial amount of rice, about 1.5 T. of paddy per 20 families. Although this amount seems limited, it has to be remembered that it is a learning process for the villagers and consequently it is important that the quantity of rice provided to start with is not too large so that the farmers feel it is within their reimbursement capacities and therefore are stimulated by the project. Subsequently however, following the Committee's yearly evaluation, CIDSE might add some more rice into the rice bank if it is felt as needed; but after that the rice bank should be maintained mainly through reimbursement.

Rice from the rice bank is distributed to the farmers during the planting season, so that villagers in need of rice during that period, are not obligated to search for food in the forest or look for other types of earning, and can therefore devote most of their time and energy towards the enlargement of their paddy area. It is also protects them from being forced into paying exorbitant interest rates on rice loans that are available from merchants or middlemen. The Rice Bank Committee is responsible for the distribution of the rice, which is based on the reimbursement capacity and the size of the cultivated area of the borrowers, and not according to their family needs.

In exchange for the loan, rice borrowers are expected to expand their paddy area to at least 360 m2 for every adult in the family, which corresponds approximately to the minimal extra work that could be expected from one person for a growing season. If needed, CIDSE can provide tools to the farmers such as hoe, shovel or plough; but these must be repayed in rice to half their price.

Technical advice and follow-up on the new paddy land is provided by extension workers of the district. Soil improvement using low external inputs is promoted. Then after the harvest, rice borrowers have to repay the rice plus a small interest (10-20%, depending on agreement with the villagers). The Committee is responsible for collecting repayments, and so far no difficulties have been encountered for loan repayments.

The Village Committee is also directly involved in the management of the rice bank by drawing up loan regulations, settling the rate of interest and loan schedule. It also has to keep records of activities, data, number of tons of rice, etc. with support from the extension worker, and has monthly meetings with the villagers.

CIDSE will support the rice bank for five years. In the fourth year, the village should repay 50% of the initial amount of rice and in the fifth year, the remaining 50%. The interest accumulated over the years will belong to the village rice bank while the repaid rice will be given to another village to start a new rice bank.

To complement this Rice Bank project, CIDSE can also provide female buffaloes to the farmers who do not have one to plough their land if the Village Committee recommends so. But in this case also, it is under the condition that the farmer enlarges his paddy field area. After four years, the female is taken back by CIDSE while the farmer can keep a calf that has been born.

Conclusion

This type of approach, although not directly dealing with a technical aspect of shifting cultivation, could play a substantial role in diminishing the extent of this practice by supporting villagers to enlarge their paddy field areas in those regions where this is possible. Examples of villages that increased their acreage of paddy land with CIDSE Rice Bank are found below.

Rice banks also expose the farmers to a process of forming a self-help organization to meet the basic needs of their community and promote at the same time collective decision-making, experience which in the long-term has the potential for solving other problems.

Yearly Increase in Paddy Land Acreage

In Villages of Bolikhamsai District, Bolikhamsai Province

Villages	Yearly increase in paddy acreage (ha)	
	1991	1992
Hatpho	5	5.4
Phonsaat	4	2
Nalong	2.2	2
Phosawat	3	7

SUMMARY OF NGO APPROACH TO SHIFTING CULTIVATION

Sombath SOMPHONE

Rice-based Integrated Farming System Project

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The NGO's approach to the issue of shifting cultivation is diversifying agricultural production and introducing rural development. The techniques used are: alley cropping, gardening, revolving funds for rice banks, animal raising (chicken, pigs, cows, buffalo, fish..), small scale irrigation, community forestry. We also do a lot on social awareness building. Social preparation such as discussion and training are an integral pan of technical assistance.

We solve problems using a multi-sectoral approach, grassroot based and with strong community participation. It is a bottom-up approach with consensus building. It is a social process complemented with appropriate resource mobilisation. Whenever possible, funds are given out to be revolved, and not to be used in one shot deal.

We put a lot of emphasis on social preparation. It is done through training activities, both formal and non-formal. We normally start with participatory problem identification, followed by an analysis of causes and effects before we discuss strategies on how to go about solving those problems communally. It is important that villagers understand that there is no long term effective remedy to their problems without them taking an active role.

They decide on the types of training required and the types of activities to be implemented. We only propose to them the available options.

Our approach emphasises utilisation of existing appropriate technology. We involve the 'beneficiary to become their own experimenting and extension agents. We often start small and with few families in few villages at the time. These serve as pilot groups. This way we slowly build up their confidence through actual implementation of project activities. After a few successful trials they will be more willing to experiment on more complicated techniques.

We take care to introduce one activity/technique at the time. Each technique is a building block towards solving a much larger problem. The aid agencies and the beneficiaries jointly evaluate each activity at a regular interval. After a period of time, say one or two years, all the activities are re-evaluated from the point of view of a programme. The experiences obtained are presented and shared with all those who are in development work. The outcome of this workshop on evaluation and sharing of experience is a common strategy and a readjusted plan for the following year.

Attached is an executive summary of such a workshop for the province of Savannakhet: "Workshop on Sharing Experience in Rural Development in Savannakhet".

EXECUTIVE SUMMARY

Workshop of

Sharing Experiences in Rural Development

In Savannakhet

5 - 9 January 1993

A workshop was set up with participants from various sectors of the provincial government: agriculture, education, health, planning and finance, and the Lao Women's Union. It was designed with full participation and a sense of ownership by the province.

The objective was to identify and select approaches and techniques which have been proven appropriate and to design a common strategy for follow up activities.

The workshop was structured to accommodate presentations of case studies by villagers, followed by those from various sectors at both district and provincial levels. The case studies described types of project activities, planning activities, coordination with other sectors, monitoring, evaluation, causes for success and/or failures, lessons learned, strategy for improvement or adjustment. All case studies are available in Lao in this report.

Experiences from outstanding provinces such as Xiengkhouang, Khammouane, and Houaphan were presented on issues of revolving funds, network of development volunteers, and management respectively.

Mr. Banthorn Ondam, a Thai veteran on rural development recommended that Laos should not follow the Thai style of using rural people to promote industry, but should adopt a more appropriate and sustainable option of using industry to promote development for and by rural people.

Between plenary presentations, the participants were divided in small discussion groups. The groups discussed and analyzed key issues which were perceived as important by the facilitators of the workshop. Results of these discussions are available in the workshop report (in Lao).

Based on the presentations and the results of group discussions the participants jointly prepared a set of recommendations in the form of a written resolution.

A summary of the resolution is as follows:

- Rural development work should start on small scale.
- Human resource development is an integral part of rural development.
- Introduction of a rural development project should be preceded by data collection and a feasibility study.
- Development workers should work for self-reliance, i.e. campaign against dependency mentality on central government or on foreign assistance.
- Many of the tested techniques have been proven appropriate and replicable in rural Lao setting. They can be implemented and managed by villagers without much technical and financial assistance.
- Such “appropriate” projects should be started first, before venturing into those requiring more financial support and more complex techniques.
- Overall, development should be people-centered, not done in response to top-down initiatives (e.g. “increase agricultural production”), but in response to the real needs of people.

Techniques and activities which were found to be appropriate include: gardening, weaving, raising local chicken, revolving fund, rice bank, chicken bank, cow bank, buffalo bank, tube well drilling, rain water jar, village and family cleanliness. In other villages without much technical or managerial skills, these can be replicated with efficient utilization of funds.

Identified shortfcomings:

- Little co-ordination between sectors.
- Lack of common goals and priorities by provincial authorities.
- Lack of a clear common strategy for rural development.

Proposed solutions:

- Setting up of a multi-sectorial coordinating committee for development t provincial and district levels, comprised of authorities as well as technicians.
- This co-ordinating committee should be an integeral part of a development planning system and the annual budget cycle.

Decisions on follow up activites:

- The provincial authority has agreed to form a co-ordinating committee for development.
- UNICEF has agreed to fund training of multi-sectorial development workers at provincial level and in a few districts, to provide technical support to the co-ordinating committee.

THE EXPERIENCE OF THE SHIFTING CULTIVATION STABILIZATION PROGRAMME OF THE DEPARTMENT OF FORESTRY

Bouahong PHANTHANOUSY

Head of Shifting Cultivation

Stabilization Programme

Dept. of Forestry

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1. PHYSICAL CONDITIONS

Lao P.D.R has a total area of 236.725 sq km, surrounded by China, Vietnam, Kampuchea, Thailand and Myanmar. It is one of the least populated countries of South East Asia and the GDP per capita comes to less than USD 200 (1989). A total of 68 ethnic groups have been enumerated, which are commonly divided into the lowland Lao (Lao Lum 55%), the midland Lao (Lao Theung 30%) and the upland Lao (Lao Sung 15%) and about 95% of them live in rural areas.

Concerning the forestry situation the following data are given. In the years of 1962-63 the forest cover of Lao PDR was 15 million hectares (64%). In 1981, according to the inventory data base aerial photo interpretation and in 1987 with the Satellite imageries, coverage came to only 11.2 million hectares, covering about 47% of the total area of the country, as shown in the figures below:

• Evergreen forest	3.4 million hectares	
• Mixed Deciduous forest	5.7	-"-
• Deciduous forest	1.9	-"-
• Coniferous	0.2	-"-
• Teak	0.01	-"-

Generally speaking, the forest area has reduced step by step and year by year. For example during the 1960's and 1970's the forest has mainly been destroyed by war, and during the past 10 years the forest has still gradually been destroyed by the practicing of slash and burn. The average forest area which is destroyed is 300.000 hectares/year including losses by forest fires and logging without sustainable management plan. As a result during 9 years about 1.8 hectares of forest land was lost, mainly in the northern provinces of Lao PDR e.g: HouaPhanh. Phongsaly, LuangPrabang Province....

2. FOREST DESTRUCTION WITH SHIFTING CULTIVATION

QUESTIONS:

- Why do people have to cut trees for upland rice cultivation every year?

- Why don't people use the same piece of land for permanent cultivation for about 10 to 20 years?

The main problems of Shifting Cultivation in Lao PDR are:

- Human population increased very rapidly and caused a high demand of food and fire wood consumption.
- Changing economic and social conditions.
- Increasing demand of suitable land for crop and food production.
- The way traditional farmers exploit upland soil for Agricultural production on a permanent or long term basis.

Regarding those problems the number of Shifting Cultivators in the 1985 census was 253,000 families and about 1.5 million people; in 1990 the number of Shifting Cultivators increased up to 277,000 families (of which 45% are Lao Sung, 35% are Lao Theung and 20% are Lao Lum).

3. TYPES OF SHIFTING CULTIVATION

Most of the upland agriculture in Lao PDR cannot properly be called "Shifting Cultivation". Swidden Cultivation or Swiddening would be a much more appropriate term. "Shifting Cultivation" is usually pictured as minorities clearing primary forest, cropping plots until the site is exhausted, then moving their village to a new site with other primary forest.

There are three different types of Shifting Cultivation in Lao PDR.

(1) On the plains, practised by the Lao Lum.

In this case, the area is not sufficient for using draft buffalo and equipment for wet rice cultivation. The people therefore have to deal with slash and burn. On the other hand rice production on low land has declined due to low soil fertility and limited application of improved management techniques. This differs from traditional Shifting Cultivation in which people have the intention to return to the same areas after a fallow period.

(2) At the feet of the mountains, practised by the Lao Theung.

In this case, some areas still contain dense forest and normally Lao Theung carry out the traditional Shifting Cultivation in this area, upto medium altitude. They use crop rotations allowing fallow periods of 5 to 15 years, depending on soil condition and land availability. The main crops are: Rice, Maize, Cassava and ChiHie. Generally, their practices are not a serious threat to forest resources and land.

(3) On the steep slopes of mountains, practised by the Lao Sung.

Lao Sung and Yao who live in the upland above approximately 1000 m, mostly cultivate poppy as a cash crop, together with a number of subsistence crops such as rice, maize, tobacco and vegetables. In view of the nutrient requirements, maize and poppy are usually intercropped. Lao Sung also planted peas and beans with poppies in order to improve soil fertility. They use only the best soils under the primary forest for poppy growing. They use the soils for agricultural purposes for a period of 5 to 10 years.

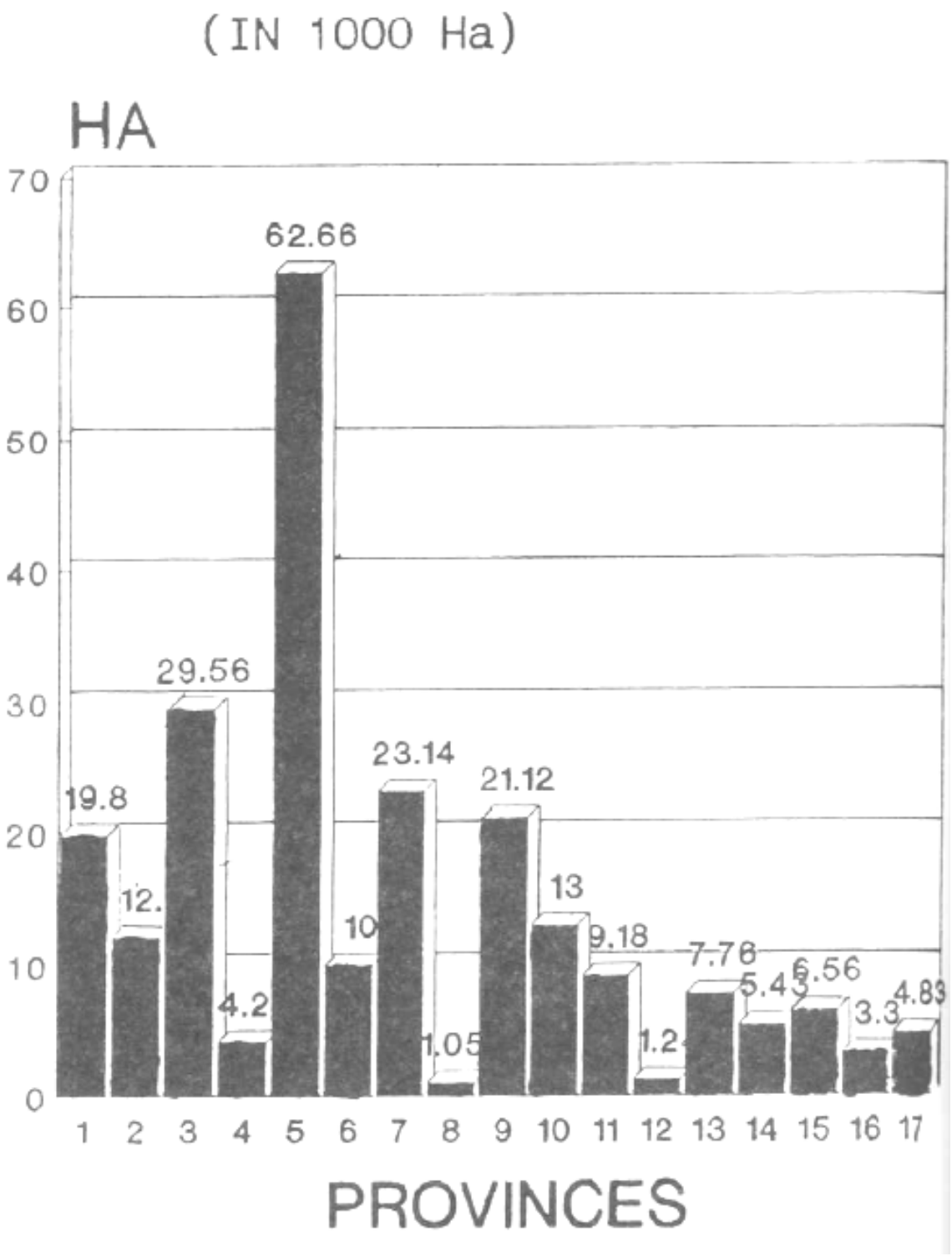

Figure 2: Hai area for all provinces (1990)

Table 9: Hai area in 1990 (in 1000 ha)

1. PROVINCES	AREAS
7. Phongsaly	19,8
8. L.Namtha	12,1
9. O.domxay	4,22
10. L.Prabang	62,66
11. X.yaboury	10,00
12. H.Phanh	23,14
13. VT.municipality	1,055
14. Vientiane	21,12
15. B.likhamxay	13,00
16. X.khuang	9,18
17. K.muane	1,24
18. S.vannakhet	7,76
19. Ch.pasack	5,43
20. S.ravan	6,56
21. A.tapeu	3,3
22. X.kong4,83	4.83
Total	
	234,955

Table 10: Number of amilies of shifting cultivators during the period of 1990.

PROVINCES	FAMILIES
1. P.SALY	23,294
23. L.NAMTHA	14,235
24. O.DOMXAY	34,77
25. B.KEO	4,965
26. L.PRABANG	73,718
27. X.YABOURY	11,76
28. H.PHANH	27,22
29. VT. MUNICIPALITY	1,241
30. VIENTIANE	24.847
31. B.LIKHAMXAY	15,294
32. XICHUANG	10,800
33. K.MUANE	1,459
34. S.ICHET	9,129
35. CH.SACK	6,388
36. S.RAVANH	7,718
37. A.PEU	3,882
38. X.KONG	5,68
TOTAL =	276,418

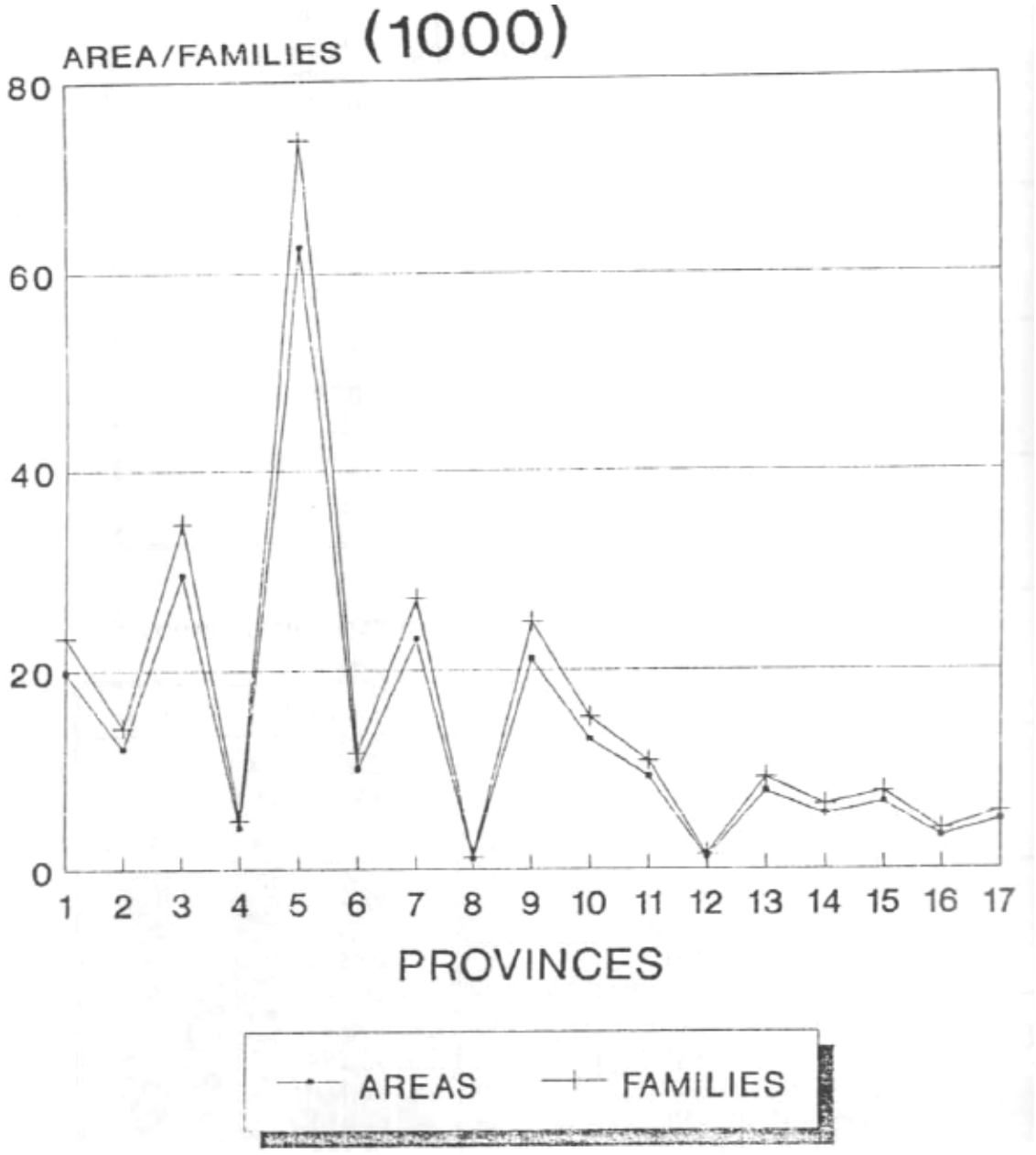

Figure 3: Area per family for shifting cultivation (1990)

4. CASE STUDY OF THONGBFIANG PILOT AREA

The Project started in mid-1989 in the pilot area of Thongkhang situated at Thongkhang sub-District, Nane District about 65 km south of LuangPrabang Province. The total area of the pilot project is 19,121 hectares, containing steep slopes, and 14 villages including three main ethnic groups (Lao Lum 6 villages, Lao Theung 5 villages and Lao Sung 3 villages). It comprises 683 households and 3,755 peoples.

The three main objectives of the pilot project are:

- Establishment of Research and Demonstration Programme in Agriculture and Forestry stabilization.
- Information and training support for the establishment of upland Agriculture and Forestry.
- Assessment of the extent and impact of Shifting Cultivation.

The project started with a Socio-Economic survey, conducting 230 household interviews. The purpose of these interviews was to gain a better practical understanding of the farming system (both socio-economic and agro-ecological aspects) of the farmers.

The main information gathered by interviews includes:

- Demography (3,755 people, 682 families).
- Members per household (6 persons/household).
- Age structure.
- Workers per household.
- Mortality rates.
- Vaccination.
- Education for Adult.
- Farming system (Agricultural land use). (Hai 70%, wet rice 7% Maize 18%, other 5%).
- Annual agriculture land use areas of ethnic groups.

For example:

Lao Lum:

Hai	1.24 Ha (68%).
Wet rice	0.15 " (8%).
Maize	0.34 " (19%)
Other	0.1 " (5%)

Yao:

Hai	0.7 " (61%).
Maize	0.45 " (39%).

Lao Theung:

Hai	1.1 " (78%).
Wet rice	0.07 " (5%).
Maize	0.19 " (13%).
Other	0.5 " (4%).

Lao Sung:

Hai	0.93 “ (53%).
Maize	0.47 “ (27%).
Other	0.35 “ (20%).

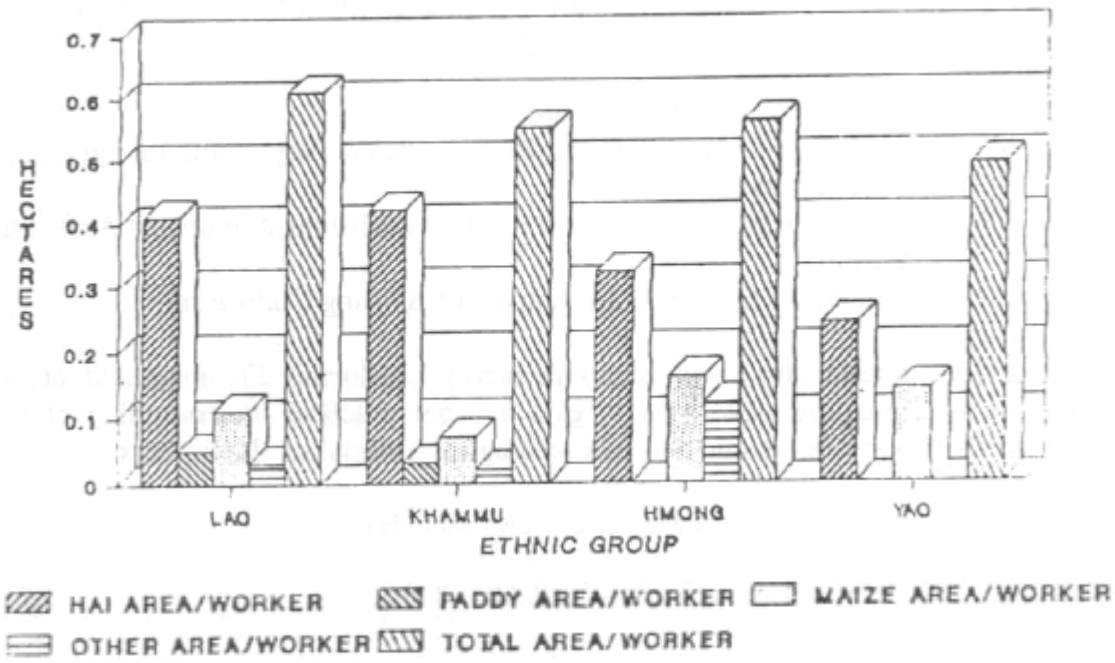

Figure 4: Agricultural land area per household worker, ethnic averages

- Production figure for major crops and rice seolf-sufficiency.
- Income sources =

Forest product	1%
Livestock	52%
Crops	20%
Loans	4%
Remittance	9%
Wage labor	9%
Handicraft	5%

- Expenditure.
- Yields for upland and wet rice production.
- Labor requirements, for example the relative distribution of labor input in Hai activities.

Hai culture taks:		% of total labor:
• Cutting	=	26
• Burning	=	2
• Planting	=	11
• Weeding	=	39
• Harvesting	=	19
• Threshing	=	9
		100

The comparison of upland and wet rice production.

In Hai cultivation:

Category.	Seed rate Kg.	Production KG.	Yield
1	12	400	1 kg = 30 kg
2	12	360	1 kg = 30 kg
3	12	288	1 kg = 24 kg
		Average =	1 kg = 28 kg

In Na cultivation:

1	12	540	1 kg = 45 kg
2	12	500	1 kg = 41 kg
3	12	480	1 kg = 40 kg
		Average =	1 kg = 42 kg

Beside the Socio-Economic data collection and survey,the project has started a Forest and Land use survey, resulting in the basic data below:

For land use classification:

- Upper Evergreen Forest 2.100 Ha
- Mixed Deciduous Forest 783”
- Unstocked Forest 8.742”
- Natural Regeneration 4.139”
- Na (wet rice) 192”
- Rock 411”

Land use based on slope classification:

- Slope from 0-5 degree

  425 Ha classified as first class, good for permanent agriculture as wet rice or cash crop production.

- Slope from 6-10 degree

  5.357 Ha, classified as second class, terracing or alley cropping systems, a little bit steep area, suitable for

- Slope from 11-15 degree

  7.450 Ha, classified as third class and suitable for agro-forestry and integrated farming systems.

- and Slope up to 21-25 degree

  3.859 Ha, classified as protected zone.

The results of the experiment and trials will be available in 1995.

(Such as pulses, pigeon pea, maize comparison. Intercropping cassava with pigeon pea, cowbean and maize. Multilocation yield trials of upland rice varieties, etc...).

5. CONCLUSION OR POLICIES

- The problem of Shifting Cultivation in Lao PDR has recently received increasing attention at national level. The government has therefore formulated a policy on this issue, of which the five main objectives are:

6) To find alternative occupation for about 227.000 families of Shifting Cultivators.

7) To protect existing forest areas.

8) To reforest up to 10 million ha of land.

9) To use existing forest resources for commercial purposes.

10) T
o develop new technologies and manpower training.

The principal tines of action suggested in the field of Shifting Cultivation are:

- Integration of Shifting Cultivation and reforestation (Agro-Forestry).
- Improvement of productivity in Shifting Cultivation systems.
- Transformation of Shifting Cultivation into permanent up-land agriculture.

The main constraints on implementation level are:

- Growth rate of population.
- Conflicting interest between Government and Shifting Cultivators. The prime interest of Government is preservation of forest but for the local people the forest is the secondary consideration and their prime interests are the agricultural activities.
- Insufficient suitable land for permanent agriculture.
- Insufficient funds for intensive cultivation.

SHIFTING IDEAS ABOUT SHIFTING CULTIVATION

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1. INTRODUCTION

There is a long standing discussion among scientists about the merits and problems of shifting cultivation, as well as possible development paths to more intensive systems of land use. That discussion has been reviewed elsewhere (Fujisaka, 1991, Roder e.a, 1991) and is hopefully continued at this workshop. This paper aims at reporting some recent practical experiences, gained by the Micro-Projects Luang Prabang, a rural development project working in Northern Laos. The project aims to better understand the problems of shifting cultivators and to assist them in trying to find answers to their problems.

2. THE IMPACT OF RAPID POPULATION GROWTH

The project pilot area comprises seven villages, with a mixed population of Lao Loum (28%), Lao Theung (58%) and Lao Soung (14%). Table 1 shows the population information, collected through registration of births deaths and migration during the three years 01/01/90-31/12/92.

The upland area cultivated using a rotation fallow system is limited and the contribution to total production made by lowland rice fields is small. Each family cultivates an upland area each year only limited by the family labor power.

Therefore, assuming that the population growth rate recorded is typical for a longer period, it would suggest that fallow periods have shortened rapidly, approximately halving in the last 20 year period (from 6-8 years to 3-4 years: this assumption has been confirmed by interview) and may halve again in the next 20 years (from 3-4 years to 1-2 years).

On the soils of the area, estimated upland rice yields vary from 2.5-3.0 T/ha after long fallow (8 years) to 1.2-0.4 T/ha after short fallow (2-3 years).. It might be expected that yields will continue to fall as fallow periods continue to shorten, without radical changes in farming systems.

At the present time, upland fields produce about 65% of total family rice consumption; therefore continuing or accelerating declines in upland yields can be expected to have a major negative impact on incomes and food consumption.

Table 1: population Nam Doug, 1990-1992

1 The authors would like to thank Ms. Hetty Breggeman and Mr. Souvanh Hansongkham, who carried out the land use study in Huay Thong village.

Table 11: population Nam Dong, 1990-1992

		No. % increase	Annual % increase	Doubling time years
Initial population:	1591			
Final population: (without migration)	1765	10.9	3.5	20
Immigration: (into village)	185			
Emigration: (from village)	83			
Final population (with migration)	1867	17.4	5.5	

3. ACTUAL YIELDS AND FALLOW LENGTHS

A number of crop cuts were taken in the period November-December 1992, to obtain more detailed information on actual yield levels in different project areas (Table 2). After harvest, the owners of sampled plots were asked to estimate the harvest. The farmers' estimates of yields turned out to be consistently lower than the estimates derived from crop cuts (Figure 1).

Only a weak correlation could be found between yield and fallow period (Figure 2). Apparently other factors such as soil type, weeding, rainfall, pests, etc. are more important yield determining factors. The big differences between various project areas are probably due to differences in soil types. A good example is the flat sandy soils found in river valleys, which cannot be used for lowland rice due to high infiltration, but give consistently high upland rice yields.

The high pressure on land in the Nam Dong pilot area is reflected in the shorter average fallow period found in the sampled fields.

4. LAND USE PLANNING

Shifting cultivators who change to more intensive land use systems, as a result of population pressure, are dealing with a land use problem. A recent survey, held in Ban Huay Tong, Nam Dong valley (see transect), showed the following results:

- The average family cannot produce enough rice to satisfy family consumption from the "hai" (upland rice field). The fallow period is reduced to 2-4 years. The size of the field is determined by the amount of labor available in the family (0.4-0.6) ha per labor unit). An average of 0.5¬1.2 T/ha, and a consumption of 250 kg per head per year, they can only cultivate enough area to feed 4 persons. The average family consists of 5.8 persons.

Table 12: Upland rice yields, from crop cuts, of fields in river valley and fields located on hill slopes of various fallow lengths; farmers yield estimates and fallow length. Micro Projects, Luang Prabang, 1992. Rice yields in kg/ha.

	Fallow periods	Nam Dong area N = 8	Nam Pa area N = 35	Phone Xai area N = 25	Pak Pa area N = 5
River valleys	4		3931	3883	
Upland fields	2		2185	2212	3463
On hill slopes	3	1953	1919	2482	2894
	4	2102	1965	3310	
	5			3468	4586
	>5		2675	3909	
AVERAGE YIELD, CROP CUT		1972	2742	3958	3263
AV. YIELD FARMERS ESTIMATE		1069	1922	2069	602
AVERAGE FALLOW PERIODS		3.1	3.5	4.6	2.8

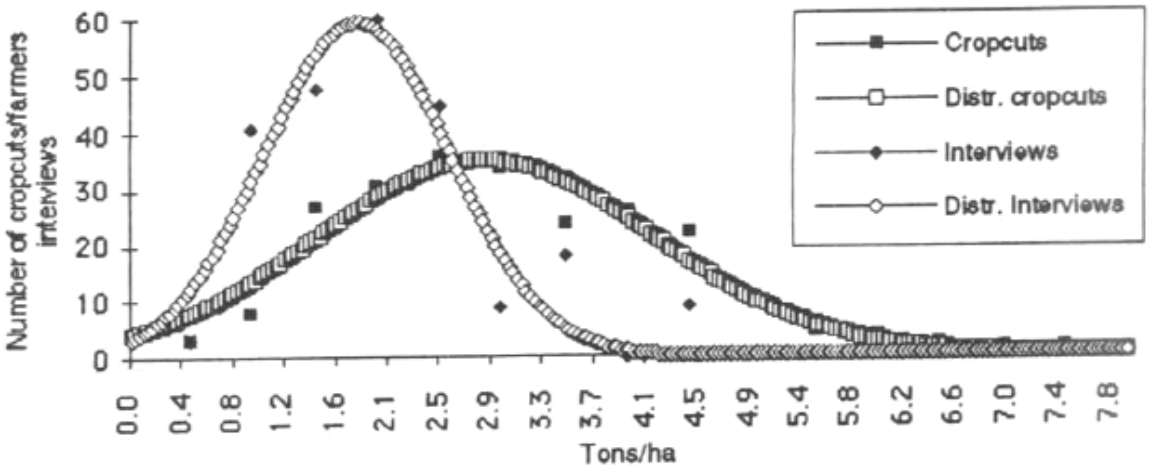


Figure 5: Frequency distribution upland rice yields Results 73 cropcuts and interviews, Micro Projects Luang Prabang, 1992

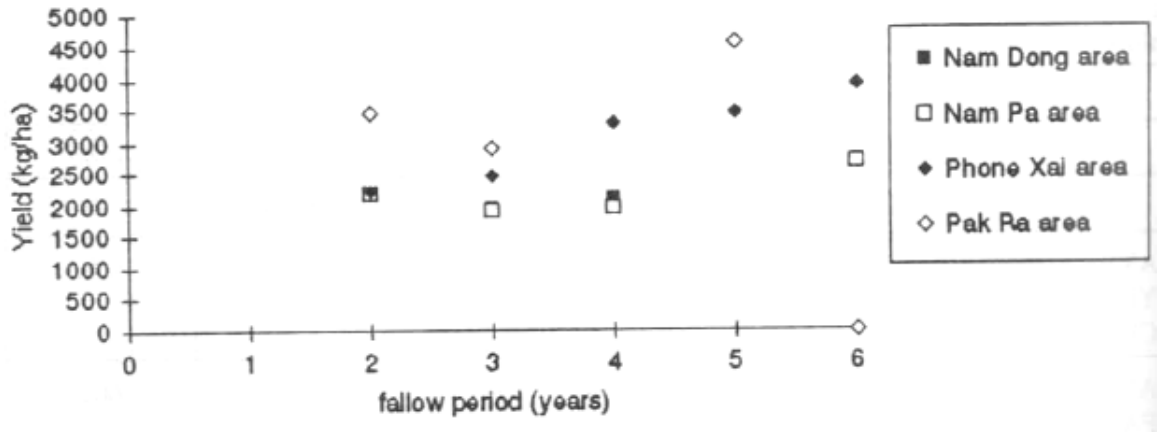
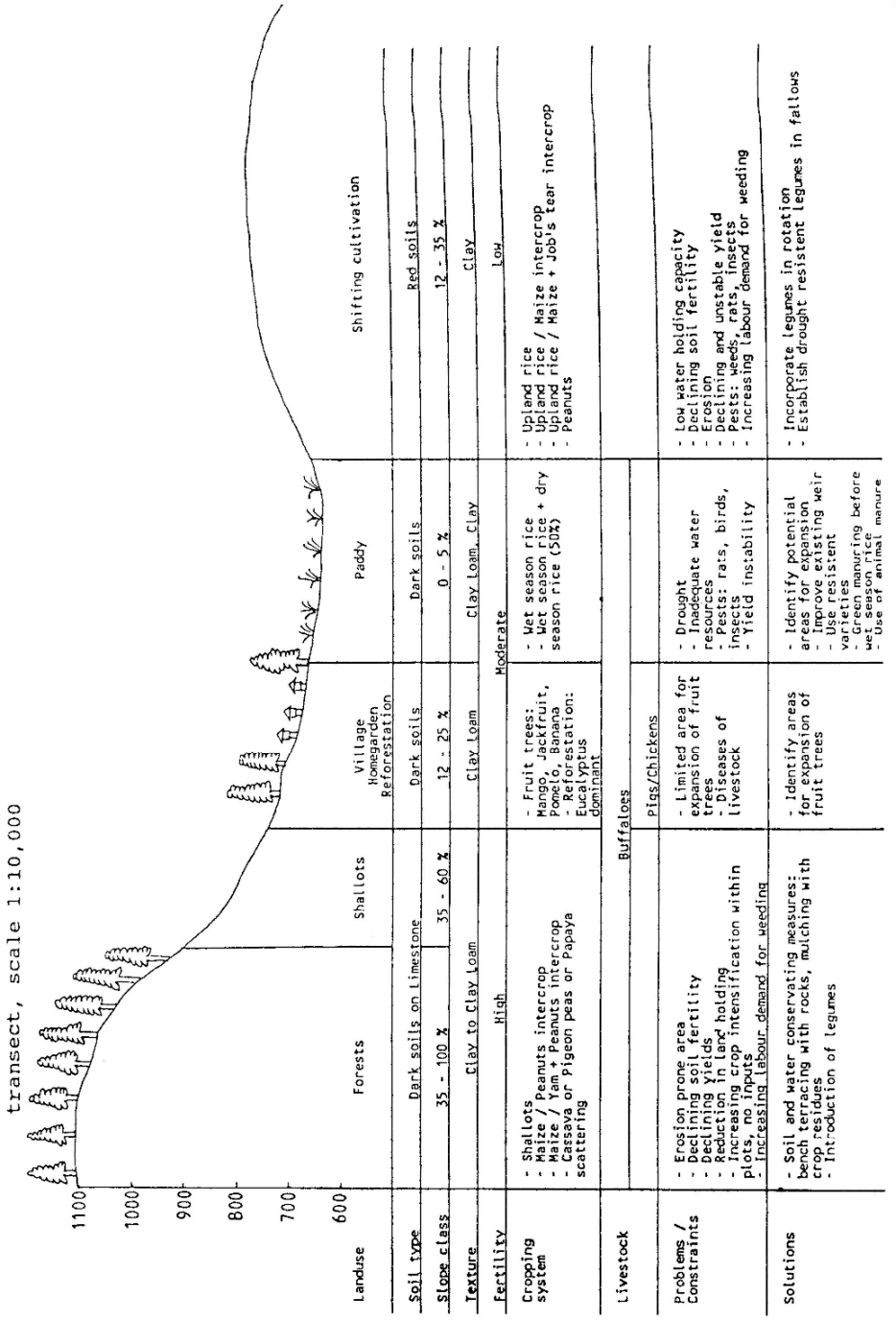


Figure 6: Upland rice yields and fallow period Micro Projects Luang Prabang, 1992 (n=55)

- Expansion of the upland rice area is not possible. Mountains make up more than 66% of the total village area. Mountain slopes are steep (generally over 40%) and unfit for agriculture. Hills occupy 25% of the total area. Less than 40% of the hills has a slope of less than 25%, the dominant slopeclass is 25-35%.
- Paddy rice is not sufficient to cover demand. The area, suitable for paddy rice is limited (6.8 ha). Less than 50% of the families in Huai Thong has a paddy plot. Yields average between 1-2 T/ha. Only limited increases in yield are expected as fertilizers and chemicals are difficult to obtain. An increase in paddy area of 1.5 ha is expected as a result of improved irrigation.
- Cash income will be increasingly necessary to buy rice for consumption. At the moment, families can generate cash from: fruit trees, semi-permanent cash crops, cash crops in hai (e.g. sesame, soya bean), vegetable cropping, livestock, forest products.
- Fruit trees establishment is limited by lack of market. Many families have planted fruit trees. If planted on good soils, they produce well. Further expansion is limited due to lack of market and limited area of good soil.
- The semi-permanent cropping systems are not sustainable. Shallots are being grown on limestone mountain slopes. A new development is the cultivation of pineapple on the loose red soils in the hills. As both crops are mostly grown on steep slopes, with soil tillage and clean weeding, the erosion rates are very high.
- Cash crop in "hai" were not successful. Various legume cash crops have been grown by farmers, such as soya beans, sesame. The yields were low and the price paid for the produce very low.
- Animal raising can be productive. Cattle and pigs are commercially raised in enclosed areas in the mountains. Diseases are limited here and water is more abundant than in the hills. Maize and cassava have been planted by some farmers to feed their pigs.
- Forest products give and extra income. Leaves, seeds, fruits, bark and trees are gathered from the forest, partly for own use, partly for sale. Merchants come to the village to buy these products, e.g. Chandi (Dracaena cambodiana). Moreover, the forest is used as a grazing area.
- Firewood is abundant in the village. The slash and burn system supplies a large part of the demand for firewood.

The advice on land use planning, given by soil scientists, is usually to delineate the land according to slope classes. Farmers are then supposed to limit annual cropping to the lower slope classes, a combination of annual cropping with anti-erosion measures on medium slope classes and planting trees on the steeper slopes. The project tries to overcome the usual lack of adaptation of such advice by discussing the survey findings with the villagers and making a land use plan together with the villagers

Transect, scale 1:10, 000



5. WHAT CAN BE DONE ?

Micro Project Luang Prabang aims to develop a sustainable use of land through a combination of participatory land use planning, rotations of crops with legumes.

The project supports family planning to enable people to control their fertility. It examines ways to diversify family income. Livestock raising is promoted and rice banks have been established.

6. ANTI-EROSION MEASURES

Previous projects working in the area, have tried to introduce terracing contour bounds, and hedge-rows (alley cropping). These efforts were not successful. The amount of labor required was very high and the effect on crop yields was often negative. Grass strips, are much easier to construct and are very effective in reducing surface run-off. Attempts to promote vetiver grass (Vetiveria zyzsanoides) were unsuccessful as farmers found no benefit from the vetiver. Also, its unexpected spreading habit turned vetiver into a weed in one village.

Recently, the price of Lemon grass (C)Inhopogon cirrarus) has risen sharply because of the activity of buyers from a lemon oil factory. This species also has good anti-erosion properties. The good price will be a strong incentive for farmers to plant rows of lemon grass in their fields. The project is presently demonstrating this practice.

7. TREE CROPS

Lack of a market has already been mentioned as a limiting factor to expansion of fruit tree plantations, although market access is being improved by project road construction. In 1992 27,523 timber, fruit and firewood tree seedlings were produced and sold from the project station, of which over 50% were teak.

An interesting development in other project areas is the development of teak plantation (Tectona grandis) by villagers established a nursery. The following year they sold their seedlings to other families. This programme has been very successful and will be expanded this year. The project will also collect data on the plantation of teak by villagers: what type of land is chosen, what are the reasons for planting teak, etc.

8. CROP/LEGUME ROTATIONS

The main requirements of an improved fallow system are weed suppression and soil improvement. The micro-projects programme follows closely the research work done in this field by the Lao IRRI project. Pigeon pea may have a potential. Several farmers decided to test it on their fields, after a visit to the Lao IRRI project.

9. FAMILY PLANNING

In collaboration with the Province Women's Union and Health Service, family planning services (pill and condom) are presently supplied to couples in the pilot area. The acceptance rate, calculated as a percentage of women aged 15-45 years, has risen from 9.0% at inception in January 1993 to 11.3% in June 1993.

This activity is complemented by programmes of infant and mother immunization (>80% completion in 1992), water supply, and improvement of primary education, with a particularly large impact on the education of girls.

10. LIVESTOCK DEVELOPMENT

Poultry, ducks, pigs may have special potential for women, who usually take care of these animals. The biggest bottleneck is health care: the project organizes vaccination, training of village vaccinators. A special women's component will support women livestock groups.

The vaccination rates among cattle and buffaloes are 65-75%, for pigs 20-30%, and for poultry 30-40%. Large animals usually roam in the forests around the village and may be difficult to locate at the time of vaccination.

A cattle credit programme has ben started to establish herds among groups of farmers who did not previously raise cattle.

Pasture development may be economically interesting to cattle owners. The project is testing pasture establishment under farmer conditions. A problem that seems to occur is the lack of pasture maintenance: farmers fence off a pasture area and then put their cattle inside the fence permanently. This leads to overgrazing and to weed infestation, notably from Mimosa invisa, which is difficult to control.

Fish pond development is stimulated by credits for renting a bulldozer for digging and for buying fingerlings. First results show an average growth rate of 75 g/m2, which compares favorably with growth rates obtained in Northeastern Thailand. The growth rate can be further improved by improved fish feeding. The project is working closely with the Provincial Fisheries Station to train fish pond owners.

11. RICE BANKS

Proposals from villagers facing acute food shortage led to the establishment of improved food security through rice banks.

An initial project contribution of about 30 kg of rice per family and a family contribution of about 10 kg was used to establish in each village a bank which releases rice at the time of most critical shortage (June/July when labor is needed for planting and weeding) and recovers the rice with 30% interest at harvest time.

After training, management is completely village based and stocks are increasing rapidly. This capital accumulation may form the basis for different investments in future.

12. CONCLUSIONS

Shortening of fallow periods is inevitable as population increases. To keep population fed and protect soils from erosion, a sustainable, intensive land use system must be developed. Micro-Projects Luang Prabang is working closely with shifting cultivators to analyses their problems and to find solutions. The project does not only look at agricultural systems, but also at land use and socio-economic solutions. Participatory land use planning, livestock development, fruit tree and teak plantations, lemon grass strips and rice-pigeon pea rotations are promising innovations, carried out by the project.

Close cooperation with Province and District authorities and extensive training programmes for staff and villagers also make an important contribution to this process.

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UPLAND AGRICULTURE - ACTIVITIES BY LAO-IRRI PROJECT

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1. Introduction

The Lao-IRRI project is a national program under the National Agriculture Research Center (NARC), Vientiane. The main components/objectives of the project are recearch and training. Within the national program, Luang Prabang was selected as the focal point for upland research and training activities. First research activities were initiated in Luang Prabang in April 1991.

The paper presented does not strictly follow the guidelines provided, since it is expected that most details of slash-and-bum practices in the provinces of Oudomxay and Luang Prabang will be provided through the other projects which specifically work in these provinces. This presentation will focus on the LAO-IRRI project activities and discuss some selected results and survey data generated through these activities.

1.1 Objectives/Research priorities

- Characterization of production systems and environments
- Collection, characterization and improvement of traditional cultivars
- Assessment and development of cropping systems optimizing production, income and soil conservation
- Development of weed management practices
- Yield loss assessment and pest and disease control through IPM

1.2 On-going research and monitoring activities (1993)

1.2.1 Characterization of production systems and environments

Survey:

- Collect information at district level on: upland rice production, constraints, extension efforts, projects etc for Luang Prabang, Sayabouri, Oudomxay, and Luang Namtha Provinces
- Nematodes (Luang Prabang and Oudomxay province)

Monitoring:

- House-hold survey focusing on rice economics (Luang Prabang)
- Soil fertility changes (Luang Prabang)
- Weed and fallow vegetation (Luang Prabang)
- Insect pests (Luang Prabang, Oudomxay, Sayabouri)

1.2.2 Collection, characterization and improvement of traditional cultivars

- Collection of local varieties in Luang Prabang, Pongsaly, Luang Namtha
- Observation nurseries collected material & improved (non-glutinous) (Luang Prabang)
- Evaluation nurseries (Luang Prabang, Oudomxay, Vientiane)

- Variety trials (Luang Prabang, Oudomxay, Vientiane, Borikamxay)
- On-farm variety trials (Luang Prabang, Oudomxay)

1.2.3 Assessment and development of cropping systems optimizing production, income and soil conservation (almost all in Luang Prabang Province)

- Agronomic studies

- Rice planting date effects
- Rice planting density effects

- Cropping systems studies:

- Crop rotation studies
- Intercropping systems
- Agroforestry systems
- Introduction trials with legumes and other crops for forage, green manure and cover crops and potential cash crops
- Introduction/variety trials pigeon pea, cowpea, wheat and maize

1.2.4 Development of weed management practices (Luang Prabang Province only)

- Evaluate effect of different weeding intervals and use of herbicides
- Effects of mulching
- Effect of burning vs not burning
- Weed control through manipulation of fallow vegetation (for example pigeon pea)

1.3 Target area

The technologies developed or adapted through the project activities are expected to be suitable for upland rice growing areas throughout the country. It is anticipated that the research activities will gradually be expanded to all provinces with substantial upland rice growing areas.

2. Summary of selected results

A comprehensive discussion on all our research activities is available in the annual technical reports (Lao-IRRI, 1991; Lao-IRRI, 1992). Additional information on specific topics can be found in publications and presentations such as: shifting cultivation systems (Soukhaphonh et al. 1992; Fujisaka, 1992), soil variability (Roder et al. 1993), and relationship between ethnic group and land use (Roder et al. 1991).

To provide information which may be of interest in the discussions to be held during this workshop, but also to illustrate our past and on-going activities the following examples are discussed in the second part of this paper:

- House-hold survey: land use, constraints to upland rice production. labor inputs, weeds, shift in weed population, and reduction of fallow period
- Monitoring of soil loss, weed population and fallow population dynamics
- Introduction, selection, establishment and effect of potential legumes to replace fallow vegetation

2.1 House-hold survey

House-hold surveys were carried out during July-September 1991 and 1992 using a formal questionnaire supplemented by field observations. Villages visited were chosen randomly. A total

of 127 house-holds were included, located in 3 districts of Oudomxay and 4 districts of Luang Prabang Provinces. The survey questionnaire focused largely on land use related issues. In this paper only the response of the informants related to production constraints, weed, and weed management will be discussed. Respondents were asked to rate a list of possible constraints and enumerate the 3 constraints they considered as the most important.

Current upland rice fields of each individual informant were visited during the interview to record observations on altitude, slope and weed presence. Weed cover and weed frequency were measured by randomly placing a 10 m measuring tape over the rice canopy and recording the weed intervals directly underneath the measuring tape in 1 in sections. The presence of a particular species in a 1 m section was used to compute its frequency. Observations were taken in 4 transects of 10 m in each field. Newly weeded parts of the field were avoided.

2.1.1 Land use, livestock, cash income

On an average, the house holds surveyed had 0.13 ha of lowland rice and 0.83 ha of upland rice (Table 1). The percentage of farmers having lowland rice was 32, 9, and 14 % for Lao Lum, Lao Thung and Lao Sung families, respectively. Farmers belonging to the Lao Lum category were more likely to have lowland rice fields, they grow less maize than the other categories and have the highest rice deficit. Livestock is by far the most important source of cash income (Figure 1). Following the results of this survey the Lao Sung farmers appear to be better farmers in many ways including:

(1) Highest rice yields

(2) Lowest rice deficit

(3) Highest number of fruit trees

(4) Highest number of livestock

(5) Highest crop diversification

Table 13: Area of rice and maize, livestock figures and trees for the ethnic categories[1])

	Loarn		Thung		Sung		Average
	Average	Range	Average	Range	Average	Range	
Lowland rice (ha)	0.25	0-15	0.04	0-0.75	0.09	0-225	0.13
Upland rie(ha)	0.75	0.25-2.0	1.00	0.33-183	0.71	0.33-150	0.83
Maize(ha)	0.12	0-0.67	0.36	0-20	0.49	1-10	0.13
Rice self-sufficiency 1991 (months)	8.1	0-12	8.4	0.12	9.6	4-12	8.6
Buffalo (nos)	1.9	0-10	1.8	0-6	1.4	0-13	1.7
Cattle (nos)	0.5	0-10	0.4	0-5	2.6	0-10	0.9
Pig (nos)	2.0	0-11	3.8	0-15	6.1	0-12	3.7
Banana (plants)	4.2	0-50	12	0-207	26	0-150	13.5
Mango (plants)	3.5	0-15	7.5	0-70	7.9	0-27	6.7

1) Sample size was: Lao Lum 47, Lao Thung 56, and Lao Sung

2.1.2 Constraints

On average weed competition was considered the single most important constraint to upland rice production (Table 2). Some of the other important constraints listed, such as land availability and labor, can be directly related to weeding requirements / problems. Regional differences are obvious for rat problems, drought problems and limits to land availability. There is generally more pressure on land in areas easily accessible by road. It is estimated that about 60% of all villages in Xiengngeun district are within 1 hour walking distance from the road. For Viengkham district this figure will drop to about 30%. It is also noteworthy that farmers consider the available varieties adequate (i.e. varieties were not thought to be a yield constraint).

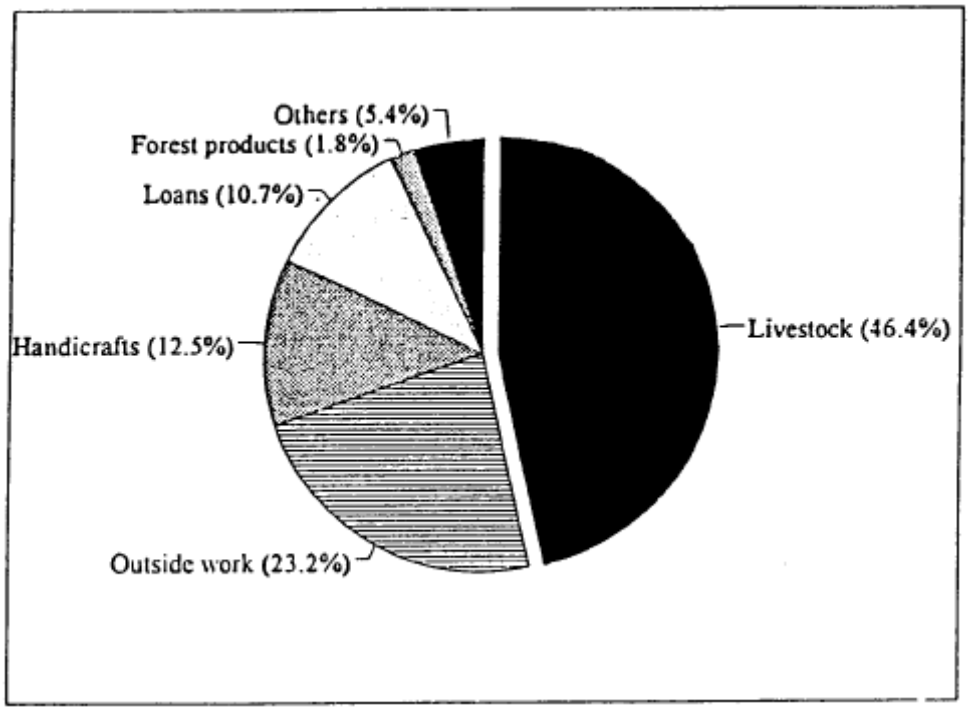

Figure 7: Main sources of cash income (Average from house hold survey)

2.1.3 Labor inputs

Because farmers customarily provide adequate weed control, weeds are less a yield constraint than a constraint to labor productivity. Weed control is by far the most labor demanding task in upland rice production accounting for 40-50% of total crop labor input (Table 3). Generally 3-4 weedings are required per season with a labor input of 147-643 days per ha. Because fields are burned in March, about 2 months before rice planting, a first weeding is often necessary before planting. Other tasks requiring appreciable labor inputs are initial field slashing and harvesting. Assuming an average yield of 1.5 MT and labor inputs of 300 days ha-1 farmers can expect 5 kg of rice per working day. Similarly 120 days ha-1 were required to produce 1.05 MT of rice in lowland production systems in Southern Laos (Schiller et al. 1991). The return on labor input is thus much lower when compared to lowland production systems, whether in Laos or in other Asian countries (De Datta, 1981). Local prices of rice and wage for labor are presently 70-100 kip kg-1 rice and 500-700 kip per labor day (1 US $ = 700 kip). At these rates slash and burn farmers still earn a daily wage which is comparable to the local labor rates.

It was generally difficult for farmers to recall the labor input for the previous season and labor inputs reported were highly variable. Differences in weed cover, working habits, distance from village, rainfall, all add to the variation. Error in area estimates may grossly magnify errors made in labor estimates. For this reason only the relative (%) contribution for each task is shown from the house-hold survey. The figures from the house-hold survey, covering a much larger geographical area, are, however, comparable to those obtained from monthly monitoring of 16 households.

Table 14: Major constraints to upland rice production indicated by slash and burn farmers of Luang Prabang and Oudomxay province

	Frequency (% of respondents)				
Constraint	Oudomxay	Viengkham	Pakseng	Xiengngeun	Average
Weeds	81	83	95	83	85
Rodents	12	85	80	38	54
Insufficient rainfall	47	49	10	83	47
Land availability[1)]	47	11	45	62	41
Insects[2)]	69	34	20	29	34
Labor	31	25	25	17	24
Soil fertility	31	26	0	29	21
Erosion	9	9	15	25	15
Domestic animals	16	21	15	8	15
Wild animals	6	22	10	4	11
Disease	6	19	5	0	8
Suitable varieties	0	0	0	0	0
Sample size	32	53	20	24	129

1) Also included the constraint "short fallow period"

2) Mostly white grub

Table 15: Labor requiement for upland rice production

	House hold survey	Additional survey	
Activity	Percent	Days ha^{-1}	Percent
Slashing	14	33 (12-61)	11
Burning	< 1	2 (1-3)	< 1
Fencing	3	2 (0-10)	< 1
Second burning	6	14 (5-30)	5
Weeding[1)]	1	13 (0-40)	4
Planting	9	29 (16-44)	10
Weeding	41	146 (45-455)	50
Harvesting/threshing	16	33 (20-71)	11
Transport	8	22 (7-47)	7
Total		294 (147-643)	

1) Includes weeding before planting

2.1.4 Weed species

Measurements in the field show Chromolaena odorata to be the most frequent and most abundant weed species accounting for 45, 34, 27, and 27 % of the total weed cover in Oudomxay, Viengkham, Pakseng and Xiengngeun, respectively (Table 4). Ageratum conyzoides, Lygodium flexuosum and Commelina sp. (mostly C. benghalensis) are very abundant in all regions surveyed. The latter is difficult to control because it can root easily from

nodes of small stem segments left in contact with moist soil. Imperata cylindrica is present but was not a problem except in very small pockets. Pteridium sp. and Cyperus trialatus although present in most areas was abundant in Viengkham district only.

The major weed species appear to be adaptable to a wide range of environmental factors. Correlation analysis between elevation, fallow period, selected soil fertility parameters and the frequency of weed occurrence showed no or little relationship. Although Chromolaena odorata is the most abundant weed species farmers generally do not consider it a major weed. Because of its growth habit (relatively few, but large plants, no rooting from above ground plant parts) it is much easier to control by hand weeding than some of the other species such as Commelina sp., or Lygodium flexuosum. Farmers like to have Chromolaena odorata in their field as a fallow species. When asked to list good fallow species, 76, 17, and 11 % of the respondents listed Chromolaena odorata, Castanopsis sp. and Dendrocalamus sp., respectively. Preference of Chromolaena odorata may be partly related to its dominance under good soil conditions but also because of its fast growth and large biomass production. Similar preferences for Chromolaena odorata as a fallow species were reported from Nigeria (Ruthenberg, 1980).

2.1.5. Shift in weed species and weeding requirements

Major weed species listed by the elderly persons interviewed were similar to those listed in the house hold interview and are not shown separately. Following the recollection of the persons interviewed no major shift in weed species occurred over the last 40 years. The introduction of Chromolaena odorata has apparently not resulted in a major displacement of other species. With a coincident reduction in fallow period the spreading Chromolaena odorata may have largely replaced tree species coppicing from old plants or growing from seeds.

The average fallow period reported was 38, 20 and 5 years for the 1950s, 1970s and 1992, respectively. Over the same period the average weeding inputs increase from 1.9 weedings in the 1950s to 3.9 weeding in 1992 (Figure 2). In his detailed description of land use practices by Lamet farmers in today's province of Oudomxay Izikowitz (1951) reported fallow periods of 12-15 years and weeding inputs in June and July. With weeding limited to a period of two months only, the weeding intensity may have varied from 1 to 2 weedings per season. . Effects of reduced fallow length are likely to become more pronounced after the same areas have been used for several short cycles. Weeding requirements and soil fertility problems may thus increase further in the near future. Increase in weed problems and decrease in soil fertility are widely cited as negative results of decreased fallow periods in shifting cultivation systems (Mishra and Ramakrishnan, 1983; Moody, 1974; Ruthenberg, 1980). The Lao farmers may be close to the critical point where it will be profitable for them to shift to a more intensive land use system.

Table 16: Cover and frequency of major weeds

Weed species	Oudomxay		Viengkham[1]		Pakseng		Xiengngeun	
	F[2]	C[3]	F	C	F	C	F	C
Chromolaena odorata	68	9.7	32	6.5	36	1.9	64	4.4
Ageratum conyzoides	31	6.6	23	5.5	11	0.7	60	3.4
Commelina sp.	18	2.6	8	1.3	22	1.2	58	3.4
Lygodium flexuosum	13	1.8	13	1.6	28	1.8	34	1.6
Panicum trichoides	5	0.5	3	0.4	6	0.3	32	1.5
Corchorus sp.	3	0.3	8	1.5	8	0.6	10	0.4
Pueraria thomsonic			7	1.3	5	0.2	12	0.7
Panicum cambogiense			4	0.5			8	0.5
Imperata cylindrica			1	<0.1	4	0.2	4	0.2
Mankep			4	0.4	2	0.1	<1	<0.1
Crassocephalum crepidioides	<1	<0.1	1	0.1			2	0.1
Total cover(cm m^{-1})		22		19		7		16

(1) Additional species of inqxmance in Viengkliam district were Clperits trialut is and Firridius sp. with frequencies of 26 and 13 % and cover of 4.5 and 3.3 cm ni'l , respectively.

(2) Frequency in transect segments of I m

(3) Covet in cm m^{-1}

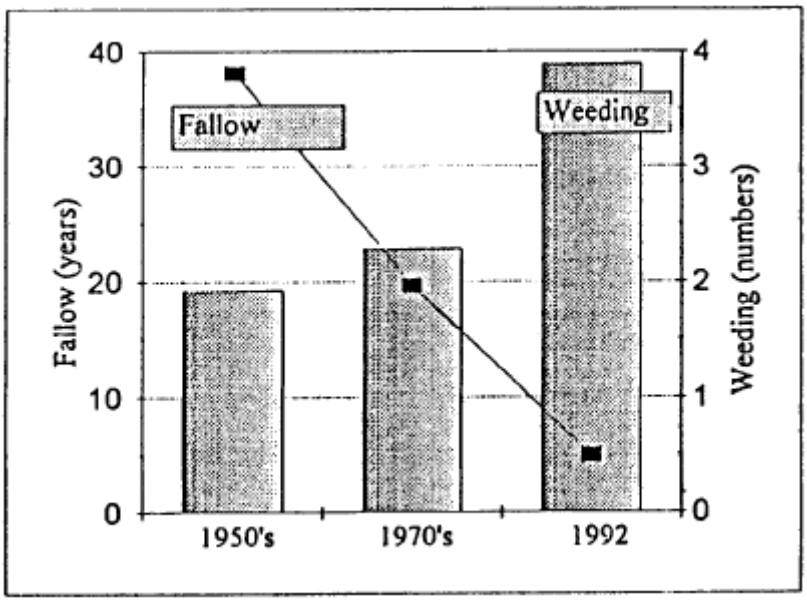

Figure 8: Change in weeding requirements (number of weedings) and fallow period (years) over the last 4 decades.

2.2 Monitoring soil fertility and weed dynamics

Seven monitoring sites with an area of 0.04 ha (20 m x 20 m) were selected in the Xiengngeun district in 1991 and an additional 4 more sites were included in 1992. Weed cover and biomass, fallow vegetation, litter fall, changes in selected soil parameters and soil loss have been monitored over time. The number of sites monitored has been reduced to four in 1993. A summary of our findings from soil loss measurements and weed and fallow vegetation dynamics is presented here.

2.2.1. Soil loss

Soil loss was measured at 3 sites during the growing season of 1992 with the objective to asses the extent of soil and nutrient loss during the cropping and the fallow period. Soil accumulated in collection ditches at the bottom of the field (20 m long, lined with plastic) was collected monthly from May to October.

Soil loss varied substantially between sites (Table 5). The differences observed are probably caused by the combined effect of soil physical (texture, clay type, water infiltration) and biological differences. Soil loss at site C4 with a slope of 40 % was insignificant. At the other two sites the soil loss observed although high, was still within the limits generally reported for the region. The results of these measurements show clearly how difficult it would be to make large scale soil loss estimates or draw general conclusions or draw generalized conclusion from soil loss measurements comparing specific treatment effects.

Figure 9: Soil loss from 3 sites in Xiengngeun district during the 1992 cropping season

Site	Slope	Soil loss in MT ha^{-1}						
	(%)	May	June	July	Aug	Sept	Oct	Total
C4	40	0.13	0.09	0.09	0.10	0.02	0.02	0.44
C5	40	0.16	16.15	8.47	0.81	1.82	1.92	29.23
C6	55	0.15	14.62	8.78	1.22	0.72	0.72	26.21

2.2.2. Weed composition and biomass at the time of rice harvest

Weed biomass was measured for the last two weedings and immediately after harvest (10 frames of 1 m2 per site). The presence of a particular weed species in the frame was used to compute the frequency.

Average weed biomass (including bamboo and trees) present at the time of rice harvest was 127 and 67 g m-2 in 1991 and 1992, respectively (Table 6). Lower rainfall, comparatively poor soil condition of the 1992 sites (soil depth), and variations in weed control probably contributed to the lower total weed biomass in 1992. Important tree species were Cratoxylon and Castanopsis sp. Similarly as reported from the house hold surveys, Chromolaena odorata is by far the most important weed species. Chromolaena odorata and Lygodium flexuosum accounted for 60 and 58% of the herbaceous weed biomass (excluding tree and bamboo) in 1991 and 1992, respectively. The relative importance of Chromolaena odorata and trees remained the same over the season.

Figure 6: Plant biomass present at the time of rice harvest as measured in montioring plots in Luang Prabang during 1991 and 1992 *

	1991		1992	
Species	Dry matter	Frequency	Dry matter	Frequency
	(g m-2)	(%)	(g m-2)	(%)
Chromolaena odorata	23 (0--42)2)	100	8 (3-14)2)	87
Conyza sumatrensis	10 (0-33)	69	1 (0-3)	7
Other broad leaf	13 (4-24)	70	13 (3-30)	90
Lygodium flexuosum	17 (7-43)	69	17 (9-20)	73
Grasses	4 (0-9)	30	4 (1-10)	53
Bamboo	15 (0-65)	24	1 (0-2)	7
Trees	45 (7-86)	90	23 (10-66)	92
Rice stems	168 (57-218)		115 (70-153)	

(1) Average of 7 and 3 sites for 1991 and 1992. respectively

(2) Range observed

Figure 10: Results of plant analysis of major species observed at the time of rice harvest in 1992

Species	N (%)	P (%)	K (%)	Ca (%)
Chromolaena odorata	0.41	0.16	0.28	0.48
Pueraria thomsonic	0.81	0.12	0.15	0.38
Ageratum conyzoides	0.36	0.15	0.28	0.93
Lygodium flexuosum	0.41	0.11	0.18	0.35
Panicum cambogiense	0.29	0.10	0.20	0.35
Tree	0.43	0.15	0.11	1.16
Rice stems	0.28	0.08	0.20	0.32

2.2.3. Composition and biomass of fallow vegetation

Average biomass (including bamboo and trees) measured at the end of the 1992 growing season was 9.8 MT ha-1. (Table 8). Chromolaena odorata was by far the most important fallow plant contributing 28-75 % of the total biomass.

Figure 11. Biomass of fallow vegetation measured in December 1992 (one year after rice harvest)

	Biomass (MT ha^{-1})				
Species	Long-O 1	Long-O 2	Phonthong 1	Phonthong 2	Average
Chromolaena odorata	3.43	6.93	4.38	4.49	4.8
Lygodium flexuosum	0.73	1.75	0.03	0.04	0.7
Other broad leaf	0..13	-	0.71	1.35[1)]	0.6
Grasses[2)]	-	0.03	0.49	0.07	0.2
Bamboo	-	-	7.27	1.11	2.1
Cratoxylon sp.	3.83	0.49	-	-	1.1
Other trees	-	-		1.81	0.5
Total	8.62	9.21	15.57	8.87	9.8

1) Mainly Kue

2) Mainly Panicum cambogiense

2.3 Cropping systems - Improved fallow

The work with cropping systems has become the most important component of our activities. A wide range of systems is evaluated including rotations, strip cropping, intercropping, relay cropping, agroforestry etc. Crops included in these studies include fodder crops, green manure crops, cover crops, grain legumes, various cereals, and trees. The activities can be grouped into

- Introduction, evaluation and selection of varieties/species
- Establishment
- Effect on succeeding crops or companion crops

As an example to these activities some of our work with cover/fodder crops is presented below.

2.3.1. Introduction, evaluation and selection of varieties / species

Introduced and local species which may have potential as: food, feed, fodder, soil cover, green manure, fallow or hedge plants were sown in a nursery at the Houay Khot station as and when seed became available.

Figure 12. Species, observations on seed production, weed suppres sion", and biomass production

Legume species	Observations 1991			Observations 1992		
	Planting date	Seed date (g m^2)	B.mass 11/11	Weed		B.mass
1. Cassia rotundifolia	22.7. 91	14/1 (1 g)	3	2	3	2
2. Desmanthus virgatus	22.7. 91	n.m.[2]	4	4	3	6
3. Centrosema acutifolium	22.7 91	4/1 (1 g)	3	4	5	5
4. " Macrocarpum 5713	22.7 91	n.m.	3	4	6	6
5. " " 5657	22.7. 91	n.m.	3	6	4	5
6. " brasilianum 5234	22.7. 91	14/1 (18 g)	3	4	4	3
7. " " 5657	22.7. 91	4/1 (3 g)	3	4	6	3
8. Dolichos lablab (Rongai)	16.8. 91	19/2 (90 g)	9	10	9	9
9. Zorinia glabra	22.7. 91	f.p.[3])	1	1	f.p.	1
10. " latifolia	22.7. 91	26/12 (13g)	1	1	5	1
11. Desmodium ovalifolium	22.7. 91	-	-	-	f.p.	f.p.
12. " uncinatum	22.7. 91	-.	-	-	f.p.	f.p.
13. Croltolaria juncia	15.6 92	-	-	-	6	6
14. " anagyroides	15.6. 92	-	-	-	6	7
15. " local	15.6. 92	-	-	-	f.p.	f.p.
16. Tehphrosia vogelii	15.6. 92	-	-	-	f.p.	f.p.
17. Calopogonium caeruleum	15.6. 92	-	-	-	8	3
18. Ruzzi grass	21.7. 92	-	-	-	f.p.	f.p.
19.						
20. Pueraria Javanica	20.8. 91	n.m.	1	1	4	2
21. Calopogonium mucunoides	20.8. 91	26.2 (50 g)	6	2	4	2
22. Cajanus cajan ICP 11298	7.8. 91	20/2 (20 g)	10	10	10	10

23. " " ICP 8094	7.8. 1	20/2 (70 g)	10	10	10	10
24. " " ICP88040	7.8. 91	20/2 (80 g)	10	10	10	10
25. Aeschynomene Americana	22.7. 91	5/11 (80g)	9	-	-	-
26. " histerix	22.7. 91	n.m.	4	-	-	-
27. " afraspera	22.7. 91	1/12 (20)	8	-	-	-
28. Stylosanthes Cook	15.6. 92	-	-	-	8	8
29. " guianensis	22.7. 91	n.m.	3	10	8	8
30. " hamata	7.8. 91	26/2 (2 g)	3	4	7	6
31. " seca	7.8. 91	n.m.	3	8	6	8
32. Centrosema pubescens	20.8. 91	4/1 (4 g)	3	4	6	5
33. Sesbania rostrata	22.7. 91	10/12 (50G)	8	-	-	-
34. Lablab local	21.7. 92	-	-	-	3	1
35. Brachiaria brizantha	22.7. 91	n.m.	10	10	9	8
36. " decumbens	22.7. 91	n.m.	8	6	-	-
37. Pueraria phaseoloides	15.6. 92	-	-	-	6	6
38. Siratro	15.6. 92	-	-	-	4	3
39. Mucuna cochinchiensis	15.6. 92	-	-	-	8	9
40. Centrosema plumieri	15.6. 92	-	-	-	6	7
41. Guinea grass hamil	21.7. 92	-	-	-	f.p.	f.p.
42. Guinea grass purple	21.7. 92	-	-	-	f.p.	f.p.

1) core scale used: Weed suppression 1 = no effect , 10 = 100 % weed suppression

Biomass yield 1 = < 1 MT, S = 3 MT, 10 = > 6 MT dry matter ha-I

2) .m. = not measured

3) f.p. = few plants only (planting density too low to assess performance)

Observations taken include: seed production, biomass production, weed suppression and persistence. Overall pigeon pea, Stylosanthes guianensis, lablab, and Brachiaria brizantha are the most promising species (considering weed suppression, ease of seed production and biomass production) (Table 9). The species Crotolaria anagyroides, Tehphrosia vogelii, Calopogonium caeruleum, Centrosema plumieri and Pueraria phaseoloides are also very promising but have been under observation for one season only.

Promising species are:

Fast initial growth:	8, 13, 14. 21, 22, 23, 24, 25, 39
Soil cover:	8, 17, 28, 29, 30, 31, 35, 37, 40
Weed suppression:	8, 17, 22, 23, 24, 28, 29, 35, 39
Biomass production:	8, 14, 17, 22, 23, 24, 31, 35, 39
Seed production:	8, 10, 13, 14, 21, 22, 23, 24, 25, 33, 39

2.2.2. Establishment by broad casting in standing rice crop

The legumes 1) Lablab, 2) Pigeon pea, 3) Calopogonium mucunoides, 4) Centro, 5) Pueraria phaseoloides, 6) Crotolaria juncia were broadcast sown into a standing rice crop at monthly intervals, starting from 16. June. This method of establishment would allow the farmer to get a legume cover without any extra labor. The following observations were made (Figure 3, Table 10):

- The rice yield harvested was 3.8 MT ha-1 on average and was not affected by the legume.
- Good establishment when broadcasting seed in June to August for calopogonium, pueraria and centrosema.
- Irregular, insufficient establishment of pigeon pea, crotolaria and lablab at all planting dates.
- Pigeon pea and crotolaria have low shade tolerance and will not survive in a good rice crop unless planted early.
- Pigeon pea and crotolaria if planted early are expected to cause yield decrease of rice.

Figure 13. Summary table of analysis of variance for rice yield, density and cover of legumes at the harvesting

Category	Rice yield	Legume density	Legume cover
Planting date (A) (PR> F)	NS	<0.01	<0.01
Legume (B) (PR> F)	NS	<0.01	<0.01
A x B (PR> F)	NS	<0.01	<0.01
CV (%)	16.6	56.3	82.5

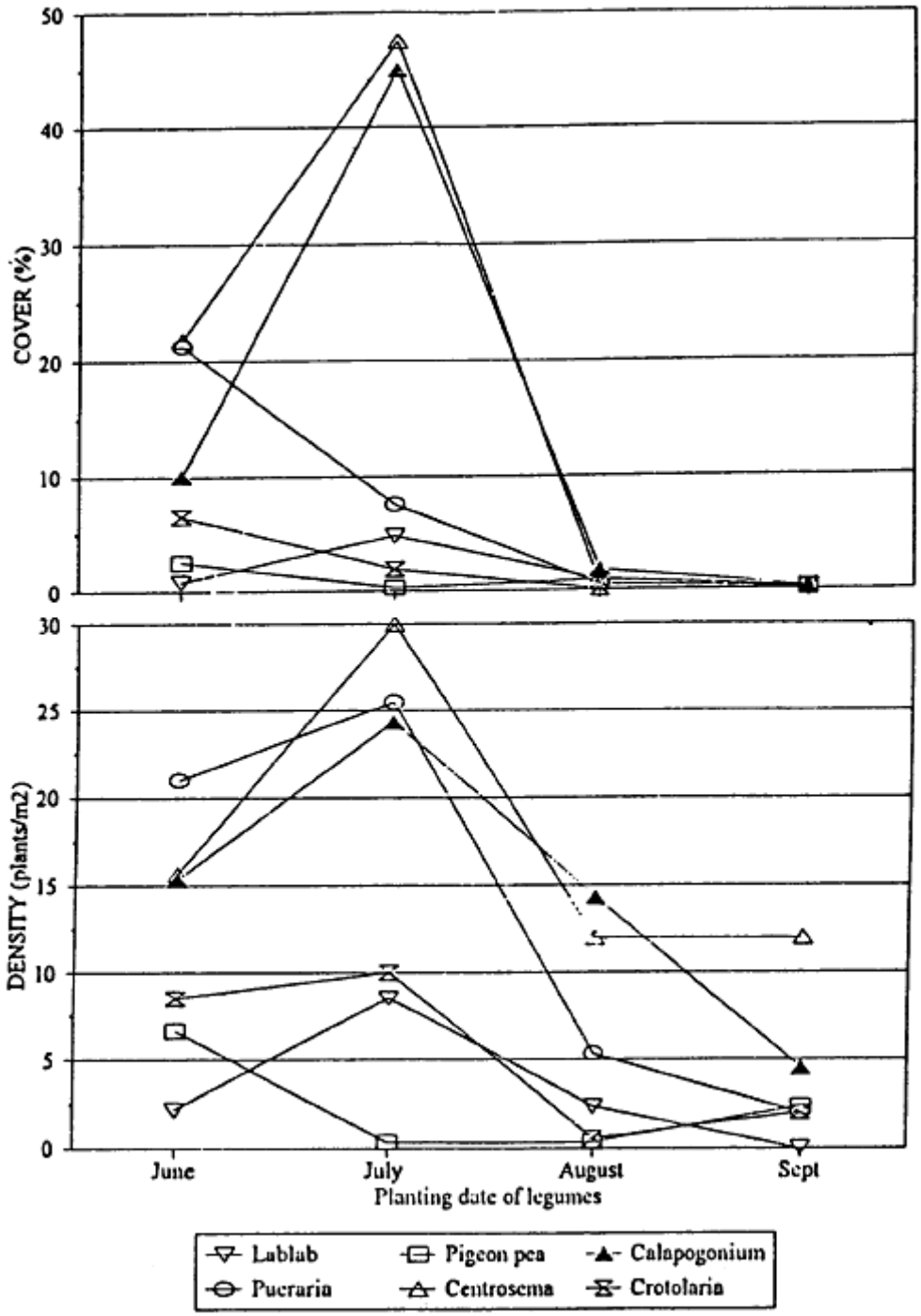

Figure 14: Legume cover (%) and legume density (plants m-2) at the time of rice harvest

2.2.3. Establishment by planting mixed with rice seed

Leucaena and pigeon pea (2 varieties) were planted mixed with the rice seed (same hill) at distances of 75 cm (every 3th row) or in separate rows. Pigeon pea strongly competed with rice crop from the time of flowering onwards and significantly reduced rice yield (Table 11). Both legumes established well, irrespective of planting method (Table 12).The plant height of leucaena was greater if planted separately but establishment was not affected.

Mixing seed with rice seed at the time of planting appears to be a possible method of establishing leucaena and other perennials with similar growth dynamics (local cassia and calliandra). Further investigations may include wider planting distance and trimming pigeon pea shortly before flowering of the rice plant.

Table 17. Treatrnents and rice yield

Treatment	**Rice yield (MT/ha)**
1. Control (rice only)	1.67
2. Pigeon pea ICP 11298 mixed	0.80
3. Pigeon pea ICP 8094 mixed	0.71
4. Leucaena mixed	1.80
5. Pigeon pea ICP 11298 row	0.60
6. Pigeon pea ICP 8094 mixed	0.52
7. Leucaena row	1.51
LSD (alpha 0.05)	0.40
CV (%)	24.6

Table 18. Establishment and growth of Leucaena (observations made on 4.12.92)

Treatrnent	Establishment (%)	Plant heingth(cm)
Planting mixed with rice	73	50
Planting in separate row	74	78
PR> F	NS	0.02
CV (%)	11	14

3. Conclusions and recommendations

The strong dependence on rice production and the preference for rice as a staple food is a major obstacle towards a shift to more productive systems.

In contrast to many traditional slash-and-burn systems (Raintree and Warner, 1986), the present upland rice production system practiced by the Lao farmer provides only marginal returns on labor. Labor inputs for weeding have increased dramatically over the last decades because of shorter fallow cycles. Weed pressure is expected to further increase, as the effect of shorter fallow may become apparent only after several cycles

Farmers are well aware of the effect of fallow length on weed abundance during the cropping period. Regulations on land use and increasing population pressure, however, do not allow them to maintain long fallow for weed management.

The high labor requirement coupled with governments intervention put heavy pressure on the farmers to change to other systems. The Lao farmers may thus be close to the critical point where it will be profitable for them to shift to a more intensive land use system.

Chromolaena odorata, followed by Ageratum conyzoides, Lygodium flexuosum and Commelina sp. are the most important weeds throughout most of the areas surveyed.

It can be expected that changes will take place. Support from the various development agencies to facilitate the transition period will be critical.

3.1. General recommendations

The government in its commitment to the development of the uplands, should seriously address the problems of:

Land tenure

Market

Education

Alternative employment opportunities

Population planning

The overall objective of agriculture development should be better living standard for the farming population rather than rice production. Farmers need to have the means to purchase food, clothes, medicines and other essential items when required. They should have access to better education.

Cash income should be generated in a diversified system to minimize market risks. Systems introduced should remain flexible to allow for rapid adjustment to market changes.

Laos' comparative advantage in agriculture, lies in its large land reserves and the comparatively low population density. Production systems requiring large areas but moderate labor inputs are expected to be most competitive. Livestock and timber production may therefore have the best potential.

Vaccination programs to protect the livestock and credit facilities to allow farmers to buy livestock and help them to capitalize on their timber plantations will be extremely important.

3.2. Recommendations relating to agricultural techniques

Perennials (fruit trees, timbers, spices, fodder) should be the main focus in any development activities.

Changing from slash-and-burn methods to systems using field preparations without burning is essential to allow the combination of annual crops with perennials and to conserve moisture.

The traditional system used by farmers is a "non-tillage" system. Although tillage could help to reduce weed pressure and may provide some short term fertility boosts it should not be considered as an alternative because of its negative effect on soil conservation.

It is often found, that a farmer may cultivate a field for periods of 5-10 years and only plant perennials when the productivity has declined. At this stage the conditions for tree growth are far from optimal. Any system (grass strips or alley cropping) that helps the farmer to postpone the planting of perennials is potentially very harmful to his long term interest.

Chromolaena odorata has various properties of a good fallow plant such as large seed production, fast establishment, suppression of grass weeds, height biomass production, and its ease of elimination by hand weeding. In future studies comparing improved fallow systems Chromolaena odorata treatments should be included as control treatments.

For "improved fallow plants" to be superior to Chromolaena odorata they will have to provide benefits such as:

a. forage

b. make it possible to convert from fallow to crop without burning

Fallow cycles of 3-5 years or rotation cycles of the same period would require at least 20 years of monitoring (3-4 cycles) to evaluate whether a system would maintain or improve the existing resource potential.

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TRADITIONAL UPLAND RICE VARIETIES IN LAOS

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Introduction

Following the 1992 statistics, upland rice accounted for 34 % of the national rice area and for 20 % of the annual rice production (State Statistical Center, 1992). Upland rice is grown in all provinces of the country and is always the major crop in all slash-and-burn systems practiced. Most farmers prefer glutinous, aromatic rice, while non-glutinous rice is generally only produced for the market or for special preparations such as noodles. A few ethnic groups mostly belonging to the category of the Lao Sung, specially the Hmong and Yao, prefer non-glutinous rice.

Rice cultivars used by the Lao farmers represent a very wide genetic diversity. This remarkable range is partly the result of the tremendous cultural and geographical diversity found in the country. Further more wild rices occur scattered in forested uplands as well as in lowland swamps. To preserve this genetic wealth a systematic collection and storage of the traditional varieties is very important.

Objectives/Activities of LAO-IRRI Project

Collection, characterization and improvement of traditional cultivars are the major activities of the Lao-IRRI project. So far a total of 544 upland cultivars have been collected in 7 provinces (Table 1). All entries collected are evaluated in observation nurseries at the Houay Khot station (single plots) and also forwarded to IRRI Los Banos to be included in the global germplasm collection, where they are stored in special long-term storage facilities. The most promising entries are selected for further observations in on-station and on-farm yield trials with the objective of identifying high yielding cultivars which are adapted to the prevailing conditions (Table 2). Important selection criteria include drought tolerance, adaptation to a wide range of soil conditions, tolerance to major disease and pests and acceptable grain qualities.

Figure 15: Upland rice cultivars collected from 1990, 1991 and 1992 harvest[1])

Province	1990	1991	1992
Luang Prabang	92	108	
Oudomxay	101	37	13
Luang Namtha		25	16
Houapanh		37	28
Xieng Khouang		41	9
Vientiane		17	
Sayabouri			10
Total	**203**	**265**	**76**

1) Provincial agriculture service staf and various projects helped considerably in the collection effort

Figure 16: Summary on varietal observations/testing for upland rice 1993

Type	Entries	Design	Plot size (m^2)	Locations
Observation nursery a) Improved varieties b) Traditional varieties		Single plot	3	• Houay Khot
Evaluation nursery	34	Single plot	4	• Houay Khot • Oudomxay • Hinhup • Nabong
Yield trial	12	RCB 4 replications	8	• Houay Khot • Pakso (high elevation) • Thonkhang • Oudomxay • Nabong • Borikhamxay
On-farm testing	4	Single plot	60 g seed	• Xiengngeun (20) • Viengkham (10) • Luang Prabang (10) • Oudomxay (15)

Traits of upland varieties

The following discussion will be based largely on field observations made on traditional varieties collected from the 1990 and 1991 harvests from 6 provinces with major upland rice growing areas.

Glutinous rice

Laos is the geographical center of a zone where farmers and urban dwellers prefer to eat glutinous rice. While Lao PDR is the only country where glutinous rice is the main staple, it is of regional importance in the surrounding areas of Burma, China, Vietnam, Cambodia and Thailand. The endosperm of glutinous rice is opaque when dry and becomes "sticky" when heated. This property is caused by a difference in the content of amylose and amylopectin. Starch of non-glutinous rice has approximately 20% amylose and 80% amylopectin. Glutinous starch contains mostly amylopectin (Watabe 1967). Rice samples from Northeastern Thailand had an average apparent amylose content of 21.7 and 4.3 % for non-glutinous and glutinous rice, respectively (Sriswsdilek et al. 1992). The glutinous property is genetically transferred by a single recessive gene. Watabe (1967) thus suggested that glutinous varieties may be mutants of non-glutinous varieties.

Varietal classification

Most Lao agronomists claim that they can distinguish upland rice grains and plants from lowland plants or grains. The main characteristics used to differ between the two types are grain size, aroma, tiller numbers and stem diameter. The same characteristics generally differentiate between the varietal groups I (indica type) and VI (japonica and javanica types) as discussed by Glaszmann (1987). Most traditional upland varieties are expected to belong to group VI, while most improved lowland varieties belong to group I. Following enzymatic tests carried out at IRRI Los Banos for upland cultivars collected from the 1990 harvest, 58 % of the varieties tested were type VI, while the remaining entries consisted of type I (28 %), hybrid between type I and VI (0.6 %) and mixtures (14%).

Morphology and maturity groups

Typical upland rice varieties have few but long panicles, medium to long helms, thick stems, and large grains. Large panicles, large grain, lodging resistance and drought resistance are important selection criteria applied by the Luang Prabang farmers (Table 3). Most farmers plant 3-6 varieties. Farmers clearly differentiate between early (kau do), medium (kau kang) and late (kau pi) varieties and most farmers will be planting varieties of each group. This allows them to get rice for consumption as early as possible, stagger labor requirement for harvest, and spread risks.

The material observed showed a wide range in characteristics such as plant height, days to flowering, and panicle numbers (Table 4). The number of days required from planting to flowering ranged from 81 to 132, but about 90 % of all entries observed flowered with in 90-120 days after planting (Figure 1). Varieties belonging to the medium maturity group are by far the most important for the farmers in terms of number of varieties available and area planted.

Plant height at maturity ranged from 88-171 cm. Plant height showed strong positive correlation with yield in both years (Table 5, Figure 2). Lodging was not a serious problem except for very few entries. Plant vigor and height are also expected to be important properties for weed suppression.

Figure 17: Farmers selection criteria[1)]

	Most important characteristic	Minor characteristic
Desired	* Large panicle	* Height tillering
	* Large grain * Adapted to environment * Lodging resistance * Drought resistance * Eating quality (glutinous, aromatic)	* Easy shattering/easy harvesting * Grain color * Moderate plant height * Early maturity * Consistent yield over years * Uniform heading * Weed competition
Undesired	* Long awn * High tille ring * Non-glutinous * Ernpty grains	* Disease resistant * Late maturity * Difficult threshing * Low tillering * Short plant height

1) Criteria listed by 3 groups of Lao Lum and Kamu farmers of Xiengngcun district (1992)

2)

Table 19. Summary of some characteristics observed

Variable	Entries		Average		Range		St. Error	
	1991	1992	1991	1992	1991	1992	1991	1992
Days to heading	198	272	103	101	81-132	84-131	0.71	0.23
Plant height	191	265	151	127	88-185	85-171	1.23	0.94
Panicle/hill	194	265	6.9	7.8	2-17	4-13	0.16	0.10
Panicle (g)	193	263	2.4	1.1	0.2-6.9	0.2-2.9	0.08	0.03
Yield (g/hill)	194	263	15.9	8.1	1.3-49.7	1.4-20.0	0.58	0.19

Table 20. Correlation between characteristics observed

Variable	Yield (g/hill)	
	1991	1992
Days to heading	-02-.24***	-0.09
Plant height	0.15**	0.36***
Panicle numbers	0.49***	0.03
Panicle weight	0.75***	0.87***

*** Probability >F <0.10

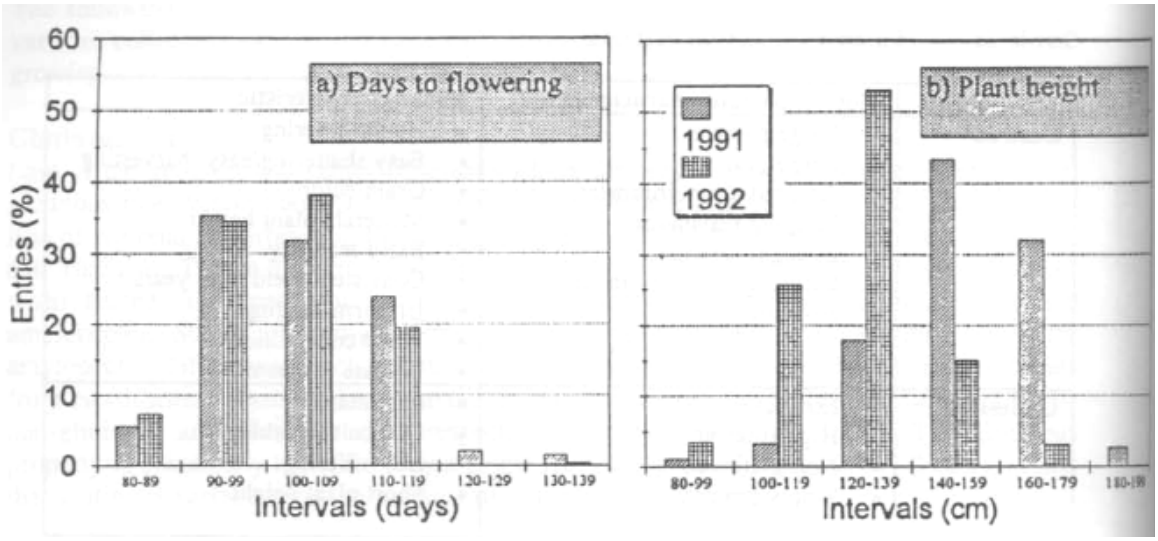

Figure 1: a) Frequency distribution days to flowering (groups of 10 days intervals)
b) Frequency distribution of plant height (groups of 20 cm intervals)

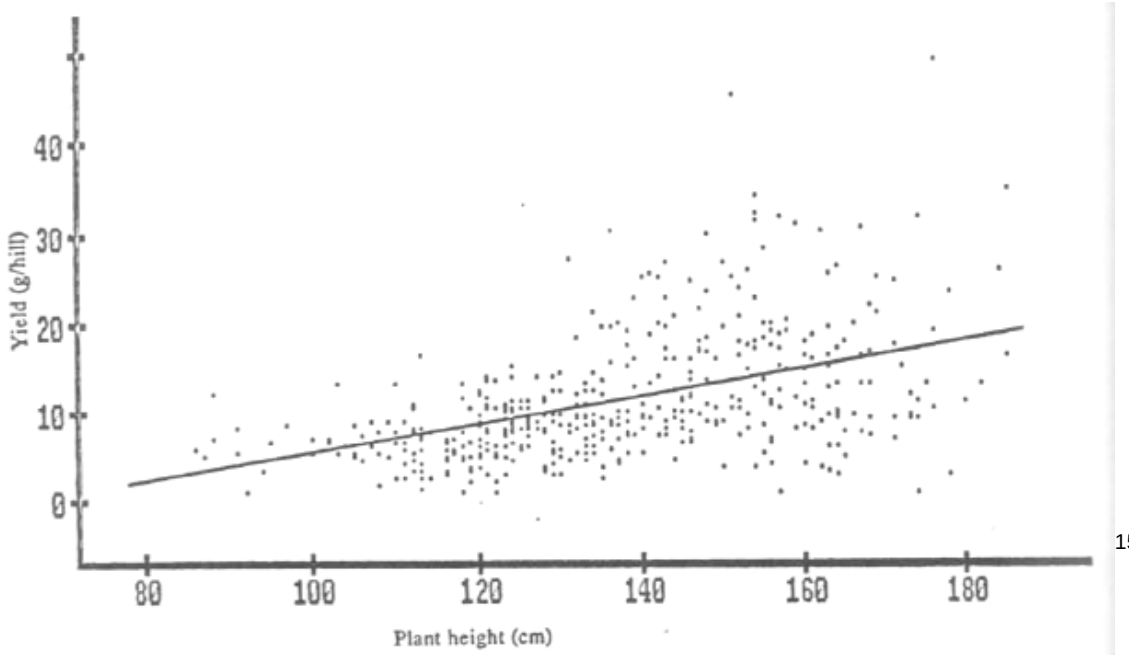

Table 21: Relationship between plant height and grain yield (observations 1991 and 1992 combined)

Additional for paper IRRI

The importance or rice in the diet of the Laotian population is underlined by its use in the Lao language the same word kau is used for rice and for food. In other words food is synonymous with rice.

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COTTON AND SHIFTING CULTIVATION IN THE LAO PDR

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1. INTRODUCTION

The Lao Government policy consists of diversifying crops besides rice production, which is by far the most important crop. On 21 March 1985 an agreement was signed between the Lao and the French Governments with regard to the development-oriented research project "Plantes a fibres et oleagineuses". Research activities are being developed in potential areas for cotton production such as Paklay (Sayaboury province), where farmers have been familiarised with growing this cash crop for a long time. Besides the selfsufficiency for fabric materials (60 to 70 kg of seed cotton per family), often processed in a "handicraft" fashion, the Government's strategy aims at producing cotton in the context of a market-oriented economy.

Cotton research is not only concentrated at Naphok research station but is also conducted in real farmers' conditions in order to test the different results acquired through research. Varietal research and studies on the evolution of pest incidence in the different potential zones with different agro-ecological conditions are indispensable.

2. AGRO-ECOLOGICAL CONDITIONS

From North to South, in spite of the great diversity of pedoclimatic conditions, farmers have succeeded in selecting the appropriate environments for cotton production (Trebuil, 1986), such as sloping land with shallow soils in the Pak Ou region (Luang Prabang province), well drained foothills with or without limestone in Muang Fuang (province of Vientiane), rich colluvial soils at the bottom of the schist slopes, black, deep and not very acid with crumb structure in the region of Paklay (Sayaboury province), land cleared for "hay" cultivation under slash-and-burn, sandy and acidic but well drained in the plains of Vientiane and Savannakhet (Castella, 1992), or also on alluvial rich and deep soils on riverbanks in Sanakham, Vientiane, Songkhon (Savannakhet province) and Khong (Champassack province), cropped in the dry season after water recession (sowing in October and harvesting in March-April) or in the wet season (Khum, 1989) on the ridges of the riverbanks which are not flooded.

In general the rainfall is relatively high from June to September (1000 mm in the region of Vientiane), but where it is in excess and would hinder cotton production, the cycle of the crop is staggered: water-receding cotton crops in the south of the country or the "foggy cotton" (Fay mok) after upland rice in the dry and cool season from September to February in the regions of Muang Fuang, Vangvieng and Kasi in the center - North of the country. With soils of good quality and a relatively low rainfall (about 1,200 mm per year), the part of the Mekong valley from Sanakham to Paklay and from Sayaboury to Luang Prabag has very favorable ecological conditions for the development of cotton production. Cotton grows well on light soils, fairly fertile with an optimum pH of 6.5 - 7.0; it requires a minimum of 14°C to germinate, its growth stops under 4°C. Water requirements are quite high: 800 mm well distributed throughout the cropping cycle; requirements are high at flowering. Sunshine is necessary at the fruiting period and maturation and this according to the cycle of each cultivar. It is necessary to control the sowing period well to avoid the rotting of the bolls caused by the last rains of the year.

3. SOCIO-ECONOMIC CONDITIONS

Cotton growing, especially practised in small family plots and most often in association with other crops, is reported to cover some 30,000 ha and to produce 14,000 tons of seed-cotton with an average yield of 400 kg per hectare in traditional cropping systems (Chazee, UNDP Vientiane) with an average ginning outcome of 33%, which is about 4,660 tons of short and coarse fibre.

In the West of the country, most of the cotton producers are Lao Loum, growing cotton in border zones such as the region of Paklay, Botene and Kene Thao (Sayaboury province). Cultivated areas vary from 1,000 to 5,000 ha according to the price of seed-cotton. Sometimes this price is in competition with those of other crops such as sesame, peanut and maize.

There is no land tenure problem in the Paklay area. Land is well distributed with an average of two hectares per family. Consequently, the fallow period can last 3 to 5 years. But the efforts for slash-and-burn after fallow is adapted to the present economic conditions by allowing the reduction of inputs to the minimum level.

During the wet season, transportation by road is difficult. From October on, when the dry season starts, transportation of seed-cotton between the producing villages and the ginning workshop is possible by oxcart or truck. The workshop serves for meetings between the farmers commercializing their cotton and the extension agents.

During the campaign of 1993, the national bank has allocated a rural credit line for the farmers of the 6 districts in the province of Vientiane, in order to boost cotton production up to 500 ha. The sale of the product is insured by a Lao businessman, with a farmgate price of 280 kip/kg of seed-cotton.

This production seems to be sufficient to provide the textile center in Vientiane and to foresee the export of the excess. The first processing (ginning) requires a maximum utilization of the ginnery, often underutilised.

In the villages, once the cotton is processed into blankets without weaving (4 kg of fibre), its price doubles. In the region of Luang Prabang those blankets are exchanged on markets for pigs and chickens by several ethnic groups who occupy different ecosystems on the slopes of the mountains.

The emergency of new outlets for the Lao cotton fibre, linked with the creation of the spinning factory in Vientiane, as well as the growing demand from neighbouring countries, has stimulated the appearance of new production systems in regions traditionally growing cotton. Cotton has become a cash crop in some places, integrated into a commercial chai of production.

4. CROPPING SYSTEMS

On the riverbanks nearby houses, cotton is grown on small plots, with various other plan species and varieties. In upland "hay" fields, genuine rotations and confirmed techniques have been reported.

Crop rotation

The crop rotation pattern on the "hay" fields is the following (in the Vientiane outskirts):

- slash-and-burn with upland rice during the first year, sometimes associated with cotton;
- possibly, second upland rice crop with or without cotton in the second year, only if the level of fertility and weed infestation is satisfactory;
- groundnut, with or without cotton, sometimes followed by a watermelon crop on an acre of the field during the second year;
- fallow period of 4 years maximum.

There is no rigorous rule systematically applied in this area. The level of fertility of the cleared "hay" field, the available workforce and the comparative advantages for commercialization of the different crops are considered.

For instance, near Savannakhet, one field was planted with a crop association of groundnut and local cotton (Fay Njay and Fay Noy) for 3 years and.has shown a very obvious decrease of fertility, resulting in a steady decrease of the seed-cotton yield:

- Year 1: 525 kg/ha 100%

- Year 2: 375 kg/ha 71%
- Year 3: 225-300 kg/ha 37-43%

In the region of Paklay, with deep soils, rich in humus, two or three years of cropping is practised. On the other hand on the sides of the Nam Ou valley with shallow soils, the rotation is shortened and simplified:

- Slash-and-burn + upland rice in the first year;
- Cotton only (Fay Noy is dominant);
- Fallow of a few years.

The assessment of the decrease in the level of fertility and the increased difficulty to control the weeds result in the decision whether or not to have a second upland rice crop cycle (with or without Fay Njay) as a cash crop in the regions of Muang Fuang and Vangvieng, where the fallow period does not last more than 2 or 3 years. In the region of Muang Fuang a cotton field with Fay Mok in a second year cropping has shown weak plants (60 cm. high) but it was sown at high density. Even if the expected production for that year would not exceed 300 kg of seed-cotton per hectare, the producer was envisaging a new cropping cycle for the third year, in order this time to demonstrate his rights to use the land.

The place occupied by the traditional cotton in these cropping systems, where the renewing of the fertility is based on a bushy short period fallow is reduced because of the principles of a well conducted slash-and-burn operation, aiming at minimizing the long-term ecological imbalances.

Mixed cropping is virtually systematically practised: upland rice, groundnut, cotton, maize, Job's tears, cassava, roselle, kenaf, indigo, chillies, various cucurbits and others.

It enhances the value of labour productivity well, in a general situation of low population density where the workforce is a limiting factor. The best use and the maximum remuneration of a day of labour become the major objectives of the farmers.

In the plains of Vientiane and Savannakhet, the associations of upland rice and cotton are common and correspond to precise production objectives. Playing an important role against the climatic hazards, these "hay" fields must be established well before the onset of the heavy rains mobilizing all the workforce in the wetland rice (rainfed lowland rice). An early sowing also restricts the risks of the easily leaching sandy soils.

As slash-and-burn is a very demanding task, the establishment of associated crops makes the best use of the cleared land. For instance, after harvesting groundnut, which occupies the field from May to August, and while the groundnut crop residues stay in the field, the cotton plants can still be in the field until the end of its cycle in December-January.

Itineraries of techniques

According to the availability of inputs, 2 itineraries of techniques are often practised; each one of them characterized by the type of variety used; leading to contrasting cultural practises, depending on the nature of the constraints (soil, climate) to which they are subject (table 1). In addition, they are adapted to the economic environment of the farms.

c. Local insect pests and their incidence

The main insect pests causing damages during the cotton cropping cycle are the following:

1) Sucking-piercing early season pests

Aphids (Aphis gossypii) cause direct damages through numerous bites resulting in leaf curl and in a showered development of the young plants. This predator is also the vector of a virus disease responsible for the malformation of plants, the "leaf roll".

Jassids (Amrasca biguttula), piercing Hemiptera, are responsible for the deformation and a reddening of the leaves due to the toxic saliva of the larvae and adults which is injected into the blade of the leaves.

Other sucking insect pests of lesser importance include the following: Bemisia tabaci, Thrips palmi and Dysdercus cingulatus.

2) Leaf feeding caterpillars

Anomis flava and Sylopta derogata are usually present throughout the cycle causing very little damage (less than 10 caterpillars per 100 plants).

3) Bollworms, late season pests

The dynamics of the population of Helicoverpa armigera is subject to important interannual variations specific for each region. The first attacks start at the formation of the flower buds (40 days after sowing). One can also observe Pectinophora gossypiella in the bolls as well as Eanias insulana and Eanias vitella which cut the tips of the stems.

Table 22. Main characteristics of tow itinerairies of technigues in use for suplying the commercial cotton chain of production in the Lao PDR

Characteristic	Traditional short-staple variety ==	Improved long-staple variety
MARKET	Self-consumption	Export to neighbouring countries
	Spinning: staple of 18-22 mm	Spinning: staple of 24-28 mm
VARIETY	Fay Noy G.arboréum	Khamkhao 1, SR1 F4
	Fay Nyay G.hirsutum	Introduced
		G.hirsutum
Itinerary of techniques:		
• Cycle	• Late	• Early
• Sowing	• Mid to end May, broadcasting or rows (associated)	• Beginning of June in rows of pure stand
• Density	• 3,000 to 6,000 plants/ha	• 20,000 to 30,000 plants/ha
• Protection	• 0 to 3 insecticide applications	• 3 to 5 insecticide applic.
• Fertilization	• No chemical fertilizers	• Sometimes urea at flowering stage
• ADVANTAGE	• No use of imputs thus no credits	• Industrial outlet for a product of high commercial value
• CONSTRAINT	• Low productivity	• Level of technical knowledge required

5. PROCESSING AND MARKETING SYSTEMS

Once the producers are well guided and know how to grow cotton with a rational use of the inputs, knowing that cotton is a very attractive crop for insects, it becomes profitable.

The village ginnery plays a role in extension. The seed-cotton is commercialized at the level of the ginnery. The ginner distributes the seeds to the producers while making contracts with a price fixed before the cropping season. Often there is no cash money available for purchasing the seed-cotton when the harvest starts.

Ideally, the spinning factory would have to intervene in the chain of production by providing credit for the ginners-buyers. It will thus be reimbursed at the moment of delivery of the fibre.

The only semi-industrial spinning unit of the country, with a capacity of 200 kg of thread per day, only needs 200 to 400 tons of seed-cotton per year for operating.

It realizes a vertical integration of the production chain: from the fibre to the fabrics and other end-products.

To respond to a demand more and more oriented towards fine fabrics, the textile center cannot only work with very short staple cotton. The local variety "Fay Nyay" (fibre of 22 to 24 mm) is used for the weft, whereas a semi-long fibre (28 to 30 mm for the variety Khamkhao 1), representing 40% of the needs, is used for the warp.

Figure 18. Evolution of the purchase price for cotton fibre by the spinning factory in relation to its staple length, for the year 1992.

Staple length (mm)	22	24	26	28
Purchase price kip/kg uss/kg=	1,000 1.4	1,200 1.7	1,300 1.8	1.400 2.0

The differences between these prices put the farmers to think and they have a tendency to orient themselves towards a variety such as Khamkhao 1 with a semi-long fibre having a high commercial value.

Two neighbouring countries are big demanders for cotton: Thailand needs 377,000 tons/year, but produces only 10% of it and Vietnam needs about 65,000 tons/year.

6. ALTERNATIVES TO SHIFTING CULTIVATION

If there is no land tenure problem, but it is forbidden to clear the forest, it becomes suitable to utilize each cultivable plot belonging to the family in a profitable way. In this case, crop rotation (cotton-sesame-legume-cotton) seems to be a good solution for the agro-economic conditions of the farms.

At the national level, the environmental debate is dominated by the deforestation problem. It is in fact an upstream problem compared to other crucial problems such as watershed degradation, biodiversity loss in natural ecosystems, soil erosion, quick sedimentation in the streams and reservoirs resulting in flash floods and a change of the quality of the water streams.

Pollution through agricultural practices drawing on irrational use of chemicals, is also a priority topic for consideration within our conditions.

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NARC/IDRC MIXED FARMING SYSTEMS IN THE ROLLING HILLS OF BOLIKHAMSAY PROVINCE

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1. INTRODUCTION

There is a great diversity in the agricultural systems of the Lao PDR due to the physical and biological environment, the ethnic groups involved, and the socio-economic conditions.

At present there is no classification of agricultural systems in the Lao PDR. However, in order to facilitate the implementation of the farming systems research during the next five years a preliminary classification can be based on the major production systems and topography as influenced by the Mekong watershed.

There are the lowland areas of alluvial plains along the Mekong River and its tributaries. These production systems are rice-based, providing people with their staple food requirements. Farmers fish and raise livestock for their protein requirements. It is in these areas that most irrigation facilities are available for dry season production. For cash income they grow fruit trees and vegetables near their houses, produce vegetables along river banks, and are involved in the production of some field crops for sale, such as cotton, sugar cane, and tobacco. Many farmers consider large animals as a form of wealth, which can be liquidated in case of emergency. A lot of the nation's food is supplied from these lowland areas. Mostly minority groups of Lao Lum inhabit these areas. The nation's major cities lie in lowland areas in which Lao Lum and other minorities (such as Chinese, Vietnamese, Indians) live.

On the foot hills, sometimes referred to as lower terraces or rolling hills and lower mountains, most of the nation's "rotational" shifting cultivation is practiced. Upland rice and maize are grown as the main crops, and livestock raising is important for their livelihood. These mostly subsistence-oriented people rely heavily upon forests for plant and animal food, medicinal plants, and wood for fuel and shelter. However bunded paddy land is scarce, it contributes significantly to the overall performance of these agroecosystems. Where water resources are available, some farmers have traditional irrigation systems and supplement their protein intake with wild fish. Lao Theung groups and Lao Lum -inhabit these areas.

There are a number of high plateaus in the country [e.g., Xiang Khuang, Na Kay in Khammouane, Bolovens in Champasak, Saravane, Sekong, and Attapeu], which have good natural pasture grasses and where farmers traditionally are used to raise animals [especially cattle] for sale. Some of these areas, e.g., Bolovens Plateau, produce some cash crops for sale such as coffee, fruit trees, vegetables, and potatoes. With cash income from the sale of these products, farmers purchase rice and other necessities. All three of the nation's ethnic groups inhabit these high plateaus.

The highlands, sometimes referred to as upper terraces, on or near mountain tops contain production systems which include crops of upland rice, maize, grain legumes, and tubers; small and large animals; and in some cases opium. Sometimes fruit trees are grown, and home gardens are very important. Many of these people practice a "pioneering" type of shifting cultivation. These areas are inhabited by Lao Sung.

2. BACKGROUND & JUSTIFICATION

1. The mixed upland agricultural livelihood systems in Bolikhamsay are still subsistence-oriented, and their performances[2] are still quite low. Much of the province's agriculture is practiced on the rolling hills and lower mountain slopes. There is still a considerable amount of shifting cultivation and rice shortages have to be supplemented and compensated for by other farming systems activities including: the production of maize, grain legumes, root crops, tobacco, fruit trees, and vegetables; the production of cattle, pigs, poultry, sheep, and goats; and hunting and gathering in the forests for natural food from plants and animals, medicinal plants, and wood for fuel and shelter. While bunded paddy land is scarce, it contributes significantly to the overall performance of farming systems. These livelihood systems do not perform well, regarding their unsustainable use of resources. Many families in these upland areas are quite poor and have insufficient rice to feed their families. Most farm families are affected by serious health problems related to malaria, gastrointestinal diseases and parasites, and upper respiratory infections. Many children are affected by at least lower level malnutrition. Infrastructure and communication are poor in these remote areas and few services are available.
2. In a 1982 study [Birgegard] on lowland rainfed farmers in Muang Paksan of Bolikhamsay it was found that 33 percent of the farmers surveyed cultivated upland rice only, 28 percent cultivated lowland rice only, and 39 percent cultivated both. In other words, 72 percent of the surveyed farmers were at least partially dependent on upland rice. In recent years provin¬cial rice production has fluctuated between small surpluses and deficits. The area of paddy land remained steady from 1984 to 1988 at around 12,000 ha, but increased in 1989 to about 17,000 ha in 1990. However, paddy yields have steadily averaged about 2.51 t/ha [whereas 2.6 t/ha is the national average]. Since 1984 the area in upland rice and the average yields of 1.66 t/ha have also remained fairly steady'. The total increase in lowland paddy production probably has been achieved by increasing the use of "marginal lands", such as those lowlying areas which are more subject to flooding and newly made paddy land at the edge of the forest. Following seasonal flooding and drought, insect and rat infestation are constraints to increased rice productivity and performance.
3. Field crop production has increased since 1984, but average [from 1984-90] yields of maize, root crops, grain legumes, sugarcane, and cotton are all still less than the national average. Only tobacco has a current average yield exceeding the national average. Market availability and access seems to be one of the chief constraints to increased performance of most of the field crops in the livelihood systems.
4. Livestock performance increases are promising since cattle and pig numbers have both doubled since 1984, and it is the livestock sector which is perhaps best integrated into the market economy. Goats, sheep, and poultry numbers have more than doubled during that period according to official data. Yet, livestock performance is constrained because of: parasites and diseases, high mortality rates among the young, and insufficient feed sources and inadequate nutrition during much of the year. Marketing mechanisms exist mostly for cattle. Pig prices fluctuate during the year, varying with the availability of rice bran. Animal diseases prevent the expansion of exports to Thailand.

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[2] Performance of systems and of its elements can be measured [after Conway 1985] by: productivity, stability, sustainability.

However, there is a distinct possibility that the area planted in upland rice may have been under-reported by a factor of four because of the government policy against upland rice production and because of the difficulty of surveying the moving upland fields.

5. Potential increases in performance of field crops, homegardens, and livestock in these upland systems are all compatible with government's policies of intensification, diversifi¬cation, stabilizing shifting cultivation, and promoting market-oriented commodities. Any effort to improve the performance of these upland agricultural systems will have to take into account the interactions between: lowland and upland rice, rice and field/horticultural crop production, crop and livestock production, and on- and off-farm activities. Since farmers lack the financial means, low-cost input technologies have to be developed to encourage them to take advantage of opportunities to increase systems' performance. Most previous attempts to establish agricultural development in the province have failed to take the objectives and needs of the villagers and the interrelated nature of their problems and potential solutions into account.
6. Bolikhamsay has been chosen because of its representativeness of agroecological situations in central provinces along the Mekong River; relative proximity to Vientiane; and the interest of its leadership in establishing linkages and cooperation with the national research system. In addition, two areas in Muang Bolikhan [Tasseng Muang Huang ang Tasseng Nam Sao] and one in Muang Pakkading [Tasseng Na Khya] have been designated by the Government as high priority areas for integrated rural development activities. Within these areas the project will undertake its research and extension activities.
7. Prior to 1991, most rainfed lowland rice related research has been component research, with an emphasis on varietal evaluation, fertilizer responses, soil fertility management and insect pest control studies. The Lao-IRRI Rice Research Project has begun research on rainfed lowland rice-based systems in Vientiane Municipality, Savannakhet, Champasak, Sayabury, Luang Prabang and Bolikhamsay Provinces. The on-farm research in Muang Paksan of Bolikhamsay is concerned with a varietal observation nursery and trials testing responsiveness to nitrogen. The Lao-IRRI Project is also undertaking research on upland rice-based systems in Oudomsay and Luang Prabang. The proposed project will utilize relevant specific findings from the Lao-IRRI work as done so far in Bolikhamsay or any other appropriate area.
8. The Upland Agricultural Development Project [WB/AIDAB/ France] will attempt to develop some crops technologies [coffee, soybeans, maize, durian, etc.] for upland areas in Vientiane, Champasak, Saravane, and Sekong Provinces. At present there are no results. When the project starts running there will be a close cooperation. The CUSO project on native pigs will initially test feed rations on-station at Nong Teng, and these will later be used for on-farm testing by this project.
9. The project is in harmony with the National Agriculture and Forestry Research Master Plan.

3. GOAL & OBJECTIVES

Goal

10. The goal of the project is: to improve the productivity and income of mixed farming systems in the upland areas [including shifting cultivation] in the rolling hills and lower mountain slopes of Bolikhamsay Province.

Objectives

11. The specific objectives are:

a. To characterize agroecosystems in selected sites of Bolikhamsay, to study farming systems and farmer practices, and to detail traditional and evolving management systems. To detail links between production, utilization, and marketing. To identify opportunities, problems and potential solutions regarding the above.

b. To design and implement on-farm intervention activities.

c. To evaluate the effectiveness of the interventions in the study area, revise as necessary and design a strategy for wider dissemination. To extend these technologies to similar areas.

d. To increase the professional capacity of researchers in the NARC and the DLVS and extension personnel in Bolikhamsay Province.

12. Activities in the mixed farming systems will focus on interactions between enterprises, farm families and natural resources. The performance of agricultural livelihood systems, including farmers' traditional and/or newly introduced technologies, will be analyzed and evaluated in terms of productivity, stability, sustainability and equitability. Established and progressive farmer management styles and decision-making modes will be studied, and subsequent appropriate interventions will be made based upon these.

13. The project will be undertaken iteratively in phases, learning from the previous lessons and building on them. Illustrative types of activities are listed below :

Year 1: Diagnosis and on-farm research in Muang Bolikhan.

Possible demonstrations of existing technologies according to farmers needs:

Crops	Livestock	Economics
Rice varieties	Disease inoculation	?
Homegardens		

Possible types of OFR:

Crops	Livestock	Economics
Fertilliy trials	Special studies	Market studies
IRM trials	Breed selection	Adoption studies
Crops as fodder		
Vutural practices		
Cultural practices		

Year 2: Diagnosis and on-farm research in Muang Pakkading and possibly Muang Thaphabat. Demonstrations and continued testing in Muang Bolikhan.

Demonstrations of previous years trials results if feasible. Possible types of OFR:

Cops	Livestock	Economics
Fertility trials	Improved husbandry	Decision-making
IPM trials	Feeding trials	Monitoring & Eval
Crops as fodder		Adoption studies
Cultural practices		

Year 3: Demonstrations and continued testing in Muang Bolikhan, Muang Pakkading, and Muang Thaphabat.

Demonstrations of previous years trials if feasible. Possible types of OFR:

Crops	Livestock	Eoonomics
Fertility trials	Improved husband dry	Monitoring & Eval
IPM trials	Feeding trials	Impact evaluation
Crops as ford der		
Cultural practices		

4. ANTICIPATED RESULTS AND BENEFICIARIES

14. The immediate beneficiaries will be the farm families of the research villages. The project results should increase cash income through more productive uses of existing enterprises; introduction of alternative enterprises; introduction of more stable and sustainable practices. Attention will be paid to problems of less advantaged farmers.

15. The project will be a key factor in,increasing the capacity to undertake R&D in the Lao PDR. The researchers in the NARC and DLVS will benefit through increased research and management skills obtained in implementing the project. This will be the first project to undertake research integrating crop, livestock, and socio-economics disciplines within the context of the national research system.

5. COMPLEMENTARY ACTIVITIES & TRAINING

16. There will be three types of training within the project:

- in-service training on research methodologies and techniques [eg., on-farm trials, RRAs, socio-economic analysis, market surveys, agroclimatology, etc.] for research technicians and extension workers;
- short-term training and study tours [eg., IPM, soil fertility, statistical analysis, etc.] for senior researchers and extension staff;
- field days and field tours for village extension workers and farmers to visit innovative farmers elsewhere.

6. ACTIVITY OF PROJECT IN 1993 , NONESOMBOUN VILLAGE , BOLIKHAMSAY PROVINCE

Accomplishments:

A. Four experiments on farming systems were presented in IDRC/MFS project and staff of Borikhamsay province and Borikhane district, for implementation in the 1993 wet season.

Varieties evaluation/screening of promising mungbean (3), maize(3), soybean(3) and upland(12) rice varieties including the use of dual-purpose type (for food and/or green manure) - 2 sets. All crops trials to be conducted on-farm at Mr. Suan's and Mr. Khamkeo's family in Nonesomboun village.

B. Diagnostic survey conducted

Selected site :

None somboun village,Borikhane district, in Borikhamsay Province.

This village was regarded as typical representative of areas of rolling hills crop production in their respective provinces and is also within the target area nominated for development by the provincial authorities.

Location :

Nonesomboun is located 28 Kms from Paksane. It can easily be reached by bus through Route No 4 going to Paksane district.

Land and Water Resources :

Nonesomboun has a total area of _____ hectares,of which _____ are planted with rice,

Land type. topography and soil :

This village is characterized as an alluvial plains with repeating patterns of low and high bounded rainfed terraces with a field slope of approximately 5-10%. Soil texture ranges from sandy loam (high terraces) to clay loam and sandy clay loam (Lower terraces). Other physical and chemical soil properties are not yet known due to absence of soil analysis. However, the predominant soil types in the village, similar as in other provinces, are known to be acidic in nature, of poor water holding and low buffering capacity.

Other facilities :

There is a primary school. The sources of drinking water are 4 open wells. Transport facilities in this village consist of wooden carts drawn by buffalo, motorcycles and bicycles. A meteorological station is situated there, about 28 km. from Paksane district.

Cropping systems :

All cultivable areas in this village are planted with rice during the wet season. After rice harvest, some farmers plant vegetables (cucumber, lettuce, chile, etc.) when there is still water impounded in the creek near their fields. Most rice varieties used are traditional • glutinous varieties.

Sources of income :

Household incomes in this village come mostly from rice production, sales of livestock and vegetable. About 30% of the total income comes from animal sales. Other sources of income are from government employment (e.g. school teachers) basket weaving, fishing and remittances from abroad.

General information about Nonesomboun village,Borikhane di strict,Borikham say Province.

Item	Nonesomboun
Location (distance from district proper)	28 Kms
Population	
Male	51
Female	51
Total	102
Number of Household	22
Ave. household Size	5
Land Resources	
Rainfed	-
Home stead	-
Uncultivated	-
Total	-
Animal Production	
Buffalo	36
Cattle	28
Hog	4
Poultry	52
Goat	25
Post harvesting Facilities	
Rice mill	-
Seed Storage house	10
Pedal thresher	-
Rice bank	1
Other Facilities	
School (Primary grade)	1
Artisan well	-
Open well	4
Health center	-
Shop/Stall	-
Transport	
Car	-
motorcycles	-
bicycles	5

bus stop	1
Farmer's association/organization	
Women's Union	-
Syndicat	-

Constraints to crop and animal production:

Problems limiting crop production as cited by farmers in the village study are the following:

1. Poor soil - major soil types are sandy in nature which were determined to be moderately acidic, of low organic matter content, of poor water holding capacity and with a low buffer capacity.

2. Low yield potential of majority of traditional glutinous varieties grown, which results in low total production, hence, low income.

3. Lack of credit and capital - majority of farmers can't afford to obtain credit from banks and private money lenders due to high interest rates and poor economic capacity.

4. Limited sources of farmyard manure and high cost of inorganic fertilizer. In animal production the major problems raised by farmers are:

1. Lack of fodder - After rice harvest, large animals (Buffaloes and cattle) are usually allowed to graze free in the field. However, towards the drier months (Feb-May), there is a serious scarcity of plant biomass to be used as fodder.

2. Lack of drinking water - since the animals are left free in the field after rice harvest and almost all of the paddies are already dry, there are few sources for drinking water.

3. High mortality caused by many kinds of epidemic diseases such as: Swine fever haemorrhagic Septicaemic, fowl cholera etc...

Recommendations :

1. A more focused interview of at least 25-30% of the total number of households in each village should be conducted to gather indepth information about the farm household e.g the qualification of labor an income contribution of household members in rice and animal production. A further survey should be done together with a socio-economist.

2. The current problem in the village request for research to be done on the following aspects:

a. Soil analysis of major soil types,

b. Studies on how to improve the fertility status of major soil types and thus the use of crops with potentials for green manure like mungbean, soybean etc.

c. Fertilizer trials using organic or inorganic sources to determine optimum requirements for major soil types,

d. Upland rice, maize, grain legumes trials using improved and traditional varieties. These can later be integrated with fertilizer trials to determine response of varieties to types of fertilizer and rates of application.

e. Evaluation of improved cropping sequences within the farm resources and management skills of farmers.

f. Research on Farmer's practices and perceptions leading to the establishment of farmer-participating systems research. This participating research is essential to develop appropriate low to medium input technologies.

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SHIFTING CULTIVATION SYSTEMS IN MUONGHOM DISTRICT LAO P.D.R.

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1. INTRODUCTION

Shifting cultivation is the most widespread traditional farming system in the tropics. The tropics cover five billion hectares amounting to 38% of the earth's surface with a population of about two billion inhabitants, equivalent to about 45 percent of the world's population.

Upland or dryland rice covers nearly 20 million hectares worldwide and accounts for only 5% of the rice grown worldwide, of which 12.8 million hectares (64%) are found in Asia. It is usually grown by the least privileged rice farmers under adverse and risky conditions. Nearly all land planted with upland rice is subject to erosion. Different forms of shifting cultivation and fallow systems exist among people in different environmental situations in Africa, South-East-Asia, Central and South America and Oceania. There are, however, many similarities among shifting cultivators and small holders practicing related agricultural production systems. All farmers involved in this and related agricultural systems are now found within the tropics and in the developing countries of the world. Mechanization is minimal and there are no draught animals, ploughs, fertilizers, irrigation facilities, plant protection measures or any other inputs typical of modern farming systems.

When farmers clear forests to plant upland rice, the land remains fertile for only a few years. Garrity, from IRRI, says "continuous cropping and soil loss make the land infertile, and weed competition becomes a problem so the farmers clear more land. Upland rice farming systems that increase rice yields and maintain soil fertility can reduce the need for farmers to open new areas".

The world's 40 million upland rice farmers consume about 90% of the rice they grow. They can rarely afford fertilizers or herbicides. Drought, diseases, acid soils and weed competition keep average yields at about 1 ton per hectare. Scientists and extension workers have demonstrated in many countries, however, that improved cropping systems and practices can be combined with higher yielding varieties to achieve a stable 2 tons per hectare under various ecosystems. It is widely practiced in West Africa, Latin America and South-East¬Asia (especially Indonesia, Thailand and Laos).

This report is based on Muong Horn district where the project (LAO/88/024) was implemented in 1989 for a three year period. This project was executed by UN/DESD New York and implemented by the Administrative Committee of Vientiane Province. The project assists rural development in the district of Muong Horn, a mountainous and isolated area of Vientiane Province populated by the ethnic subsistence farmers practicing shifting cultivation. This district is situated east of the Nam Ngum reservoir in Vientiane province. It is situated 140 kms to the north-east of Vientiane towards the northern mountain range and the Nam Sane valley.

Immediate objectives of the project were:

- Improve access to Muong Horn District,
- Meet food requirements and raise incomes and living standards of the people in the district,

- Help reduce environmental degradation caused by shifting cultivation through the development of irrigation in the lowland and the introduction of improved farming systems for the upland.
- Provide support to intensify community and social development in the project area in line with district and village needs.
- Assist the opening up of the district by providing administrative and education facilities.

The project strategy for agricultural development was focused on:

- Measures to reduce soil erosion in the upland system,
- Measures to arrest soil fertility decline in both upland and lowland systems,
- Provisions for increasing household incomes,
- Changes which permits farmers to adopt permanent or stable forms of agriculture in both lowland and upland systems as an alternative to shifting cultivation,
- Measures which are compatible with the government's policy of reducing deforestation.

The target groups in the project were ethnic minorities, of which the Hmong group, being the principal ethnic group of the Muong Hom district, represented 75-80% of the population.

The various activities of the project were concentrated or implemented in only 13 key villages out of 66 villages in Nam Sane Valley.

Data, figures, tables and references used in the articles are derived from field surveys, observations, experiments, interviews with farmers and bibliographic studies.

2. ECOLOGICAL CONDITIONS

The district extends for an area of 2800 km2 and has an estimated population of 18000, divided between 66 villages according to 1990-1991 district records. The district itself is situated in a valley called "Nam Sane", and has 5 sub-districts. The region is mountainous • and forest covers 90% of its surface. The elevation extends from 200 to 2,128 m a.s.l. It has tropical as well as sub-tropical types of climate.

During the rainy season (from May to October) the heaviest falls are recorded in July and the lightest recordings in October. Detailed rainfall records are shown in ANNEX 1. The data were recorded at the project's own meteorological station.

The average maximum temperature recorded was 32°C and the minimum was 22°C. A maximum temperature of 40°C was also recorded in Muong Horn district.

The Nam Sane valley of Muong Horn district has silty loam and sandy loam soils adjacent to Nam Sane river.

With regard to the physical characteristics of the upland soil, the soil texture is analyzed as sandy clay, sandy clay loam and clay loam. The soil colouring is a dark yellowish brown. Soil is found to be strongly acidic having an average soil pH of 4.3. The average organic matter percentage of the upland soil is 250-medium. Details of soil analysis and soil physical characteristics are shown in ANNEX 2 & 3.

The most important rivers are the Nam Ngum with its tributary the Nam Bak and the Nam Sane with its tributary the Nam Khui - both of which debouch into the Nam Ngum lake - the Nam Maug and its tributary the Nam Horn that debouches into the Mekong and the Nam Phuan with its outflow into the Nam Gniap.

Some of the dams have been constructed and upgraded in the project area for supplementary irrigation for lowland farming systems. The details are shown in ANNEX 4.

As it is a mountainous district, it has a mixed type of forest with different types of forest crops, such as Maisak, Maidu, Maiso, Maitae. The project has introduced fast growing forest trees such as Eucalyptus Camaldulensis. It has distributed many Acacia mangiume, a fast growing Nitrogen fixing tree, to the villagers. We can observe these plants in farmer's backyards in some of the villages.

There are many bamboo forests in the districts. With respect to wildlife there are more deer and wild pigs in the forest than other forest animals.

3. SOCIO-ECONOMIC CONDITIONS

There are four ethnic groups in the district, Hmong, Laoloum, Laokang and Yao. According to the district statistics up until 1992 the population in the thirteen villages of the project command area comprises of Hmong (48%), Laoloum (23%), Laokang (20%) and Yao (9%). Most of the Hmong people understand and speak the LaOloum language, but other ethnic minorities do not speak and understand the Laosung language. Details of ethnic groups in the project area are shown in ANNEX 5.

Land and population trends statistics show that irrigation in the lowland is increasing whereas upland shifting cultivation has been decreasing since 1988. The population has been increasing since 1988 and immigration has been high since 1990. Details are shown in ANNEX 6. In fact, from an analysis of district statistics over four years, there has been an increase of Laoloum every year.

The average Muong Hom settlement in Nam Sane valley consists of traditional clustered, nucleated villages, with, newer linear and fragmented settlements situated along the road from Done Horn to Vangluang. These types of settlements are favoured by the district administration because of the ease of access and control.

Many newer immigrants come from Xiengkhouang (12.4%), Luangprabang and Sayaboury (31.3%), Vientiane province (50%) and Borikhamsai. (6.3%). These immigrants came mainly for clearing new paddy land (60%).

Hmong and Yao people like, or prefer, to settle in mountainous rather than flat areas. Other ethnic groups, such as Laokang and Laoloum prefer to settle on the bank of the river on flat land or in valleys.

Taylor (Socio Economist, 1991) indicated that the distribution of labour was reasonably well-spaced over most of the year for shifting cultivation with critical peaks through June/late July for lowland rice cultivation. People in the district are engaged in various occupations and teachers, boat drivers, taxi drivers, public servants, state farmers, soldiers, police, traders, shopkeepers, machine repairers, labourers on road and bridge maintenance can be found. Only 2.9% of the population is available for general labour.

The project road network of 50 km between the villages of Done Horn and Napho (Project area) was upgraded to an all-weather standard. The project roads also form part of the access road to the UNDCP project area Phalavek'. This project assisted with some maintenance and improvement of the access road, as well as the construction of an entrance road to Khonvat Village, the headquarters of Muong Horn district. In addition, the 19 km section of road between the villages of Napho and Phalavek was upgraded by cooperation between the two projects during the 1991-92 dry season.

In most of the villages there are either primary or middle level schools. There is a big high level school in Khonvat.

The district capital, Khonvat, has a hospital and district health service, staffed by government doctors and nurses. The services provided were found to be very ineffective at the start of the project because of the lack of drugs and because the staff did not receive their salaries in time. This resulted in the staff spending most of their time on their own income and food generating

activities. The project established a revolving fund in Khonvat as well as in village 516 on the edge of the Nam Ngum by providing some funds.

There are no village health clinics or community health workers in any villages except for the capital Khonvat, village 516 and Phalavek. But there are many pharmacies in Khonvat nowadays. Malaria still ranks as the most problematic and debilitating illness in Muong Horn. The symptoms of malnutrition are prevalent among children under five years of age. Some villagers, mostly Yao, in the project area suffer from an iodine deficiency disorder.

Extension was the most important and difficult part of the agricultural programme; seeking the farmers to alter and improve their existing methods of production. The project identified the perceived needs of the community in 1990 through village problem census meetings (VPCM). These showed the farmers immediate priority needs as:

- an irrigation system
- land clearing for paddy cultivation
- small & improved farming tools and equipment
- agricultural chemicals
- fruit tree seedlings
- clean village drinking water
- improved rice varieties

The Government extension service was found to be in-effective in the district. The staff and officials of the district agriculture office lacked the ability to motivate farmers because they were not aware of the principles and philosophy of agricultural extension activities. The project's staff guided and discussed different agricultural extension teaching methods and its needs and importance to improved farming systems.

It is very difficult to find work for farmers in the off season and available work is for a short duration. Hence there is very little cash entering the village economy from outside sources. The village labour pool remains fairly constant throughout the year.

Some 80% of Muong Hom villagers needed to borrow money at some time or other and do so from friends or relatives or, up to five years ago, from the district bank (now defunct).

Traditionally, any new settler who clears and works land claims that as his own, though in the case of Hmong swidden this is true until the family moves on elsewhere simultaneously rescinding any prior rights to that lot. A newly introduced system and legal code may cross¬cut traditional conceptions of "land rights" and now identifies "ownership" based on family size and land productivity.

There are no tenant farmers in the district. All households farm their own land with an average lot being 2.2 hectares per family.

Villagers have inadequate rice for domestic consumption in the late dry season, which affects around 30% of the total population, and some families have to obtain rice on loan or purchase, or fall back on maize or root crops. Hmong usually consume or prefer non-glutinous rice. In the late dry season most of the Hmong families consume cassava, a root crop, when there is a shortage of rice.

Most households have small vegetable gardens for domestic consumption or perhaps a small raised platform for growing onions, garlic and herbs away from domestic animals. Fishing is an important activity. The lake, dams, rivers and streams are seemingly abundant sources of protein with fish, frogs and crabs as well as small forest animals in the vicinity that also provide a source of protein. Besides a little surplus of vegetables sold in the Khonvat market other sources of supplementary income for villagers include forest products (41.2%), sewing (29%), small retail trading (23.5%), and blacksmithing (4%).

Mostly Hmong and Yao farmers hunt and sell wild animals such as deer, wild pigs and other animals as a source of income.

Sericulture and weaving are two of the activities which are now in operation as a source of income. Some of the older Laoloum village women in the district showed a desire to recover and improve, their weaving skills and to stimulate an interest in the younger generation, to ensure that weaving skills will be passed on. In Lao PDR and other countries there is a high demand for traditional village weaving using natural fibers of silk and cotton with natural organic dyes.

Villagers, with assistance from the project, cleared a demonstration area of approximately 1.0 hectares at two different sites at Ban Vangluang and planted Mulberry trees. Local Lao silk worms were used and silk is produced in the village for sale in Vientiane. A hybrid variety of silkworm (Lao-Japanese) has also been introduced and the villagers are now producing both local and improved silk. Sericulture has potential in Muong Horn as a long term income generating activity, which villagers are capable of managing themselves. The project also formed various weaving groups in its command area. The project supplied combs and materials for their loom and the ladies involved in the weaving business commenced weaving. The original weaving group has now grown to 14 families. The result is that weaving groups in three villages now produce naturally dyed cloth, which they market themselves.

Two six-month sewing courses and mechanical training courses were organized by the project to develop skills among trainees.

Illiteracy among Muong Hom adults was around 28%, of whom 75 % were females. Some 50% finished primary education (40% females), 15% finished intermediate (34% females), 7% finished secondary school (no females) and only 1% went on to some higher education (no females).

There is no land tenure system in the district to make farmers more responsible and to encourage investment in sustainable farming methods.

The available lowland being developed is continuously being taken up by the longer term residents, with the newly arrived generally having to move directly to shifting cultivation to produce their rice requirements.

There is a continuous immigration of communities or families from neighbouring districts and provinces every year, creating population pressure.

There is a lack of preventive health education and community development programs. Upland soil is deteriorating due to soil erosion and low fertility status.

There is a deforestation problem because the forest products have become a source of income for Moung Hom farmers.

There is no credit agency or banking system in the Muong Horn rural community for effective motivation to develop or improve farming systems by lending capital from these agencies.

Farmers are still following or practicing the same traditional method of shifting cultivation rather than establishing stabilized permanent upland sites.

There is more lowland which could be developed and maintained as lowland rice production.

There is a lack of cooperation in the district. If there was cooperation they could guarantee the selling and buying of agriculture commodities which would assist all in the district.

There are still many potential areas to develop or build weirs and darns to irrigate lowland rice farms as supplementary irrigation systems.

4. CROPPING SYSTEM

Farmers in Muong Horn are practicing upland rice cropping based on a mixed cropping system. They grow various crops in the upland fields. Upland rice is intercropped with other crops such as maize, cotton, cucurbits, cucumber, cassava, wild yam, watermelon, musk melon, chillies,

sesame, peanuts etc. Usually the farmers grow cassava along the border of the field. In more infertile land farmers grow cassava alone (mono-cropping). In some villages farmers were found to grow maize inter-cropped with peanuts. Seven to eight different upland glutinous rice cultivars were found in Moung Horn district. Hmong farmers preferred to grow non-glutinous rice whereas other ethnic groups preferred to grow glutinous rice. Most of the farmers finished their upland rice seeding between the 3' week of May and the 1St week of June. The combined average rice yield for both types of upland rice (glutinous & non-glutinous) was recorded as 1.5 ton/hectare. Present average bush fallow rotation in Muong Hom is 3 years. More detail is shown in ANNEX 7. The majority of the farmers (66%) were found to grow glutinous rice because of the higher yield. Most of the farmers preferred to grow "Dengpi", a late maturing glutinous rice and "Khaukao", an early maturing glutinous rice. These two varieties were found to be very popular in the district. None of the farmers in Muong Hom district were found to grow upland rice in virgin forest. They grow rice only after slashing and burning bush vegetation. Most of the upland rice growers were found to follow a three year bush fallow rotation with one year of rice on the same land. It indicates that the bush being slashed and burned for growing upland rice is becoming less fertile every year, allowing only one crop of rice after each slash and burn. Thus, the farmers are not growing rice continuously for two-three years. They are growing rice only after every three years with bush fallow rotation. There were long bush fallows and cropping intervals in Muong Horn prior to 1970 when population pressure was low but nowadays, due to population pressure, there are shorter bush fallow intervals and declining soil fertility. Details are shown in ANNEX 8.

The project concentrated its upland work on the establishment of perennial grass strips 1 meter wide grown on the contour at a vertical intervals of 3 meters for erosion control. Between the grass strips, to assist in improving and maintaining soil fertility, grain legume cover/cash crops of blackbean, ricebean, mungnut, cowpea, soyabean and pigeon pea were rotated with local upland rice varieties. The layout of the upland site and the crops demonstrated and tested during the project are shown in ANNEX 9. The upland site has been cropped every year since 1987. Hence, the fertility level was very low at the start of the project. This was verified by the first season's results in 1990, when both yields of rice and grain legume crops were extremely poor with all plots that followed 1990 legume plots giving slightly better growth but the yields were similar to those obtained in 1990. These yields are extremely poor when compared to the farmers' shifting cultivation average of 1.0¬1.5 ton/hectares of paddy.

The results of the observation trials show that the grass strips grew well and did their job of controlling erosion. The grass strips of Brachiaria decumbens and Setaria sphacelata cv Kazungula established well at the sites and were successful in reducing erosion. Brucharia, because of its vigorous growth, was the most effective, but this also resulted in spreading more easily, requiring the farmer to trim it back to the original planted width.

The poor crop yields can be attributed to low soil fertility, organic matter and pH. The system of rotating rice with legumes was not able to improve crop yields over the three year period. A block of forest trees and cashewnut trees were grown on the steeper slopes of the upland site in 1989 for demonstration, giving good initial growth. Coffee planted on flat upland near Nam Sane River was found to have a more vigorous vegetative growth than those plants planted in steeper upland areas. But cashewnut plants, even if grown on steeper slopes, in sandy loam and stony land, had good growth with profused branches.

Various legume crops were introduced by the project such as soyabean, mungbean, ricebean, blackbean, pigeon pea, and groundnut in command villages rotated with upland rice. Thus the area covered with grain leguminous crops is increasing in the district due to market facilities with access to transportation. The existing cropping calendar for both farming systems - upland and lowland - is as follows:

Upland rice (shifting cultivation)

Slash/cutting	-	February/March
Burning	-	
Fencing	-	April
Planting	-	
Weeding	-	Late April
Havesting	-	Late May/June
	-	July/August
	-	October/November

Lowland Rice

Seed bed preparation	-	June
Transplanting	-	Late June/July
Weeding	-	August/September
Harvesting	-	Late October/November

The farmers use bamboo and timber to make fences in upland fields in late April. The farmers are found to sow 8-10 rice seeds per hill and they do not bother or care to close seeds. This is one of the agronomic cultural practices which is technically not correct, but adopted by most of the farmers in the district. It affects the possibility of high seed rates per hectare and leaves an uncertainty about the percentage of rice seed germination as the seeds are damaged by insects and eaten by birds. The farmers are found to be stereotyped into using many seeds per hill without closing seeds with soil even after various demonstrations made by project agricultural technicians on this aspect. They sow rice seeds by the dibling method. They sow randomly, having an average plant spacing of 25-30 cm. They weed 2-3 times depending on the availability of friends and relatives as labour. Muong Horn farmers assist each other during times of planting upland rice without having to hire people; but the owner farmer provides lunch with locally available Laolao as an incentive. They also do not forget to make a temporary cottage/hut on one side of their upland farm. This is the farmer's temporary house during the upland crop cycle. They harvest their rice in the field and bring the produce to the house later. The weeding is done with a local-made, small, spade-like mechanical device with a sharp edge (veak).

Some of the motivated farmers have started to grow legume crops in rotation with upland rice just to maintain soil fertility and develop soil structure.

Glutinous rice was damaged more by birds than non-glutinous rice. This was also observed in a dry season rice demonstration plot at Apc's paddy block where Salakham 69 (glutinous) and U-9 (non-glutinous) were grown for varietal study.

Termites, white grabs, aphids, ants and mole crickets were identified as insect pests in the upland. Rats and birds were also found to damage crops heavily.

Brown leaf spot, blast and bacterial leaf blight were common diseases identified. Micronutrient deficiency symptoms were also observed.

Nya kew (Ageratum conyzoides), Nya Kilo (Chromolaena odorata) and Nya Kha (Imperata cylindrica) are some of the common weeds identified in the upland. A few weeds like Digitaria ciliaris and Cyperus iria were also identified in some of the sites.

There are many factors which do not allow the farmers to secure more lowland rice production. The farmers are not adopting cultural practices in time with the appropriate recommended technology. They begin by ploughing their rice field only one to two weeks prior to the actual transplanting. They do not bother to puddle their field correctly. They do not do any more weeding in their lowland rice field after the initial weeding. These are only a few factors of many which reduce crop production: The farmers were found to grow lowland rice as a mono-crop even after they had supplementary irrigation facilities to grow other crops. There are a few motivated farmers who are growing legumes in rotation with lowland rice.

5. ANIMAL PRODUCTION SYSTEM

Most of the farmers also raise poultry and some pigs in small temporary cottages or huts, built near upland fields. They do this only during the upland rice cycle period; usually they raise poultry (chicken, duck, turkey) and pigs at their permanent house.

The Hmong ethnic minority is very much involved in shifting cultivation. Usually shifting cultivators raise different kinds of animals such as cattle, buffalo, horses, pigs, goats, chickens, ducks and turkeys, but the shifting cultivators in this area, especially the Hmong minority, were only found to raise goats and horses.

Livestock is an important part of the farming system in the project area. There is a high population of cattle and buffalo because of the relatively large grazing areas. The use of buffaloes as draught animals is increasing. Livestock population in the project command area is shown in ANNEX 9. The farmers are raising only local breeds of poultry, cattle and other livestock. Farmers were not found to be adopting improved animal husbandry techniques. Small animals receive some supplementary feeding mainly from household scraps plus rice husk and cassava when available. The large animals graze freely over the land and generally their condition is good throughout the year; but grazing lands are being lost each year to intensive agricultural production.

The management system for grazing animals is extensive in the dry season. Owners simply release their stock to graze in the lands surrounding the village (including paddy fields). In the wet season the paddy fields are fenced, and cattle therefore are allowed to graze unrestricted in the evening and during the day. Buffaloes, however, are contained in the evening by shepherding or tethering, hand feeding with rice straw is practiced and no green forage is fed. Farmers expressed the opinion that the quality and quantity of food for grazing animals is adequate. The villagers have adopted the practice of fencing all cropping land, both upland and lowland, as a protection against grazing animals.

The project has introduced improved pasture grasses to the agricultural centre. Kazungula, setaria, Brachiaria decumbens and the pasture legumes Centrosema pascuorum cv Cavalcade and C.pubescens, Stylosanthes scabra cv Seca and S. hamata cv Verano, Calopogonium muconoides and Pueraria phaseoloides. All have shown excellent growth and are used in increasing the farmers awareness of improved pasture species and the eventual introduction to the farmers' fields. For farmer training, a constructive 3 days of livestock training in pasture management and practical animal health, including vaccination, was organized at the Lao Australian Livestock Project for 26 farmers. As Lao farmers, the Muong Hom farmers are also engaged in fishing when they have leisure time after growing and harvesting upland and lowland rice crops. The Nam Sane river and the Nam Ngum reservoir are the main sources of fishing in the district.

Animal deaths through diseases are common, with serious epidemics occurring in all animals. The main animal diseases are hemorrhagic septicemia in cattle and buffaloes and hog cholera, swine fever, newcastle fever, newcastle M, fowl pox and fowl cholera in the smaller animals.

The project concentrated on improving the veterinary services of the district through the district veterinary department. Two veterinary training courses were organized for district officers, and included a vaccination program for Muong Hom villages implemented under the control of the district veterinary officers, with equipment and vaccines supplied by the project. The income from the program enabled the district to set up a revolving fund for the continuous purchase of livestock vaccination drugs.

6. SILVICULTURAL FORESTRY SYSTEM

Muong Hom district does not have a history of tree cropping, but previous projects introduced and distributed Robusta coffee and cashewnut seedlings in the area. The project continued with the options to maintain a range of possible cash crops for farmers. The project also encouraged tea, fruit trees such as custard apple, lime, guava, jujube, tamarind and coconut for village backyard plots. Seedling production is shown in ANNEX 10.

Following up on the initial work, robusta coffee and cashew were planted in the upland. Experience however showed that the upland sites, having been subject to continuous shifting cultivation, were infertile and proved to suffer from severe moisture stress during the dry season, resulting in the loss of the earlier planted coffee in the drier upland sites. Hence coffee and cashewnut plantings were concentrated on the toe slopes and areas of the lowland unsuitable for irrigated rice production.

There are a few trees around the houses of the longer established villages such as mangoes, jack fruit, bananas, papaya and a local fruit, mak-nam-nom (milk fruit).

Farmers in Muong Horn district have not practiced afforestation for they have not been planting various forest trees species in their unused unfertile uplands; but in 1991-92 the project and district administration began a program of afforestation by distributing various forest trees such as Maidu, Maitae, Maiketsana, Maisak, Fangdeng, Eucalyptus, Acacia, Leucaenca, etc.

7. PROCESSING AND MARKETING SYSTEM

Farmers in Muong Horn thresh upland rice at the site itself. They have been using a local mortar for milling their upland paddy. But the project, as well as some wealthy men, established mechanical power-operated rice mills in some of the villages for milling paddy. Farmers use a local method for the ginning of cotton and kapok. But the project demonstrated, as well as introduced, some mechanical processing equipment such as a pulping machine and cashewnut sheller to process coffee and cashews produced in the district and the farmers involved in these new crops have benefitted by selling processed produce locally and in the Vientiane markets. Similarly 120 kg of grain legumes and pigeon pea (red gram) produced in Muong Horn in 1991/92 was sold in Viehtiane for making Dhal for customers. This was simply done to motivate farmers so that they would become aware of the importance of the crop which is very suitable in Muong Horn on the dry land because of its good vegetable growth as well as its yields. Now the improved access has also brought companies and merchants to Muong Horn to purchase farmer's produce and they are also encouraging farmers to diversify into new crops such as sesame and castor oil.

Marketing of agricultural products is confined to intra and inter-village barter and trading, with little trading outside the project area. Livestock is kept as "wealth Banks" and is sold for cash on occasions of necessity or for special purposes. It appeared that pigs set the highest price followed by cattle and buffaloes. Forest products such as Maiketsana are traded to supplement incomes. Small amounts of background crops are sometimes sold but are mainly a dietary item.

8. ALTERNATIVES TO SHIFTING CULTIVATION

A study regarding upland farming systems experiments conducted in the project command area shows that upland, based on percentage of slope, should be planted or covered with various types of crops. Sloping areas are planted with forest trees. Further down the slope fruit trees are planted and lower still leguminous crops in rotation with upland rice. This was found to be a good and effective way to develop soil structure by increasing nitrogen and organic matter content.

Muong Horn upland soil, which is acidic in nature and has a low organic matter content, is found to be good for planting cashewnut seedlings on a normal slope. Robusta coffee grew well on the flat land on the bank of Nam Sane River. It was also economically viable and appropriate to grow sesame crops.

There is a great problem with soil erosion in upland farming systems or shifting cultivation practice. It was found economically as well as technically reliable to establish permanent contour grass strips to control soil erosion and to grow forest and tree crops, fruit trees and legume crops in rotation with upland rice. Muong Horn farmers are still stereotyped because they have got 'child recordings' about the principles, philosophy and practices of farming systems.

9. CONCLUSION & RECOMMENDATIONS

Successful initial development continues to attract migration and resettlement. More irrigated lowland needs to be developed for families that have arrived and expected future arrivals, to stop them from moving into shifting cultivation.

A major part of the catchment area for Nam Ngum Reservoir's hydro-electricity production, the main export of Laos, lies in this district. The protection of this important national resource requires an ongoing program in the catchment area to reduce shifting cultivation by developing all suitable lowland for paddy production as well as continuing work to find sustainable agricultural systems for the upland.

A three to four year period is not enough time to draw results regarding stabilized upland farming systems to replace shifting cultivation. Thus the time has come to conduct trials and experiments on these farming systems by developing cropping patterns with reliable and appropriate recommendations so that farmers involved in shifting cultivation will prefer to establish permanent upland fields rather than to be stereotyped into adopting shifting cultivation.

The experiments or trials should be focused or based on the soil improvement in order to secure sustainable rice yields with leguminous crops rotated with upland rice.

As leguminous crops enrich soil with added nitrogen and organic matter they should be selected for further tests/trials based on the farmer's food habits, market values and soil types.

Experiments conducted on upland farming systems show that groundnut and pigeon pea grown between grass strips had better plant growth and production than other leguminous crops such as blackbean, ricebean, mungbean, soyabean and longbean etc.

In shifting cultivation there has been a problem of soil erosion deteriorating soil structure and fertility due to run-off of top soil. The experiment established with perennial contour grass strips of setaria & signal grass reduced the soil erosion problem. This method of erosion control has been chosen because it is cheaper than making terraces (Baht 400/Rai for grass-strips and Baht 1200/Rai for terraces); less wastage of land, grasses are cut for animal feed; simple and easy for the farmers to afford and adopt; requires less labour than terraces.

Establishment of income generating activities, cottage industries and promoting Lao weaving tradition in the district will divert the rural work forces attention into these enterprises rather than becoming engaged in shifting cultivation.

District committees should maintain the revolving fund established in Khonvat hospital and village 516 clinic to mobilize those in a proper and effective way to strengthen community development activities.

Prior attention should be given to preventive health education and community development programs such as the establishment of more drinking water wells and septic toilets.

The district/province authority should support the establishment of an agricultural curriculum in all schools along the line of the Tai For-Phor-Or Scheme. A nutritional program can simultaneously be introduced.

And farmers were more motivated after getting income by promoting and expanding their hidden skills in this profession.

There is now a need to develop and introduce diversified cropping systems in the uplands also based on community interests and skills to reduce shifting cultivation practices. In Muong Hom, some of the upland sites were developed by planting mulberry to develop sericulture as a source of income.

Similarly, cash crops such as sesame, sunflower and castor oil, coffee & cashew could be taken as substitute crops in upland areas. Growth and production of sesame and caster oil, cashew and coffee crops grown in Muong Horn district were found to be satisfactory.

Experiments conducted in lowland rice with organic and inorganic fertilizers treatments showed that the application of organic fertilizer such as cattle manure was very effective and economical, regarding yield potential per unit area.

Farmers were made familiar with a better use of unused natural resources like cattle manure for manuring their lowland fields. This was an extension teaching method, as a field visit was performed at demonstration sites to accelerate the diffusion process for better and effective adoption of this important, vital, reliable, and very local technology.

The district administrative authority should start developing lowland paddy fields, so that more families can be involved in rice cultivation rather than getting engaged in shifting cultivation for growing upland rice.

The construction of dams, weirs and spillways in the, project area for supplementary irrigation should be given priority regarding its timely and proper care and maintenance in an appropriate technical way in order to establish continuity in lowland rice production with the greater involvement and participation of farmers.

The trend towards immigration among the people in the district results in an increased area under shifting cultivation. So dialogue must be maintained between district and province authorities on the proposed resettlement and the productive capacity of the land and its likely effects in the Nam Sane valley.

Similarly, it was not economical to use chemical fertilizers in fertile soils, and fertilizers applied in unfertile soil resulted in limiting the availability of other nutrients.

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ANNEX 1

Rainfall agriculture centre Muong Hom

Date	1990								1991												1992						
	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	Jul
1	-	15	6.5	-	-	-	-	-	-	-	1.2	-	-	-	57	-	-	-	-	-	-	0.6	25	-	-	2	-
2	2	48	8	-	5.8	-	-	-	-	-	-	-	-	1.5	-	-	2	-	-	-	-	23	-	-	-	28	-
3	13	25	9.7	-	2.4	-	-	-	-	-	-	-	15	19.5	25	-	22	35	-	-	-	-	-	-	-	-	-
4	1	27	10.2	-	8.9	11.5	-	-	-	-	-	-	-	13.6	24.2	-	18	-	-	-	-	-	-	-	-	58	-
5	-	24	38.2	65.5	-	73	-	-	-	-	-	8.6	-	23	-	-	-	-	-	-	-	-	-	-	-	0.5	-
6	-	10	14	-	-	-	9.5	-	-	-	-	-	-	-	-	-	2	0.5	-	-	-	-	-	-	0.5	-	25
7	20	4.5	1.5	5.6	0.8	55	-	-	-	-	-	-	18	31.5	3.5	-	-	2.5	-	-	-	-	-	-	-	32.5	-
8	-	110	18	1	29.5	-	-	-	-	-	-	-	30	5	-	-	25	-	-	-	-	-	-	-	-	-	69
9	-	6	2.2	-	9	10.2	-	-	-	-	-	-	10.2	4.5	-	70	30	-	-	-	-	-	-	-	-	2.5	16
10	-	6.5	29	8.2	2.5	-	-	-	-	-	-	-	-	7.5	-	-	36.5	-	-	-	-	-	-	-	-	11	-
11	12	22	3.5	7.5	44.4	-	-	-	-	-	-	-	-	0.6	-	5.5	-	-	-	-	-	-	-	-	12	-	-
12	15	-	0.3	-	10	-	-	-	-	-	-	-	-	17.4	36.2	8.5	-	6.5	-	-	-	-	-	-	-	-	16
13	20	-	-	12.7	12.0	-	-	-	-	-	-	-	6.2	-	-	-	6	-	-	-	-	-	-	-	20	19	47
14	5	-	13	-	-	-	-	-	-	-	41.5	-	-	-	239	15.5	2.5	3.5	-	-	-	-	-	-	-	52	5
15	49	11	1.6	-	27.5	-	-	-	-	-	-	-	5.3	-	47	3.8	12.5	-	-	-	-	-	-	-	-	40	2.5
16	18	-	-	13.8	2.6	-	-	-	-	-	-	-	2.5	-	-	12	3	-	-	-	-	-	-	-	3.5	-	-
17	5	-	2.6	-	-	-	-	-	-	-	-	-	24.5	26	2.5	6.4	-	17	-	-	-	-	-	-	-	-	13
18	0.5	-	29.5	14	-	14	-	-	-	-	-	-	5	6.2	-	6.8	48.5	-	-	-	-	-	-	-	-	11	-
19	23.5	25	11	41	9.8	10	-	-	-	-	-	12.2	1.5	-	-	14	-	-	-	-	-	-	-	-	8.0	8	-
20	122	20	109	-	12	6	-	-	-	-	-	1	37	-	-	7.7	-	1.5	-	-	-	-	-	5	40	7	-
21	4	15	5.6	-	4	-	-	-	-	-	-	-	7.2	9.3	4	0.5	3.5	-	-	-	-	-	-	-	-	10	226
22	1	23	-	7.9	-	-	-	-	-	-	-	-	-	48	62	-	6.5	-	-	-	-	-	-	-	-	-	64
23	9	13.5	27	-	-	-	-	-	-	-	-	-	-	10	22	3.2	3	-	-	-	-	-	-	-	21	-	-
24	28	10	-	62	-	5	-	-	-	-	-	-	-	9	34	18.5	-	-	-	-	-	-	-	66	28	-	21
25	-	6.5	7.5	3.2	-	2.5	-	-	-	-	9	-	-	16	39	12.6	-	-	-	-	-	-	-	-	5.5	-	31
26	51	55.5	23	5.7	4.2	-	-	-	-	-	-	-	-	38	31	-	-	-	-	-	-	27	-	-	-	-	40
27	35	53	35	3	1.3	-	-	-	-	-	-	-	-	50	-	4	-	-	-	-	-	3.5	-	24	-	-	10
28	50	15.5	135	12.8	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	21	-	15	-	1.5
29	30	-	105	9.2	-	-	-	-	-		-	-	-	-	7	16.3	-	-	-	-	-	-	-	-	17	-	46
30	45	-	115	18.5	-	-	-	-	-		18	-	-	17	10.5	40	-	-	-	-	-	-	-	-	-	7	44
31	38		40	-	-	-		-	-		22		-		31	8.3	-	-	-	-	-	-	-	-	-	-	8
T	597	546	801	292	187	187	9.5	0	0	0	92	22	162	354	676	254	221	67	0	0	24	56	21	95	172	289	685

ANNEX 2

Analysis of upland soils – agricultural center and farmers fields

Lab. No.	Fe Mg/100g Soil	Acidity(EA) Me/100g of soil		Cation exchange capacity of soil													%	Effective CEC me/100g soil	Ca+Mg / K me/100g Soil
				me in 100g soil							% Element in sorption complex								
		Al	H	Hh	Ca	Mg	K	Na	S	T	Hh	Ca	Mg	K	Na	B.S			
2201/91A	25.2	3.14	0.06	12.08	0.25	0.22	0.22	0.04	0.73	12.81	94.30	1.95	1.72	1.72	0.31	5.70	3.93	2.14
2202 B	22.2	2.95	0.05	11.55	0,30	0.17	0.21	0.06	0.74	12.29	93.98	2.44	1.38	1.71	0.49	6.02	3.74	2.24
2203 C	18.0	2.93	0.07	11.90	0.22	0.24	0.18	0.04	0.68	12.58	94.59	1.75	1.91	1.43	0.32	5.41	3.68	2.56
2204 D	20.4	2.95	0.05	11.38	0.20	0.30	0.20	0.10	0.80	12.18	93.43	1.64	2.46	1.64	0.82	6.57	3.80	2.50
2205 E	17.4	3.15	0.05	11.90	0.20	0.24	0.16	0.10	0.70	12.60	94.44	1.59	1.90	1.27	0.79	5.56	3.90	2.75
2206 F	19.8	-	-	11.90	0.22	0.29	0.18	0.06	0.75	12.65	94.07	1.74	2.29	1.42	0.47	5.93	-	2.83
2207 G	34.2	2.92	0.08	12.43	0.25	0.30	0.20	0.07	0.82	13.25	93.81	1.89	2.26	1.51	0.53	6.19	3.82	2.75
2208 H	29.4	-	-	11.73	0.50	0.82	0.20	0.05	1.57	13.30	88.20	3.76	6.17	1.50	0.38	11.80	-	6.60

Lab. No.	Sampling Depth Cm.	pH		Electric Conductivity EC Ms/Cm	% C	% OM	N Mg/100g Avail.	P Ms/100g Avail.	K_2O Mg/100g Avail.
		H_2O	Kcl						
2201/91A	0.10	4.4	3.7	90.16	1.46	2.52	17.50	2.52	10.40
2202 B	0.10	4.5	3.7	46.06	1.38	2.38	13.40	1.49	8.00
2203 C	0.10	4.4	3.7	146.2	1.38	2.38	12.88	1.26	7.20
2204 D	0.10	4.5	3.7	83.30	1.34	2.31	13.16	1.26	9.60
2205 E	0.10	4.2	3.6	83.30	1.22	2.10	13.37	1.37	6.40
2206 F	0.10	4.2	3.7	74.48	1.26	2.17	16.66	1.14	7.20
2207 G	0.10	4.2	3.7	96.04	1.86	3.21	17.01	1.49	8.00
2208 H	0.10	4.5	3.8	90.16	1.66	2.86	15.75	1.83	10.40

ANNEX 3

Soil physical characteristics

Lab. No.	% of particle size distribution mm — Pipette method >2.0	2.0-0.2	0.2-0.02	0.02-0.002	<0.002	Soil texture	Soil colour	Liming estimates Cao T/ha= Hh.0.56 (Depth 30 cm)
2201 A	-	Soil sample not enough			-	-	10 yr 4/4 (moist) dark yellowish brown	7.0
2202 B	-	"	"	"	-	-	10 yr 4/6 (moist) dark yellowish brown	6.5
2203 C	-	12.2	37.7	10.3	39.8	SC	10 yr 4/6 (moist) dark yellowish brown	6.8
2204 D	-	23.8	36.0	14.9	35.3	SC	10 yr 4/6 (moist) dark yellowish brown	6.4
2205 E	-	9.7	33.3	23.3	33.3	CL	7.5 yr (4/6 (moist) strong brown	6.8
2206 F	-	12.0	38.6	22.0	27.4	SCL	10 yr 4/6 (moist) dark yellowish brown	6.7
2207 G	-	Soil sample not enough			-	-	10 yr 4/4 (moist) dark yellowish brown	7.0
2208 H	-	16.8	30.1	23.6	29.5	SCL	10 yr 4/4 (moist) dark yellowish brown	6.6

Location of samples: A-D Agriculture centre upland demonstration July 1991
E-H Farmer Bounyon upland farm Samkhone village July 1991,
site was a 1 year rice crop following a 3 year bush fallow

Source of analysis: Soil Research Centre
Ministry of Agriculture and Forestry
Vientiane
Lao PDR
17/07/1991

ANNEX 4

Lowland irrigated wet season rice area Muong Hom District 1985-1992

Year	Irrigated Hectares	Bunded rainfed Hectares	Average paddy yields Tonnes/hectare
1985	20	25	2.0
1986	107	31	2.0
1987	197	133	2.0
1988	200	202	2.5
1989	203	222	2.5
1990	223	321	2.5
1991	442	373	2.5
1992	518	399	2.5

Source: District statistics.

ANNEX 5

TABLE 2: **ETHNIC POPULATION PROJECT AREA 1985-1992**

Year	Population total	Ethnic groups			
		Hmong	Lao Loum	Lao Kang	Yao
1985	4311	2315	844	664	488
86	4557	2457	863	748	489
87	4870	2503	869	1005	493
88	5371	2739	904	1236	492
89	5675	2923	955	1302	495
90	6094	3010	1107	1456	521
91	6517	3157	1390	1445	525
92	7598	3642	1751	1546	659

Source: District statistics

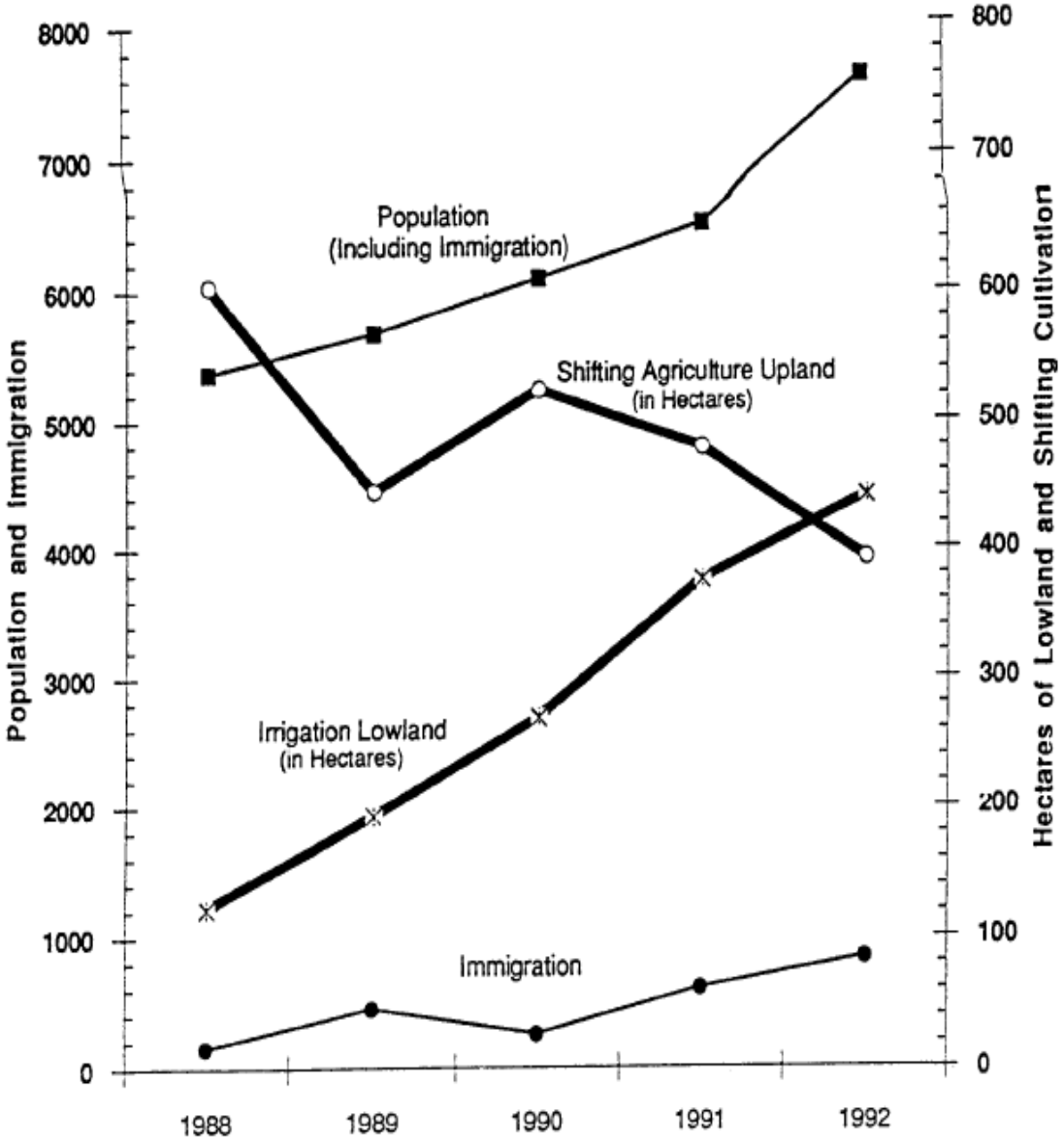
TABLE 3: **IMMIGRATION TO PROJECT AREA 1985-1992**

Year	Individuals	Ethnic groups			
		Hmong	Lao Loum	Lao Kang	Yao
1985	36	18	-	18	-
86	84	42	18	24	-
87	132	60	30	36	6
88	156	54	18	42	42
89	450	186	48	6	210
90	258	186	60	12	-
91	606	438	90	12	66
92	836	425	281	26	104

Source: District statistics and problem census 1992

ANNEX 6

Land use and population trends - project area 1988-1992



Source: District Statistics and Project Problem Census Statistics 1991.

ANNEX 7

Upland rice crop cutting survey results

Village	Ethnic group	Rice Variety *G NG	Date of Sowing	No of hills per M2	No of plants per hill	No. of tillers per M2	Plant height cm	Date of harvest.	Days to maturi-ty	Yield t/ha	Years rice grown on this plot
Thamdin	Hmong	Khauchau Deng (NG)	10/07/90	9	6	52	142.5	25/10/90	107	1.38	1982,86,90
Thamdin	Hmong	Khauchau Deng (NG)	05/07/90	9	6	57	137.7	16/10/90	102	0.82	1982,86,90
Phonmuang	Laolum	Dengpi (G)	06/06/90	9	9	81	126.9	15/10/90	131	1.51	1982,86,90
Phonmuang	Laolum	Khau Lakham (G)	07/06/90	9	9	80	136.2	16/10/90	131	1.85	1982,86,90
Phonmuang	Laolum	Dengpi (G)	05/06/90	8	7	58	123.4	16/10/90	132	1.75	1982,86,90
Sankhone	Laokang	Khauchau(G)	04/05/90	13	8	101	129.3	29/08/90	117	1.84	1982,86,90
Phonlao	Laokang	Khauthon(G)	20/05/90	18	6	111	143	02/09/90	105	1.31	1982,86,89,90
Phonlao	Laokang	Khaukao (G)	06/06/90	13	6	80	125	11/09/90	97	1.36	1986,90
Vangluang	Laolum	Khaukao (G)	14/05/90	12	10	124	128.7	05/09/90	104	1.30	1990
Houaylane	Laolum	Kangsan (G)	22/05/90	13	8	99	120	09/09/90	110	2.63	1980,85,90
Napho	Hmong	Khauchau(G) Kau	28/05/90	10	7	65	163	13/10/90	136	0.92	1989,90
Napho	Hmong	Khauchau(G)	03/06/90	12	4	52	161	22/10/90	141	1.48	1990
		AVERAGE		11	7	80	136.3		118	1.5	

* G - Glutinous variety
NG- Non Glutinous variety

Note. The present bush fallow period for all sample sites is 3 years

ANNEX 8

Expected soil fertility under two shifting cultivation systems in Muong Hom

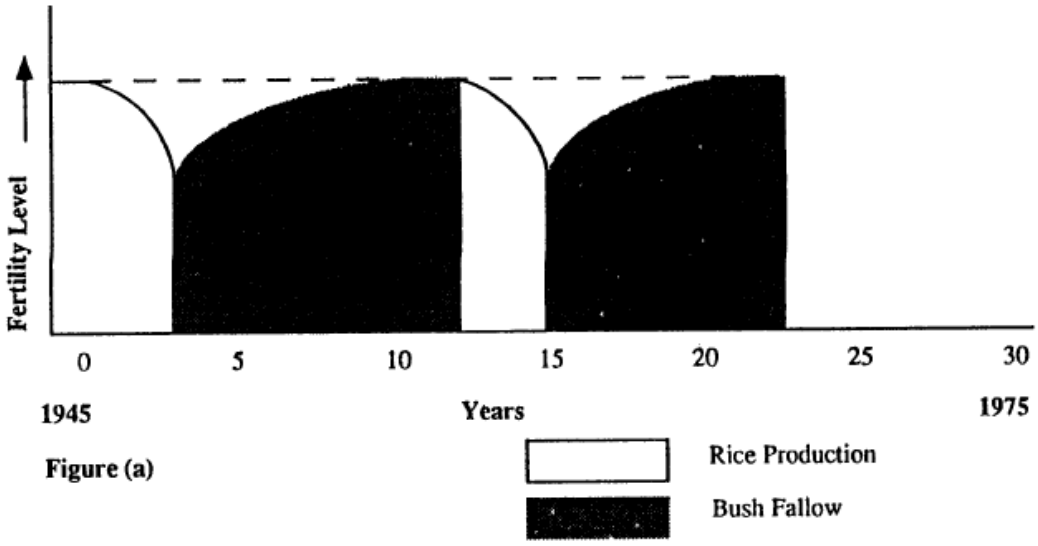


Figure (a)

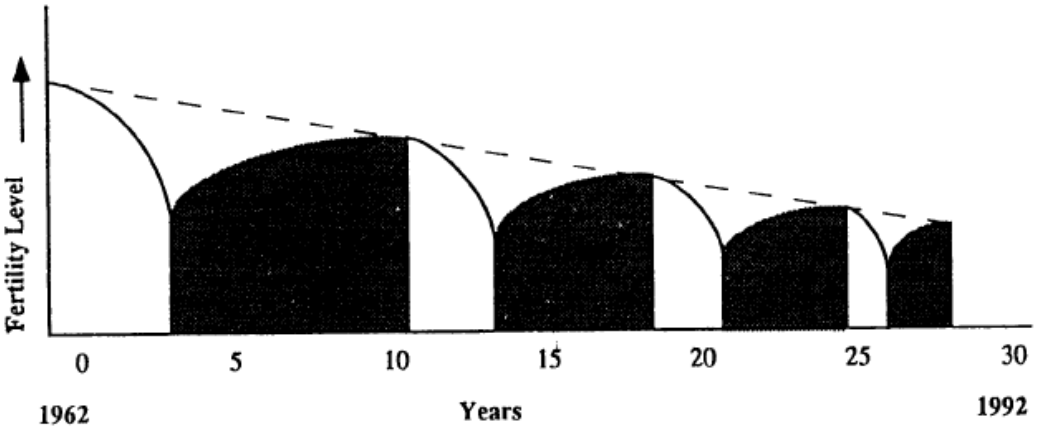


Figure (b)

Figure 1.(a)

Figure 1.(b) A sustainable shifting agriculture system, with long bush fallow and cropping intervals. From village discussions, it was found that similar systems existed in Muong Hom prior to about 1970, when population pressure was low.

The unsustainable system; shorter bush fallow intervals and declining soil fertility, caused by population pressure. Muong Horn district now has an average bush fallow rotation period of 3 years as shown here.

(Adapted from Brady, N.C. The Nature and Properties of Soil, 1984)

ANNEX 9

Agricultural centre upland farming systems demonstration site

		Tree Crops		Sowing date
Terrace 1	Forestry varieties	Maisak, Maidu, Maiso, Maiter, Acacia mangium, Eucalyptus camaldulensis	120 trees	6/06/90
	Cashew nut		47 trees	20/05/89
Terrace 2				
1990	Stylosanthes verano			16/05/90
1991	Stylosanthes verano			
1992	Rice	Variety-Khau Kheyo		02/06/92
Terrace 3				
1990	Black bean	Lao varieties		28/05/90
1991	Black bean	Thai varieties		11/09/91
1992	Pigeon pea	Lao variety		04/06/92
Terrace 4				
1990	Rice	Variety-Kower Variety-Khauphedeng Variety-Khau Hok		16/05/90
1991	Centro cavalacade			16/05/91
1992	Rice	Variety-Khau Kheyo		02/06/92
Terrace 5				
1990	Black bean	KKU - 305		28/05/90
	Black bean	KKU - 264		
1991	Centro cavalacade			16/05/91
1992	Pigeon pea	Lao variety		04/06/92
Grass Strip - Kazungula setaria				
Terrace 6				
1990	Rice	Variety-Kobot Variety-Namhu Variety-Kow Kang San		22/06/90
1991	Pigeon pea	Lao variety		15/05/91
1992	Rice	Variety-Khau Khenyo		03/06/92
Grass Strip - Brachiaria decumbens				
Terrace 7				
1990	Black bean	Lao variety		28/05/90
1991	Rice bean	Lao variety		15/05/91
1992	Pigeon pea	Lao variety		04/06/92
Grass Strip - Brachiaria decumbens				
Terrace 8				
1990	Black bean	Lao variety		28/05/90
1991	Rice	Variety-Khau Igoi Variety-Khau Khao Variety-Khau Hok		17/05/91
1992	Pigeon pea	Lao varieties		04/06/92
Pineapple Strip-Lao Variety				
1990-1992	Stylosanthes verano			

100 Metres

50 Metres

ANNEX 10

Livestock populations-project area 1992

Village	Cows	Buffaloes	Pigs	Chickens	Ducks	Goats	Horses
Napho	115	90	202	724	296	12	18
Thamdin	79	27	184	1500	1600	35	-
Kengsane	190	62	163	700	524	15	-
Hinso	50	30	60	350	50	20	-
Phonmuang	230	110	100	1000	500	-	-
Samkhone	228	112	214	158	50	-	-
Phonlao	19	100	30	50	20	-	-
Vangluang	60	200	25	250	50	-	-
Phonsay	178	73	117	581	200	-	-
Nasay	50	100	200	2000	40	-	-
Chiangmi	100	8	150	200	30	4	5
Nam Ying	40	61	80	800	200	-	8
TOTAL	1339	973	1525	8313	3560	86	36
Mortalities 1991	16	46	313	3620	555	8	1
Percentage mortalities	1	5	20	44	16	9	3

Source: district statistics

ANNEX 11

Seedling production agricultural center 1989-1992

Year	Coffee varieties		Cashew nut	Coconut	Custard Apple	Tea Lime Guava Jujube Tamarind	Mai ketsana Fang Deng Daun Mai Do Mulberry
	Robusta	Cultimor					
1989	13,000	-	3,000	-	2,000	2,000	-
1990	8,000	*10,000	-	224	-	120	-
1991	700	-	-	1,360	1,500	-	4,500
1992	3,000	-	3,000	1,400	-	400	10,500

* Produced for the Highland Integrated Rural Development Project LAO/89/550

ANNEX 12

Robusta coffee and cashewnut trees in farmers' fields 1992

	Coffee		Cashew nut	
Villages	No. Farmers	No. Trees	No. Farmers	No. Trees
Napho	1	350	2	1,700
Namying	11	*2,160	-	-
Houaylane	4	490	-	-
Samekhone	4	220	-	-
Khonevat	29	1,490	4	1,200
Kengsane	4	1,300	6	1,500
Thamdin	2	760	2	600

* 210 trees Caltimor variety

A PICTURE OF SHIFTING CULTIVATION IN THE PROJECT ZONE.

Leik BOONWAAT

Project Coordinator

Highland Integrated Rural Development Pilot Project.

UNDCP/DESD/LAO/89/550

UNDP, P.O.Box 345

Vientiane, Lao PDR

1. BACKGROUND

The Highland Integrated Rural Development Pilot Project is funded by the United Nations International Drug Control Programme, executed by the United Nations Department for Economic and Social Development and implemented by the Ministry of Agriculture and Forests. The Project started in July of 1989 with a duration of five years. The Project zone covers the sub-districts of Palaveck and Phou Ngou in Moung Hom District, Vientiane Province.

The main objective of the Project is to create suitable economic and social conditions to enable farmers in the Project zone to give up opium poppy cultivation.

The Project is doing this by providing villagers with a package of benefits which include: improved roads, communication and access to markets; introduction of agricultural programmes and construction of irrigation schemes to increase agricultural and livestock production and thus family income; the development and establishment of a Primary Health Care system and setting up of community development activities to help women and further increase family income with small income generating activities; development of rural institutional building as well as assistance to improve educational facilities.

The Project's agricultural strategy aims at providing

1. Village food self sufficiency
2. Increased family income through increased agricultural productivity.
3. Promotion of better soil conservation methods to help avert environmental degradation caused by slash and burn cultivation.

The Vientiane Province letter 26/85 states the official policy concerning slash and burn cultivation.

It states that villagers are only allowed to practice slash and burn cultivation if they do not have sufficient lowland paddy. They are not allowed to slash primary forest. Only secondary forest not exceeding five years of growth can be cut except if the forest is situated at sources of water, in village reserved forest and on steep slopes where there is a possibility of uncontrolled forest fire. Each family should cultivate five upland plots on a rotational basis.

METHODS

The fmdings presented in this paper were collected from a number of crop data surveys carried out yearly by the Project extension staff, from informal but structured interviews carried out with farmers in 14 villages and with district officials as well as from personal field observations made during long term stays in the project zone.

2. ECOLOGICAL CONDITIONS

There are steep mountain ranges extending in an east-west direction, elevations for cropping land range from 300 to 1400 meters above sea level. The highest mountain in the Project zone is

Phu Sam Sao which reaches 2126 meters a.s.l. Slopes vary from 2-4% in the valley basins to >50% for some upland fields.

Major rivers are the Nam Hom, Nam Nyok and the Nam Nyiep. Average rainfall per year is about 2300 mm. Minimum temperatures of - 2°C in January to a maximum temperature of 40°C in April are the extreme temperaures.

The climate is tropical to sub-tropical with a wet season which starts in May and ends in October followed by a dry season.

Deposits of layers of sedimentary rock (sandstone) are common within most of the Project zone. The soils in the mountainous areas are typical tropical brown soils (Orthic Acrisols, Lithosols) sandy to sandy loam. The pH for upland fields are 4.5-5.8. In the valleys richer tropical soils (Dystric Nitosols, Ferralic Cambisols) are more common.

Hmong soil types

1. Ah sor jay da	sandy yellow soil
2. Ah sor jay da	sandy grey soil
3. Ah sor jay du	sandy black soil
4. Ah sor jay du cher da	sandy black yellow soils.

(good for maize, chillies, and opium)

1. Ah lod da lia	Red clay loam soils
2. Ah lod dad a	Yellow loam soils
3. Ah lod dad u	Black loamy soils
4. Ah lod dad u chuer lia	Red and black loamy soils

(Good for rice)

Vegetation is characterized by bamboo secondary forest on the lower slopes and permanent forest on the higher slopes in the Palaveck sub-district. In the valleys and lower slopes typical vegetation mainly comprises of Eupatorium odoratum with patches of bamboo, spiny Datura spp, thorny Mimosoideae shrubs.

LAND USE

District figures in 1993 say the primary forest still covers 60% of the land in the Project area, with secondary forest covering 25% and only 15% of the total land area being utilized for cropping.

Most of the land on slopes up to 600 m asl has been used for shifting cultivation at some time or another. Permanent forest with hard wood still covers the higher, steeper slopes and mountains.

Some of the land (a total of about 130 ha.) in the Palaveck valley basin is used as lowland paddy, of which most is rainfed with some form of supplementary irrigation from small water diversion weirs. In the Sam sao valley land is just being bunded and prepared for lowland paddy cultivation this year. A small area of the Nam Nyiep valley basin is used for lowland rainfed paddy.

3. SOCIO-ECONOMIC CONDITIONS

There are 8 main village clusters and 14 villages in the Project zone. In these villages about 616 households are counted with an estimated predominantly Hmong population of 4495. Most of them are subsistence farmers who have grown or are growing opium poppy. Some livestock is raised, mostly for special religious and social occasions as well as to sell in times of need. Villagers hunt for bear, wild boar, deer, and monkey to supplement their diet as well as collecting kissana and wild cardamon from the forest to supplement their incomes.

Before the arrival of the Project in 1990 the area was isolated and remote, with access only by walking track. Travel from Vientiane to Palaveck took a minimum of two days. Access to government credit schemes, markets and health services was non-existent. Villages had no water supply systems or latrines. There were only three small primary level schools. Farmers had little access to agricultural tools and implements. Some were found made from parts of crashed jets and helicopters. The Project has made many improvements since.

4. CROPPING SYSTEMS

The main crops grown are upland rice, maize, cassava and to a smaller extent opium and chillies. Vegetables such as cucumber, pineapple, sweet melon, pumpkin, yardlong beans, sponge gourd, mustard leaf, onions, chayote, sugarcane, soyabean, mungbean, groundnuts, tomatoes, sweet potato and taro are commonly intercropped or grown on the borders of upland fields.

Upland rice is grown between 300 to 700 m asl. Cassava and chillies are grown up to 800 m asl. Maize is grown from 300 to

> 1000 m asl. Opium is grown above 1000 m asl. All these crops are grown under the shifting cultivation system. Some large households which have four different upland fields at different elevations, are growing four different upland crops. Opium is usually grown after the maize is harvested in fields above 1000 m asl.

Fields are slashed in late January or February and burning is commencing in March, followed by clearing and fencing of fields.

Upland rice:

The fields are seeded by dibbling in May. 5-8 seeds are planted in a hole and left uncovered. This is usually followed by two to three weedings in June and July. Harvesting commences in late September unto October. Weeding requires the highest labour input.

Upland rice varieties grown include:

Lao nasme:		Hmong name	Type.
1.	kao deng	blia lia	Non glutinous
2.	kao sao kao	blia der	“
3.	kao lia	blia zia	“
4.	kao dum	blia du	“
5.	kao nyo deng	blia blao lia	Glutinous
6.	kao nyo kao	blia blao der	“
7.	kao nyo dum	blia blao du	“
8.	kao daw	blia cho	“

Most varieties take about 120 days to mature except for the 150 days late maturing ' blia dar' and the early maturing ' Kao daw' which matures in 90 days. The Kao daw is not much grown now due to problems from birds because it ripens earlier. On average 46 kgs. of seed will produce about 100 baskets or 1200 kgs. Yields vary from 1 to 2.2 tons/ha, with an average yield of 1.5 tons/ha.

Farmers have identified grasshoppers and rats as the main pests. The worst weeds were identified as Nya (Phu chi), Nya per (lia ka dia), Nya sa tong (chao) and Nya falang (chao falah).

Upland rice is usually grown in an upland field for only one season whereafter it is abandoned. Though in some newly opened areas two or three .successive crops may be grown. The average fallow period in this area is between 6 - 7 years. Some farmers plant cassava in the second year after planting rice in the first year.

An exception is Sop Phuan village where farmers claim a rice crop has been grown successively for 10 years in a flat upland field without a big decrease in yields.

Maize:

Varieties grown include:

1.	yellow maize	Pok ker da	both non-glutinous, glutinous
2.	white maize	Pok ker der	both non and glutinous var:
3.	red maize	Pok ker lia	non-glutinous
4.	early maize	Pok ker blao	glutinous
5.	striped maize	Pok ker zia	glutinous
6.	black maize	Pok ker du	glutinous
7.	pink maize	Pok ker sia	non-glutinous
8.	pop corn	Pok ker pa	non-glutinous

Planting takes place with the first rains in late March till early May and harvesting begins in June to August. Three to four seeds are planted in a hole. No thinning and usually only one weeding, two to three weeks after emergence is carried out. Farmers did not identify any serious pests during the growing stages of maize. Maize is usually grown for two successive years before the field is abandoned. Farmers say that 1 Kg. of seed will produce a yield of 100 kgs. Pumpkin and sweet potato are usually intercropped with the maize.

Cassava:

Two varieties of cassava commonly grown are:

1. Gon dong lia red cassava
2. Gon dong chwua green cassava

Planting of cassava using cuttings is carried out in March or April. Harvesting of the crop begins after the first year and into the second. Two to four weedings are usually carried out in the first year followed by a single weeding in each following year. The freshly harvested cassava is used to feed pigs after being beaten into edible pieces. Red cassava can be harvested over a longer period than green cassava. The field in which green cassava has been planted and harvested is abandoned after the third year. The Hmong farmers say that a bitter substance in green cassava develops after the second year and can cause pigs to die. Farmers estimate that they can harvest up to 5 kgs of cassava per plant/year.

Chillies:

Three chillie varieties are commonly grown.

1.	Big chillie	kwa sor per
2.	long chillie	kwa sor lia
3. small chillie		kwa sor owa chua

Chillies are planted directly from seed or from transplanted seedlings in April to May. At least two weedings are carried out. Harvesting commences in July and continues up to October to November. Prices for dried chillies range from 500-800 kip per kilo in the Project zone. Usually only one crop is grown on a field before it is abandoned. Some families grow chillies intercropped with their maize. Farmers estimate harvesting 1 kg of chillies from two good plants.

Opium:

After the maize is harvested in fields where soil conditions and elevation is suitable the land is cleared and made ready for broadcasting of the small opium poppy seed in September. Thinning is carried out in October. Weeding is carried out two to four times. Weeding is called " for dai " in Hmong. The farmers use a hoe to scrape weeds and cover it with earth in the field. Harvesting begins in December up to January. Mustard, tomato, shallot, garlic, sweet pea and potatoes are commonly intercropped with the poppy. Opium poppy is cropped for two to more years on the same field. In some areas farmers have said they have cultivated opium for ten successive years on the same field.

5. ANIMAL PRODUCTION SYSTEMS

According to a Project survey carried out in 1992 livestock figures in the Project zone are as follows.

Category	No:
Buffalo	1277
Cattle	2630
Pigs	5062
Goats	95
Horses	46
Poultry	6748

Livestock are traditionally free to range. Annual fencing using bamboo is necessary for most upland fields except for opium. The District is trying to implement a new policy in which cattle are kept in enclosures far from cropping areas during the cropping season and pigs are kept in pens nearer to the villages but this has only been tried in some villages with limited success. Straying cattle still poses a serious problem to the growing crops. Barbed wire is proving increasingly popular with farmers and as they are able to gain more money from new opportunities provided by the Project more and more farmers are buying barbed wire for more permanent fencing.

Disease outbreaks can be serious and have been known to wipe out entire village pig and poultry livestock populations. Traditionally the Hmong upland farmer would take some of his chicken and pigs to raise in his upland fields. Because of the isolation of his field the animals are not effected by disease outbreaks in the villages and ensures there is always some livestock left to reproduce again.

6. SILVICULTURAL SYSTEMS

Main commercial tree species that are growing in the Project area are:

Mai Ken, Mai Du, Mai Pwe, Mai Yang, Mai Dai Hor and Mai Long Leng.

An interesting forest product is an aromatic wood called kissana. Kissana is probably the result of the Kissana tree's natural healing response which produces this aromatic resin after an infestation of beetles. The best quality kissana is said to be able to fetch prices of over TB 25,000 per kilo. Kissana is illegal because of the deforestation caused by those who cut trees to find it. It is used for making incense.

Fruit trees grown include Pomelo, Mango, Jackfruit, Orange, Guava, Mak lot, Lime, Peach and Bananas. Villagers have said six different varieties of bananas are commonly grown in the upland: Kwai Nam, Kwai Gnouk, Kwai Som Yai, Kwai Som Noii, Kwai Kai and Kwai Kung.

7. PROCESSING AND MARKETING

Traditionally rice is pounded but recently 7 rice mills have been established. Farmers are selling their surplus rice to the neighbouring rice deficit areas of Moung Horn and Xia som boun.

The harvested maize is stored in a raised bamboo barn which is sometimes rat proof. Some maize is hung over the fireplace. The villagers say the smoke helps to keep the weevils away. Over 80% of the stored maize is infested with weevils within four months after harvesting. The Project is conducting experiments to improve post harvest storage of maize using proper crop sanitation and re-usable plastic bags. Maize is not sold but produced for household livestock consumption only.

Chillies are dried after harvesting. Improper drying results in whiten dried chillies which fetch low prices from traders. The Project is promoting improved processing of dried chillies to get a more uniform red colour.

Cassava can not be kept for more then 3 days, thus forcing the Hmong women to walk up to their upland fields to harvest cassava every other day. Drying of cassava chips has been tried but farmers complain that pigs do not like the taste of dried cassava.

8. ALTERNATIVES TO SHIFTING CULTIVATION

The upland farmer's main complaint on why he has to abandon his field after a year or two of cropping is decreasing yields and serious weed infestation.

The official District policy is that each upland farmer should have five plots of land which he should cultivate on a rotational basis. The District is also implementing a trial land tenure system.

The control of soil erosion is a most important factor of sustaining an upland cropping system.

The Project has set up demonstration trials of improved soil conservation methods in pilot fanner fields using (see annex):

1. contoured grass strips on a 3 meter vertical interval.
2. lemon grass strips on contours.
3. rock bunds.
4. log bunds laid along the contours.
5. Nitrogen fixing trees planted along the contours.

Contoured grass strips have proved to be the most effective way to decrease soil erosion (see annex 11). Setaria, Signal and Brachiaria ruziziensis (Ruzi) were the grass varieties used.

Where rock and log bunds are available, they have also proved to be effective.

The Project has been encouraging a few pilot farmers to use these soil conservation methods, which has enabled two crops to be grown successively on the same plot without much decrease in yields. The farmers then seed the field with a local pigeon pea variety before it is being left fallow. This should ensure faster regeneration of fertility as well as provide increased food protein sources before the land is theoretically cultivated again on a 10 year rotation cycle.

The problems are:

a. whether there is enough arable land available for such a system to support an ever increasing population,

b. the need for permanent fencing of these fields to prevent livestock damage and

c. the need of a land tenure system which would give ownership or right of cultivation to the same farmer in order to provide some motivation to implement these new practices.

In some upland fields the Project has promoted the intercropping of coffee and other tree crops. The aim is to have the field permanently tree cropped after the upland rice is harvested. This has proved successful with coffee in Sam Sao village.

The Project has conducted field days for villagers to visit various upland demonstration sites where they are able to see and participate in ongoing cultivation activities as well as to discuss various implications of the demonstration trials.

9. CONCLUSIONS AND RECOMMENDATIONS

At present in the Project area upland slash and burn fields are left fallow for an average of 6-7 years before being cultivated again. Farmers have said that after this period yields of crops are just as good as from a new field.

Increasing population pressure and decreasing arable land will mean shortened fallow periods in the future. Government policies are also restricting the slashing and burning of new areas. Project opportunities have also made villages more permanent and less likely to move.

The only sure way so far of reducing upland shifting cultivation areas has been the provision of new lowland paddies to slash and burn farmers. Here again increased population pressure will bear on limited available land resources which can be developed into paddies.

Improved soil conservation methods and improved fallow with a legume cover help to manage soil degradation and hasten regeneration of soil fertility. The main difficulty has been to get the farmers to appreciate the need to adopt these new practices which request more labour input and don't give any immediately evident benefits.

The farmers point out to the still vast areas of forest remaining when asked to try these new practices. Many are beginning to understand the problems which would come with the inevitable increasing population pressure. It is important that trials carry on and appropriate answers are ready before it is too late.

I would like to recommend that meetings be conducted on a regular basis to exchange experiences and that a group of relevant people from different organizations and projects will be set up to work out a more coordinated approach towards solving the problems of shifting cultivation in Laos.

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ANNEXES

1. Results from Upland evaluation sites. (Source: Hoey .P.M. A Farming Systems Approach To Stable Agriculture in the Uplands of Northern Thailand.)
2. Upland Development Program. Upland Conservation Cropping Demonstration. Horn That Vilage. LAO/89/550.
3. Upland Development Program. Upland Conservation Cropping Demonstration. Palaveck Village. LAO/89/550.
4. Upland Development Program. Upland Conservation Cropping Demonstration. Sam Sao Village. LAO/89/550.

5. Upland Development Program. Upland Conservation Cropping Demonstration. Sam Sao Village. LAO/89/550.

6. Upland Development Program. Agroforestry Demonstration. Sam Sao Village. LAO/89/550.

7. Upland Development Program. Agroforestry Demonstration. Sam Sao Village. LAO/89/550.

ANNEX 1

Results from upland evaluation sites

TREATMENT	YIELD (t/ha)		Runoff (m3)2	SOIL LOSS t/ha
	Maize	Rice		
Treaditional	2.9	0.9	2770	45
Terraces	2.6	0.9	610	1.0
Strip Cropping	3.6	2.1	880	5.2
Leuceara	4.3	1.6	1260	21
Grass Strips	4.5	2.0	513	1.3

1. Yield figures are the mean of 2 replicates with runoff tanks for the two years. 1985, 1986

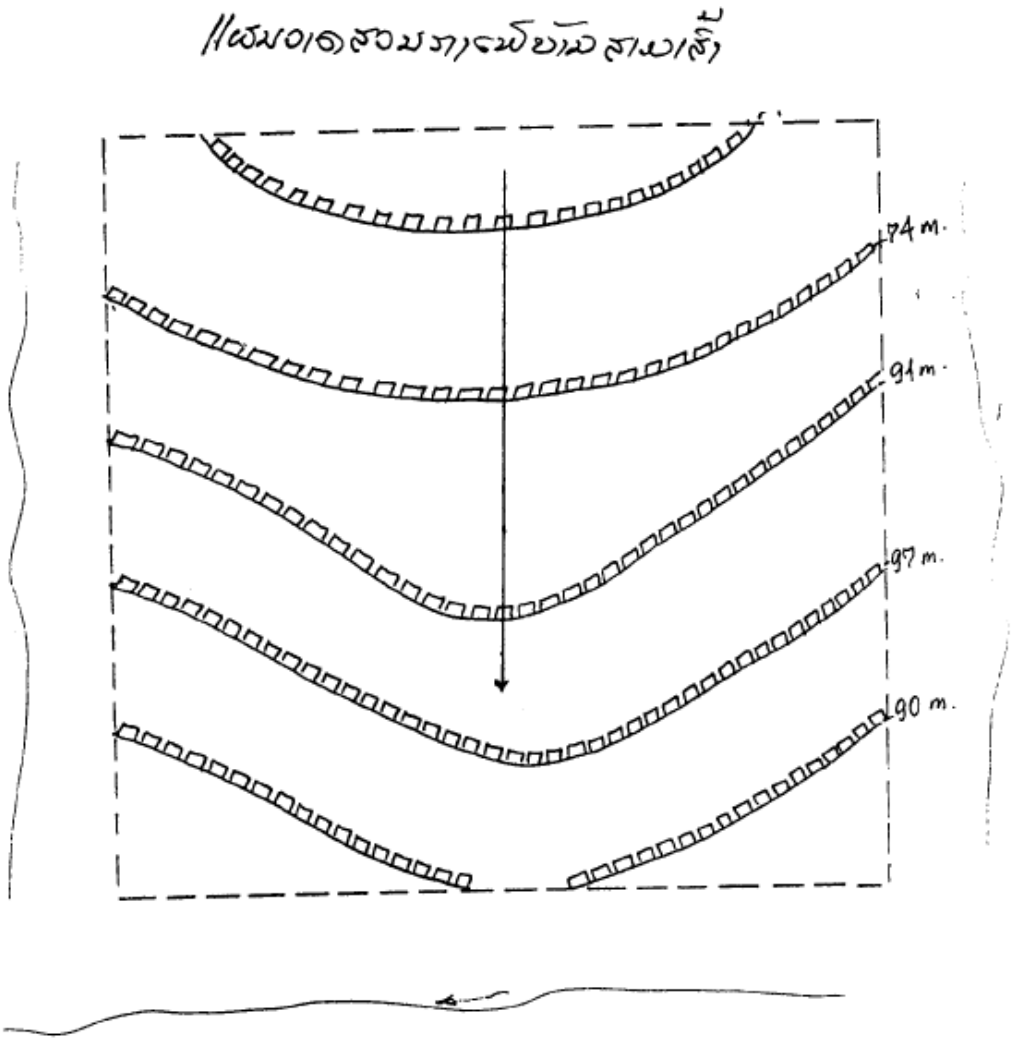
2. Soil loss and runoff figures quoted are the mean for the two sites for 1966 only. The figures quotes underestimate total soil loss as there was some rain before the tanks were completed.

3. Yield for maize crops grown using traditional methods. Figure quoted is average of 15 eplicated crop cuts in farmer's fields in the same area.

(SOURCE: HOEY P.M.' A FARMING SYSTEM APPROACH TO STABLE AGRICULTURE IN THE UPLANDS OF NORTHERN THAILAND.')

ANNEX 2

Upland Development Program. Upland Conservation Cropping Demonstration. Hom That Vilage. LAO/89/550.



Upland Development Program

Agro-Forestry Demonstration

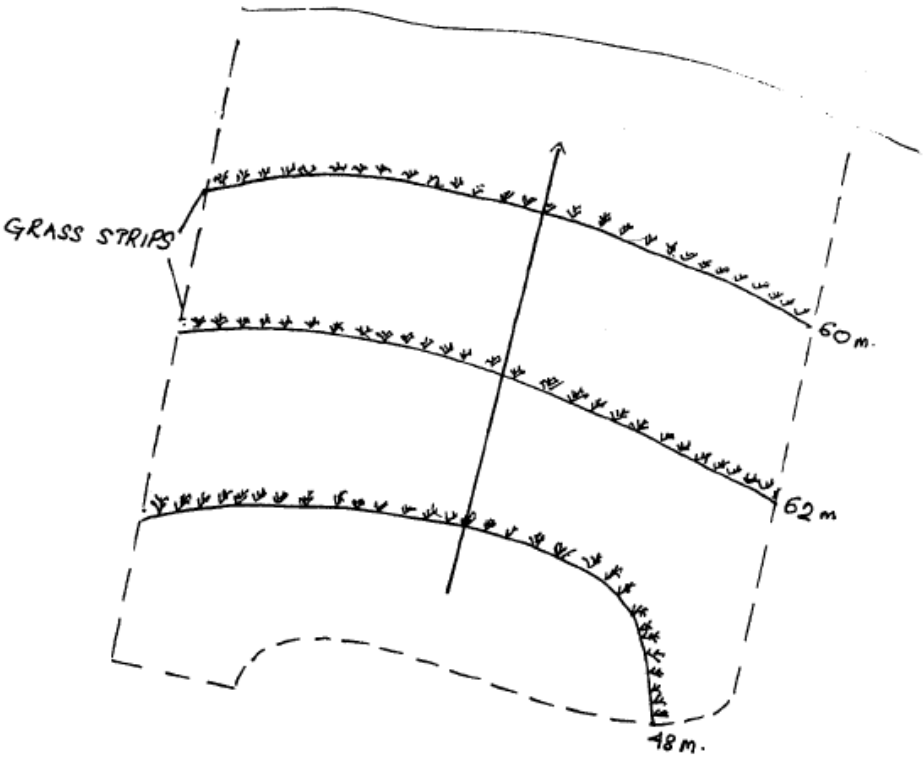
Upland Coffee.

Village - Sam Sao.
Farmer -Community Program.
Extent - 1 Ha.
Plants - 1000 Catimore var. coffee.
Date planted - July 1992.

Treatment;
* Contour stone bunds using material at site.

ANNEX 3

Upland Development Program. Upland Conservation Cropping Demonstration. Palaveck Village.LAO/89/550.



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Upland Development Program

Upland Conservation Cropping

Field Demonstration

Village	- Sam Sao
Farmer	_ Village Community.
Crop	- Job's Tears
Planted	_ June 93
Treatments	_ Contour Grass strip-conservation barriers.

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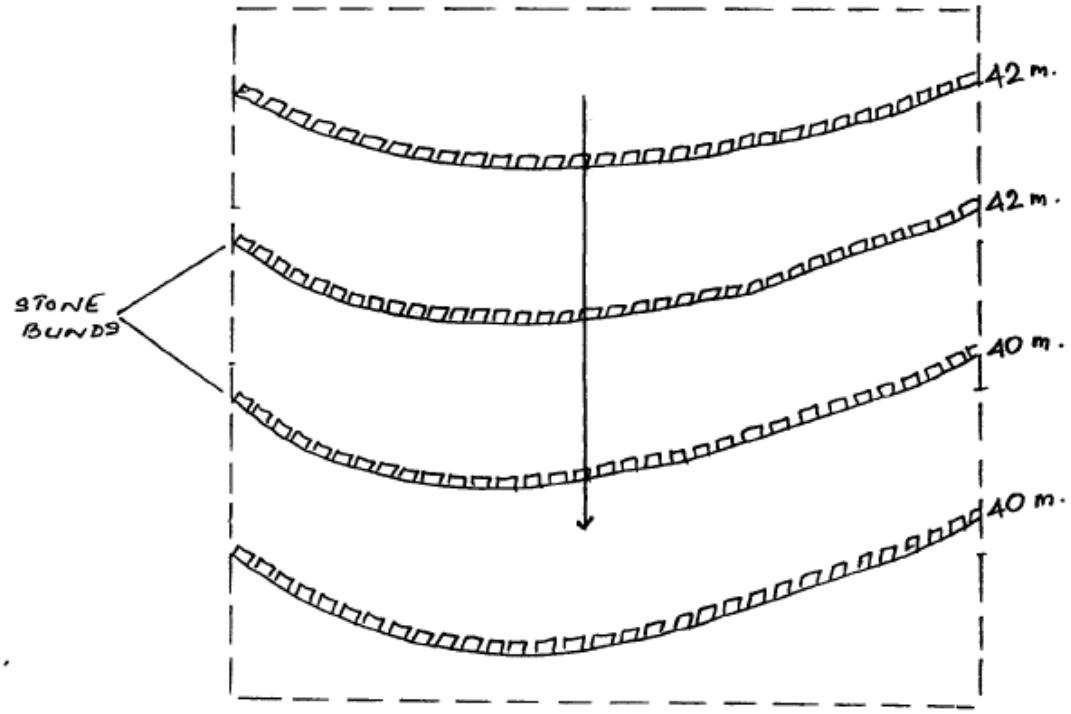
ANNEX 4

Upland Development Program. Upland Conservation Cropping Demonstration. Sam Sao Village. LAO/89/550.



Upland Development Program

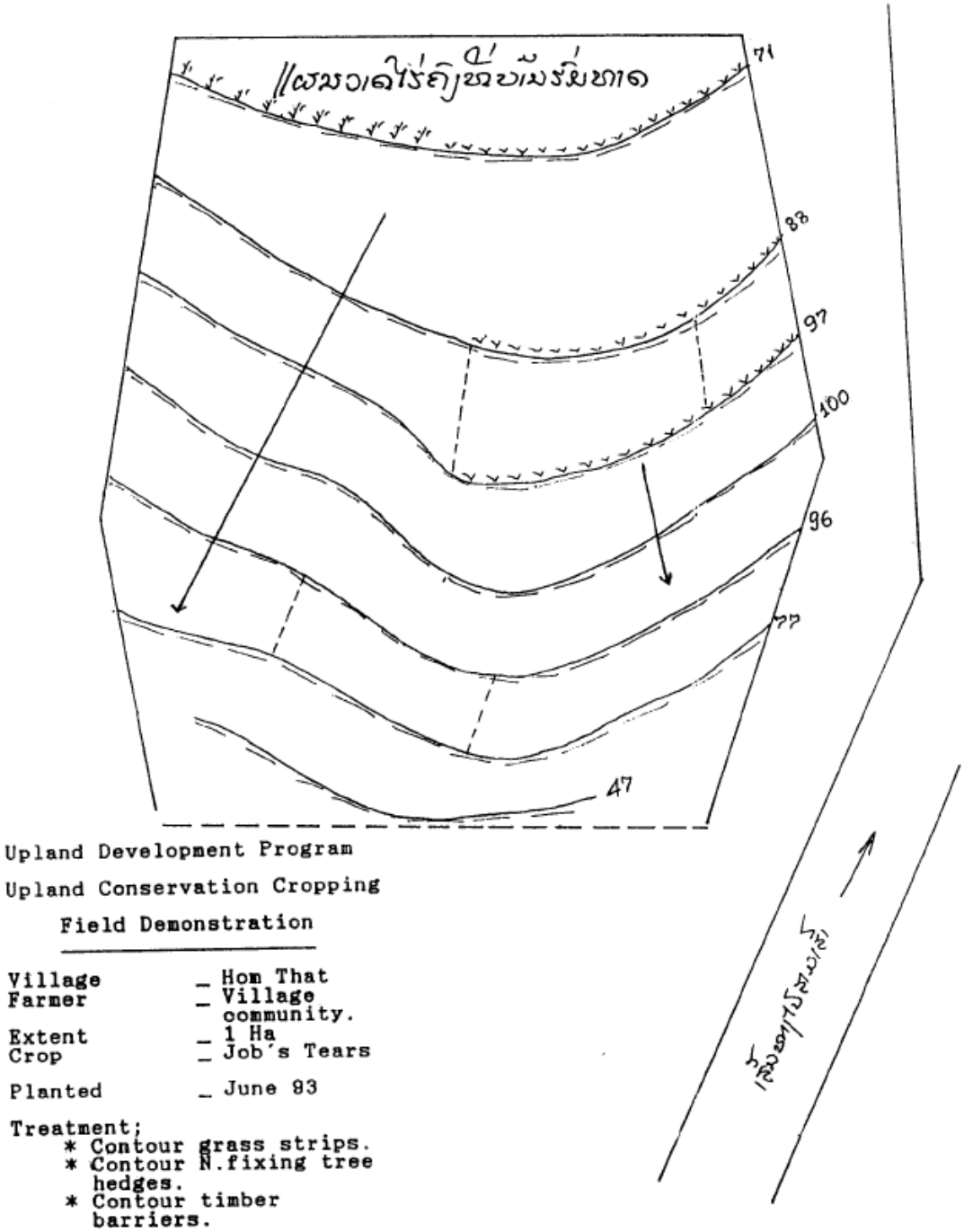
Agro-Forestry Demonstration

Mai Kessina.

Village : Sam Sao
Farmer : Village community.
Extent : 1000 M2.
Plants : 100
Planted : July 1992
Treatment;
* Contour stone bunds, using material at site.

ANNEX 5

Upland Development Program. Upland Conservation Cropping Demonstration. Sam Sao Village. LAO/89/550.



Upland Development Program

Upland Conservation Cropping

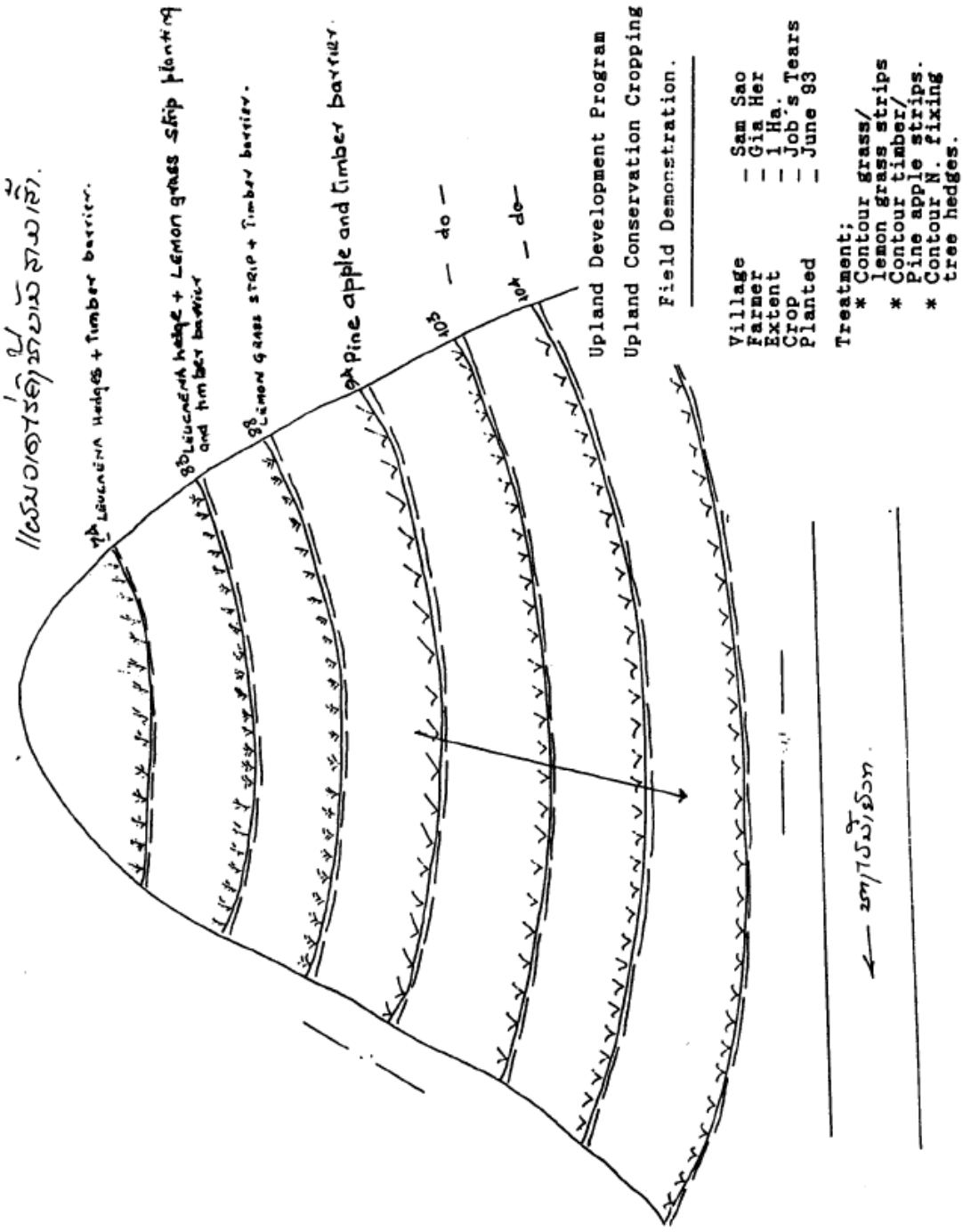
Field Demonstration

Village	_ Hom That
Farmer	_ Village community.
Extent	_ 1 Ha
Crop	_ Job's Tears
Planted	_ June 83

Treatment;
* Contour grass strips.
* Contour N.fixing tree hedges.
* Contour timber barriers.

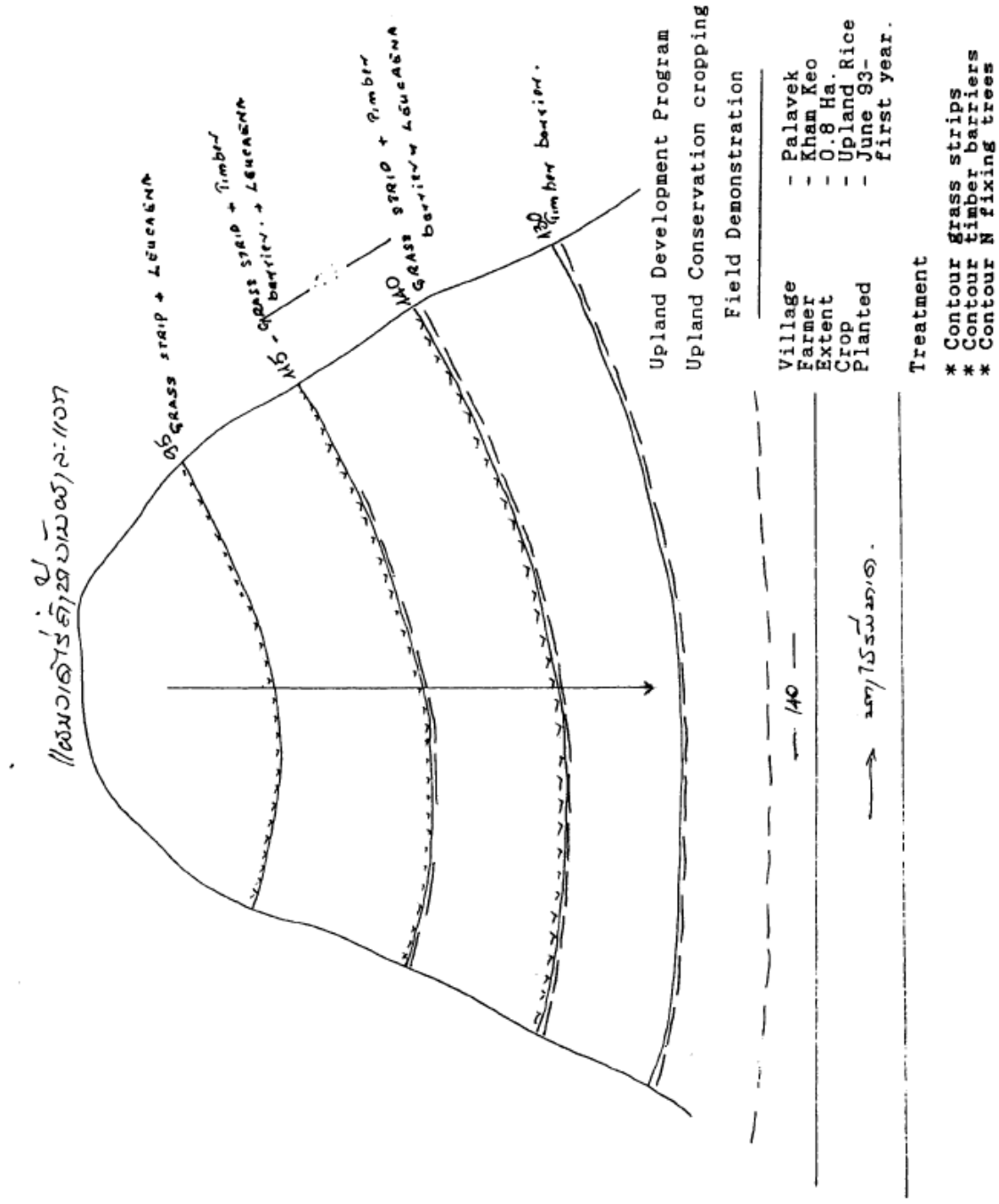
ANNEX 6

Upland Development Program. Agroforestry Demonstration.
Sam Sao Village. LAO/89/550.



ANNEX 7

Upland Development Program. Agroforestry Demonstration.
Sam Sao Village. LAO/89/550.



SHIFTING CULTIVATION PRACTICE OF XIENGKHOUANG PROVINCE

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Xiengkhouang Highland Development Programme.

IFAD/UNDCP/OPS/LAO/91/551-3

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Vientiane, Lao PDR

1. INTRODUCTION

Description of Project

Xiengkhouang Highland Development Programme.

IFAD/UNDCP/OPS/LAO/91/551-3

Programme Structure

Three projects are placed under the Programme to reach the overall Programme Objectives. The Projects are:

LAO/91/551 Agricultural Development in Province of Xiengkhouang.

LAO/91/552 District Development in Opium-growing Areas of Xiengkhouang. LAO/91/553 Labour-based Road Construction in Opium-growing areas of Xiengkhouang.

Objectives and Strategy

LAO/91/551 Agricultural Development in Province of Xiengkhouang.

A Project for The Agricultural Development of the entire province.

With the strategy of disseminating appropriate agricultural practices and technology to disadvantaged farmers through technical reinforcement of existing Government infrastructure, organizing and establishing principle villages, model farmers and village volunteers to fulfill the following objectives:

- To ensure food security for poor households,
- To increase agricultural productivity, production and household incomes,
- To introduce alternative farming systems in opium-growing areas.

1.1 Target Group

Disadvantaged farmers of the whole Province.

12900 People will have benefited by the end of the 7 year Project term.

1.2 Target Area

Districts of the Province.

The Project activities are being carried out in Khoune and Nonghet Districts in the first year of the Project, Kham and Pek District in the Second year and the rest of the Districts in the third year of the Project.

1.3 Implementation Arrangements

The Ministry of Agriculture and Forestry is the implementing agency of the Project. The Project plan was formulated at a meeting of Provincial Agricultural Department and Project Personnel has been organized before an annual activity plan has been drawn. The Annual Workplan Implementation meeting was organized with the assistance of grassroot level field staff from the Districts and Provincial Agricultural Department to be able to explain the plan to the responsible staff.

1.4 Project Duration

There is an IFAD loan fund for seven years and the United Nations International Drug Abuse Control Programme fund for the Technical Assistant accounts for three and half years.

The Government Policy towards shifting cultivation in the Project area (Provincial Level) is to stabilize shifting cultivation by promotion of alternative sedentary crop cultivation. Food self sufficiency is the main objective for the Agricultural sector of the Province. But so far no definite measures to reduce the shifting cultivation have been adopted by the Province, except that new paddy land is being opened up in Mokmai District (Tha Thum and Thavieng sub Districts) for the farmers who moved down from the mountains and who mainly depend on upland shifting rice cultivation.

2. ECOLOGICAL CONDITIONS OF THE PROJECT AREA.

Xiengkhouang is one of the northern Lao Provinces which lies about 180 km northeast of Vientiane. The distance by road through Luangprabang Province to the west is about 450 km.

The total area of the Province is 1,980,000 ha. of which 17% is arable land. Only less than 2% is under cultivation. 15% Is pasture land and 69% (1.34 million ha) is covered with forest.

Pek, Phaxay and Phoukout District are at an elevation of 1100 meter, Khoune District at 800 meter, Kham Distract at 600 meter elevation and Nonghet and Mok Mai District at 1300 to 2000 meter.

The Project area had monsoon climate. Average annual rainfall is 1500 mm. Only 20 % of the rainfall falls in the dry season. The highest temperatures occur in April/May (over 28°C) and the lowest temperatures occur in December/January (below 10°C). Temperatures are considerably lower in the higher area of the Province (Nonghet and Molmiai District). Pek

District Weather station is the only weather station of the Province. Mini weather stations are being installed in the Project TTDCs (Training Trials and Demonstration Centres).

Pek, Phoukout and Phaxay districts are covered by the rolling hills of savanna grass land. Grasses and pine trees are the main vegetation of these three districts. Mixed Deciduous and, bamboo forest are found in Kham and Nonghet District. Hill evergreen forest is found in the highest mountains of the Province especially in Khoune District where Sandal wood is growing.

The average soil pH of the Districts are: pH 4 to 5.5 in Pek, Phoukout and Phaxay District, pH 5 to 6 in Khoune District, pH 5.5 to 6.5 in Kham District and Nonghet District. Soil records of Mokmai District have not been collected yet. High levels of Phosphorus and Potassium are found in Nonghet District. Phosphorus deficiency is found in Kham District. The soil nutrient contents of the remaining districts are not available.

No proper wild life record is available. But wild life is found in the dense forests of Nonghet and Mokmai Districts.

Xiengkhouang Province is well endowed with numerous streams and rivers which supply enough water for both the dry season and the wet season for crop cultivation through proper irrigation system. Some of the lowland paddy fields are irrigated by a weir made by the villagers with locally available materials (600 of such local made weirs cover 2000 to 3000 ha). The Government has constructed 37 irrigation schemes with the participation of the villagers which cover 4000 ha. Rehabilitation of the existing schemes and development of new schemes is being carried out by the irrigation component of the Project.

3. SOCIO ECONOMIC CONDITIONS OF THE PROJECT AREA

Xiengkhouang Province comprises 7 Districts, 55 sub Districts, 538 villages and 31710 families. Lao Loum occupy the low land and narrow valleys with numerous streams and rivers between the stiff mountains slopes. Lao Theung villages can be found on the intermediate areas of around 600 meter elevation.

All three general ethnic group (Cultural Group) Lao Loum, Lao Theung, Lao Sung are found in Xiengkhouang Province.

The total population of the Province was 190,261 in 1992. 52% Represent the age under 15 yrs old. 40% Of the total population is considered as labour force.

The average growth rate of the population is 2.55 % according to the latest data available. Population density is very low at 10 persons per km2.

Lao Loum comprise Tai Phuan, Tai Cha, Tai Meuai and Tai Dam with a population of 114,156, which represents 60% of the total Province population (190, 261).

Lao Theung ,Khamu and Laophong are found in Xiengldiouang Province with a population of 19,026, which represents 10 % of the total Province population.

Lao Soung comprise White Hmong and Striped Hmong and are found in Xiengkhouang Province with the population of 57,078, which represents 30% of the total Province population.

As in all the Provinces of northern Laos Lao Soung choose the mountain tops to set up villages. Here the climate and the limestone mountains are ideal for opium growing, which has supplied the family income for generations.

3.1 Main products and activities

The main products of the Province are livestock, rice and garlic.

Total rice production of the Province in 1992 was 37,566 tons (197 kg per head). Maize is the second staple food of the Lao Soung and a significant amount of 5178 tons of maize was produced in 1992. The Lao Soung of Nonghet district bartered maize for salt from Vietnam at the rate of 1 kg maize to 1 kg salt. 98 Tons of garlic was produced in 1992. Most of it is exported to

the Vientiane market. Xiengkhouang province is well known for cattle production. Total livestock population in 1992 comprised 61,689 cattle and 50,018 buffaloes.

The total rice cultivation area (both paddy and upland rice) is 21,931 ha. of which 9319 ha is upland rice. The average yield obtained was 1.11 ton/ha in 1992. Maize (mainly grow on shifting cultivation plots) occupied 3625 ha.

Although Xiengkhouang Province has numerous kinds of fruit trees (especially sub-tropical and temperate fruit trees) fruit production is only for the local market and self consumption. Fruits exported to other Provinces or Countries (e.g.: Vietnam, Vientiane, Luangprabang) are rarely seen. Small amounts of pears and peaches are transported to Vietnam, Vientiane and Luangprabang. Due to the lack of proper packaging and poor roads, most of the fruit has usually perished by the market destination and most of the traders are not interested in the fruit market. Fruit preservation, processing and the development of proper management techniques of harvesting and post harvesting are being introduced by the Project.

Xiengkhouang Province is one of the heavy opium producing province with the total opium production of 7 to 14 tons raw opium annually. Most of the opium is produced by Hmong, situated on land with a suitable environment for opium growing (high elevation, fertile narrow valleys between limestone mountains etc.). Some Lao Loum and Lao Theung villages in an environment as stated above produce opium too. The opium produced by Lao Theung (who have the highest opium addiction rate) is mostly for self consumption.

3.2 Health and education

The Provincial Hospital of Phonsavanh Town is set up with Mongolian aid. Khoune, Kham, Nonghet, Phoukout and Mokmai have District Hospitals. Shortage of medicines and facilities is common. Most of the villages far from the main road are not reached by the Medical service staff. Common vaccination for children can not be done in such remote areas of the Province. Measles and smallpox are still found among children of remote, isolated areas of the Province such as with the Lao Phong minority of Nonghet District. Malaria, skin diseases and tuberculosis are major health problems. Hmong villages usually have traditional medicinal herbs in their home garden and use it for traditional healing. Every Hmong village has a traditional healer and a Spiritual Practitioner (Maw Yao) and they are the only persons available for healing various sicknesses. Opium is a major multipurpose medicine for people in isolated area. The highest opium addict rate is found among the Lao Phong, usually due to the use of opium as a painkiller.

More than 1500 government staff members are employed by the Province Education Department. The schools of the District towns usually function well. The schools in Lao Theung, Lao Sung and Lao Phong areas are mostly primary schools of only two curricula. Teaching hours are usually only 2-3 hours a day, allowing enough time for students and teachers to work in crop cultivation. The teachers are paid insufficiently and irregularly (once in 5-6 months).

3.3 Road network and access to the markets

Route 7 is the main road of the Province which crosses the Province from Route 13 to Vietnam border. Route 7 meets Route 6 at Kham (Chom town) District. From Kham Route

6 continues north towards Huaphan Province and Luangprabang. There is a paved road from Phonsavanh to the Vietnamese border, through Kham town and Nonghet town. Part of route

7 from Phonsavanh to Route 13 is only passible if there have not been heavy rains. There is laterite dirt road from Phonsavanh to Khoune. The road from Khoune to Mokmai district is only passible if there have not been heavy rains.

The road to Thathum sub district in Mokmai district, to open up the low flat land, is under construction.

The villagers along the main roads can bring their products to the markets by regular bus services between the District towns and the Provincial Capital. But most of the villages are located far from the main road, so only the foot paths provide access to the markets. Some Hmong farmers use

horses for transportation. But most of the foot paths are narrow and cross steep slopes of narrow valleys, so they can not be used by harnessed or packed animals.

Regular flight services link Phonsavanh with Vientiane. The small plane Y12 (17 seats) and a helicopter are used for the service. Two flights daily ar operated between Phonsavanh and Vientiane. The military base can be used for bigger planes, but it is not open for civil aviation.

3.4 State of access to government extension services

No significant extension service activities are provided to the farmers. Animal vaccination services, law enforcement campaigns for the reduction of opium production, addiction and trafficking and regular health services can only reach the villages close to the main road and some sub district villages. For the Agricultural Extension service, The Project is organizing Principle villages, model farmers and Village Volunteers for the agricultural extension service, in order to disseminate proper agricultural practices.

3.5 Food availability (rice and others)

Rice is the staple food for the Lao Loum and Lao Theung. For Lao Sung, rice and maize are stable food. Only Kham District could produce sufficient food for the District. The additional rice is usually imported from Vietnam and Vientiane.

Root crops (Arrow root, Cassava, Sweet potato, Taro) are additional food crops in case of food shortage. Arrow root is mostly planted by Lao Sung, cassava is mostly planted by Lao Theung and sweet potato and taro are only planted small scale in home gardens. Chronic food shortage usually occurs among Lao Sung and Lao Theung. To be able to overcome the food shortage root crop plantations are made by the families in fields separated from upland rice fields. The period of food shortage varies from 2 to 6 months among Lao Sung and Lao Theung (Khamu and Lao Phong). Root crops are used for animal feed in normal times and for human consumption as additional food in the case of food shortage.

3.6 Local management of natural resources

Slashing of original forest or regenerated forest is prohibited by the Provincial Government. Local timber companies are prohibited from logging. The villagers can cut trees for construction of their own house, but they need a special authorization of sub District and District officials.

With agreement of the Government, a Taiwanese company is logging Sandal wood at Khoune District. A reforestation programme for Sandal wood is being carried out by this company. The timber company has it's own rural development programme and reforestation programme, in agreement with the Provincial Government.

3.7 Subsistence vs market oriented rural economy

Except at Kham and Khoune District, farmers produce garlic at a commercial level. It is exported to Vientiane through local traders and some fruits (mostly pears and peaches) are exported to Vientiane, Luangprabang and Vietnam. No market oriented rural economy exists.

3.8 Major socio economic problems

The major socio-economic problems of the Province are:

the absence of a good road network from the villages to the markets, the impassable condition of the road from Phonsavanh to Route 13 during the rainy season, lack of a satisfactory extension system and sufficient staff, lack of development schemes for markets for farmers products, poor access to education and health services.

4. SHIFTING CULTIVATION OF XIENGICHOUANG PROVINCE

The Project area comprises 3 main Agroecological zones and Production System.

Agroecological zone/ Production System	Rolling hills & Savannah Pek and Phoukout 900m to 1200 m	Warm Valleys Kham and Khoune 500 m to 800 m	Mountainous Nonghet and Mokmai 1200 m and above
Crops	Rainfed and Irrigated rice upland rice	Rainfed and Irrigated rice, upland rice, vegetables	Upland rice, Opium, Vegetables
Livestock	Cattle,Buffalos, Chickens, pigs	Cattle, Buffalo, Chickens, Pigs	Pigs,Cattle,Poultry
Forestry	Hunting	Hunting	Hunting
Other		Sericulture & Weaving	
Ethnic Group	Thai Phuan, Thai Lao,Hmong	Thai Phuan, ThaiDam,Thai Meungai,Thai Lao,Khamu,Lao phong	Hmong, Thai Phuan, Thai Dam
Soil type	Red laterite acidic soil	Dark brown forest volcanic soil	Dark brown loamy lime stone soil

In Xiengkhouang Province, shifting cultivation is practised for both rice and maize planting. Rice and maize are planted both seperately and as mixed crop cultivation. Shifting cultivation is also practised for opium cultivation. But the most opium is produced on permanent opium plots with fertile soils at the foot of limestone mountains and in the family owned home gardens of villages of high elevation. Most of the opium fields found on the shifting cultivation sites belongs to Lao Theung, who usually plant opium for their own consumption and do not have family home gardens in their villages. Since opium growing within the shifting cultivation system takes place on a very small scale compared to rice and maize, only the last two will be discussed.

Shifting cultivation practices in Xiengkhouang Province differ within the above mentioned agroecological zones.

4.1 Shifting cultivation Practice on Rolling hills and Savannah Grasslands

Mostly only rice is planted in shifting cultivation of the Rolling hills and Savannah grasslands. Most of the soil is red laterite clay loam and sandy clay soil of pH 4 to 4.5.

- Land Preparation (slashing, burning, clearing, tilling) and Planting

No slash and burn is practised. Land preparation is usually done by hand hoe, buffalo and tractors. One till ploughing is done in January and February. The ploughed land is left to dry for one month or more, until the grasses have died. Harrowing is done in March and April and broadcasting or dibbling rice seeds in May.

-Pests

Insect Pests

Leaf eating insects (Grass hoppers and Hairy caterpillars), Stem Borers and white grub are the major insect pests.

Rodent

Rattus rattus and Rattus exulentus are sometimes serious pests at the ripening stage. Rattus bengalensis is rarely found.

Diseases

Brown spot (Helminthosporium) is the only rice disease found on young plants (tillering to maximum tillering stage) mostly due to drought.

Weeds

Congo grass (Imperata cylindrica), White head (Eclipta alba) and Goatweed (Ageratum conyzoides) are the major weeds. Congo grass and Goatweed are usually found in the first year of cultivation. In the second and third year White head is more likely to be found. Appearance of White head and Gomphrena celosioides is the symptom of exausted poor soils.

- Weeding

Weeding is done two times in the first year of cultivation and four times in the second year, which has a more serious weed problem.

Since land is ploughed and the weeds are dried out in the first year, no serious weed problems are encountered in the first year of cultivation. Farmers usually abandon the field when the Eclipta alba and Gomphrena celosioides weeds are appearing.

- Cultivated period

Mostly the land is utilized for two years. If the soil is fertile, it is used for three years.

- Fallow period

Since the availability of savannah grassland is still high (not much savannah grass land is used for upland rice cultivation) and most of the population of the Rolling hills and Savannah grassland area have paddy fields which are situated between rolling mountains, the fallow period is longer (7 to 10 years) compared to other agroecological zones.

- Associated crops

Usually only corn is mixed with the upland rice of savannah grassland.

- Yield

Rice yields of 1 to 1.5 ton/ha can be obtained in the first year. Yields of the second year are less than 1 ton.

- Slope

Most of the upland rice fields of the Rolling hills and Savannah grassland are located in flat or slightly sloped (under 40%) valleys or at the foot of the mountains where soils with a thick organic layer (0 layer, 15 - 30 cm top soil) can be found.

-Erosion

Since rain water can flow freely on the rolling hills and slopes of savannah grassland, soil erosion by rain water is a significant cause of loss of top soil. Soil erosion rates might differ with the different slope percentages. Proper records of soil erosion rates are not available and it is being evaluated by the Project.

The thick grasses of the Rolling hills and Savannah grass land could prevent erosion to some extent.

- Soil erosion control measure

Significant thickness of the original existing grasses of Savannah grassland can prevent soil erosion to some extend. This can be done by growing rice in horizontal, 3 to 6 meter wide plots (depending on the degree of slope), leaving one meter wide existing grasses as grass strips

between the rice growing plots (instead of introducing other grassess). This practice will be easier to introduce to farmers than e.g. alley cropping.

- Fallow crops improvement

Pigeon pea (tolerant to acidic soil) is selected and introduced for fallow crops improvement, as the soils in this agroecological zone are acid and lack weeds which can replenish good biomass or nutrients to the soil.

4.2 Shifting cultivation Practice of Warm Valleys

Rice and maize are mainly grown as mixed crops in the shifting cultivation systems of the agroecological zone of the Warm Valleys, which can be found in Kham District and Khoune District of Xiengkhouang Province.

- Land Preparation (Slashing, Burning, clearing, tilling) and Planting

The regenerated forest or bushes are slashed in January, whereafter they are dried for a month or more, to be burnt in the last week of March or in the first week of April before the New year rain. Ground clearing after burning is done just before the planting of rice. The rice is usually planted soon after the new year rain (Mid April) to May. Rice is planted with dibbling stick.

- Pests

Insect Pests

Leaf eating insects (Grass hoppers and Hairy caterpillars), Stem Borer and white grubs are the major insect pests.

Rodent

Rattus rattus and Rattus exulentus are sometimes serious pests at the ripening stage. Rattus bengalensis is rarely found.

Diseases

Brown spot (Helmintho sporium) is the only rice disease found on young plants (tillering to maximum tillering stage) mostly due to the drought. False smut is found as minor fungal disease.

Weeds

Giant mimosa (Mimosa pigra L), Bitter bush (Nya Falang; Chromolaena odorata), Pig weed (Amaranthus spinosus), Goat weed (Ageratum conyzoides) are the major weeds during the first and second year of cultivation.

Congo grass (Imperata cylindrica) can be found in the following years of cultivation and is the sign of poor soil fertility due to the intensive cultivation.

- Weeding

Weeding is done 3-4 times in the first year of cultivation. Five weedings might be needed for the second year of cultivation, which has more serious weed problems.

Farmers usually abandon the field when Congo grass (Imperata cylindrica) begins to occupy the field.

- Cultivated period

The ethnic minorities of this zone are mostly Lao Loum and Lao Theung. Lao Loum mainly depend on the lowland paddy and only the families with insufficient rice grow upland rice in the land nearby their paddies. Lao Loum grow rice for two years in one place but Lao Theung mostly use a cultivation site for only one year.

- Fallow period

The fallow period for the Lao Theung in the past 10 or more years was 10 to 15 years for one cycle of shifting cultivation. The soil occupied by the Lao Theung in•Xiengkhouang is more fertile

due to the black forest volcanic soil (Kham District). Thus the vegetation of the land used one year for slash and burn upland rice cultivation can be regenerated within 7 to 10 years to reach to the previous vegetation. But due to the population growth after 1975, the fallow period is nowadays only 3 to 4 years in the village lands nearby the road where the population density is higher than in isolated areas far from the main road.

The fallow period is still 7 to 10 years in isolated areas far from the main road where most of the Lao Phong minorities are dwelling.

- Associated crops

Maize, sorghum, millet, cotton, pumpkin, white gourd, mustard, tomato, ginger, long beans, bitter gourd, peanut, taro, sesame and chillies are the associated crops of shifting cultivation area in this zone.

- Yield

Rice yields of 2 to 3 tons/ha can be obtained in the first year. Yields of the second year are less than 2 tons.

- Slope

Most of the upland rice fields in this zone are located on fairly steep hill sides (10 - 60 %).

- Soil erosion control measure

Since the loamy soils of this zone and the upland rice fields are mostly situated on the foot or the sides of the mountains, agroforestry (planting of teak and fruit trees with rice base) and grass strips with Vetiver are being introduced to control soil erosion.

- Fallow crop improvement

Since there is a good vegetative cover of Chromolaena odorata and Mimosa pigra L no fallow crop improvement activities are planned for this agroecological zone.

4.3 Shifting cultivation Practice of Mountainous Zone

Rice and maize are grown as separate or mixed crops in shifting cultivation systems of the Mountainous agroecological zone, which can be found in Nonghet and Mokmai Districts. The most fertile soils are ussually used for the opium growing.

- Land Preparation (Slashing, Burning, clearing, tilling) and Planting Two different methods of land preparation are practised.

4.3.1 Tilled land.

The mountainous zone of Xiengkhouang Province is mostly occupied by Lao Sung. The mountains are limestone. 20 - 70 % Of the land surface is covered with the rocks and gravel. Most of the Lao Sung choose to live in the mountain tops. Therefore arable land availability for crop cultivation is very limited and intensive crop cultivation is inavoidable.

To be able to improve soil texture and available plant nutrients for intensive cultivation, farmers in this area till the land by hand hoe and sometimes by ploughing with buffaloes.

Rice or Maize are planted with dibbling stick.

4.3.2 Slash and Burn

The regenerated forest or bushes are slashed in January and are dried for one month or more whereafter it is burnt in the last week of March or in the first week of April before New year rain. Ground clearing after burning is done just before the planting of rice. Rice is usually planted soon after the new year rain until May. Rice is planted with dibbling stick.

- Pests

Insect Pests

Leaf eating insects (Grass hoppers and Hairy caterpillars), Stem Borer and white grubs are the major insect pests.

Rodent

Rattus rattus and Rattus exulentus are sometimes serious pests at the ripening stage. Rattus bengalensis is rarely found.

Diseases

Only False smut is found as minor fungal disease.

Weeds

Goat weed (Ageratum conyzoides) and various grasses are major weeds.

- Weeding

Weeding is done 3-4 times for rice and two times for maize.

- Cultivated period and fallow period

Land is used for 2-4 years for rice. After rice the land would be planted with maize for 2-3 years, followed by a fallow period of 5-7 years, until the next planting.

Some plots are used only for maize for 5- 6 years, and left for 6-7 years until the next planting.

- Associated crops

If rice is planted seperately, maize is mixed as an associated crop. Mustard, lettuce, coriander, snow peas, radish and cabbages are associated crops.

If maize is planted seperately, soyabean, peanut and mungbean are usually planted as mixed crops under the maize plants.

- Yield

Rice yields of 1 to 1.5 tons/ha can be obtained in first year. Yields of the second year are 1 ton or less.

- Slope

Most of the upland rice fields in this zone are located on 30° to 75° steep slopes.

- Soil erosion control measure

Grass strips with Vetiver are being introduced for soil erosion control.

- Fallow crop improvement

In this Agroecological environment the soil surface is not covered by any vegetation in the dry season, therefore Pigeon pea is the ideal fallow crop to cover the soil surface with good biomass media.

5. PROJECT'S ACTIVITIES TOWARDS STABILIZATION OF SHIFTING CULTIVATION

5.1 Small Scale Irrigation Schemes

Renovation of existing irrigation systems and the design and establishment of new irrigation schemes is being carried out by the Project. All these schemes are based on establishing Water users groups and Credit loan systems.

The farmers who mainly depend on the shifting cultivation for sufficient food and family needs will benefit from the double rice cropping system and cash crop cultivation which will be coming along with irrigation system .

5.2 Road Network

The access roads from the villages to the markets which are being constructed under the Road Construction Project will be used by the farmers to bring their products to the markets which will improve their buying capacity and consequently shifting cultivation can be reduced to some extend.

5.3 Agroforestry, Grass strip cultivation, Fallow crop improvement

These activities are being carried out with the aim to stabilize shifting cultivation.

5.4 Maintaining and improving existing local fruit trees

Fruits will be produced for markets (domestic and abroad) and cottage industries.

5.5. More family income boosted by livestock activities

The activities of the Project include the introduction of cattle banks and animal husbandry services and the improvement of animal feed.

5.6 Organizing non agricultural activities

Sewing and weaving activities for women are supported, to generate more income.

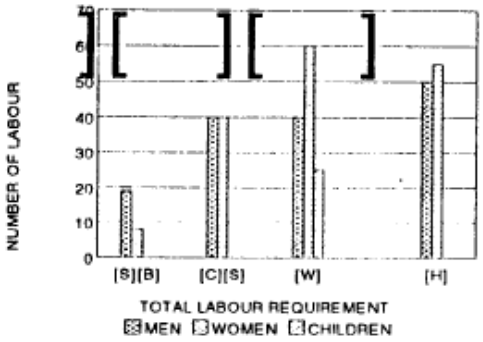
5.7 Exploring potential cash crops

Organic vegetable production and fruit production are promoted, to replace imported fruits from the Vientiane market and other cities.

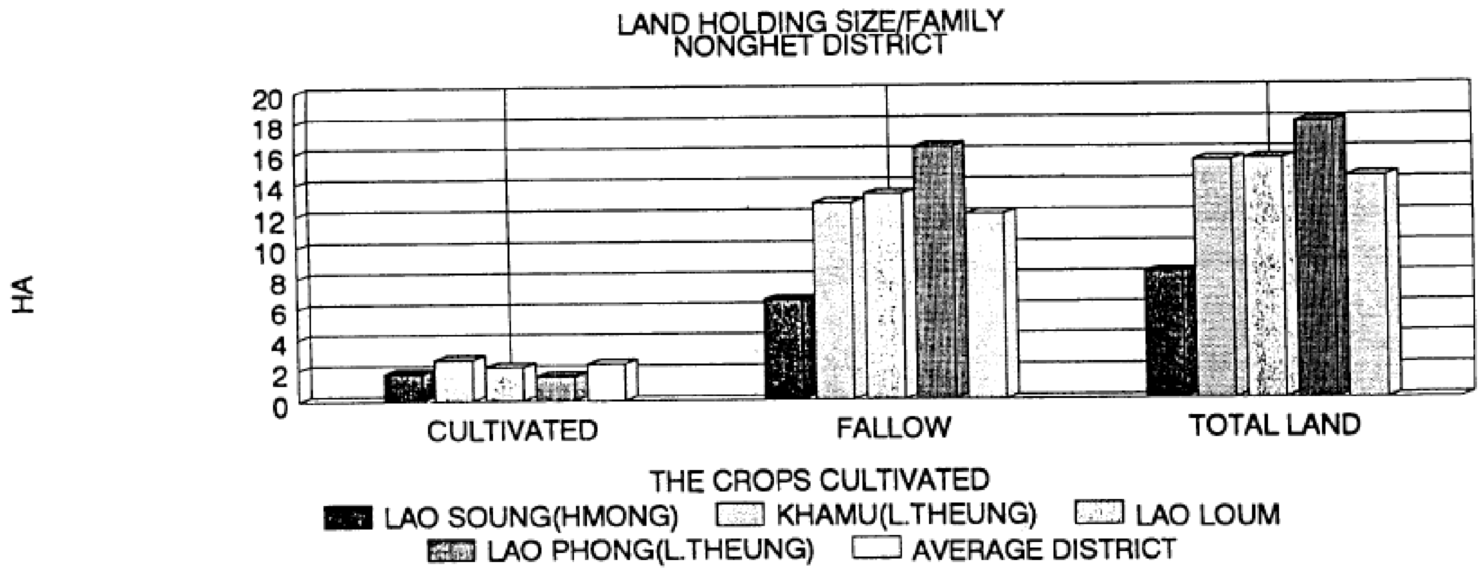
Crop cultivation Calender of UPLAND RICE .

The Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Field activities												
Slash the regenerated forest												
Burning												
Land clearing and planting												
First weeding												
Second weeding												
Third weeding												
Harvesting												
Threshing Winowing Transporting												
Labour Requirement												Grand
One Hac												Total
Total		25	2		80	60	40	20	40		65	332
Men		17	2		40	20	15	5	20		30	149
Women		8	0		40	30	15	15	20		35	163
Children under 12yrs old		0	0		0	10	10	5	0		0	25

LABOUR DISTRIBUTION OF MEN,WOMEN, AND CHILDREN TO UPLAND RICE CULTIVATION



[S][B] = SLASHING AND BURNING
[C][S] = LAND CLEARING AND PLANTING
[W] = WEEDING (3 TIMES)
[H] = HARVESTING,THRESHING,WINOWING AND TRANSPORTATION



	Ethnic group	No.of families interviewed		Upland Rice area ha	Low land rice area ha	Corn area ha	Root crops area ha	Cotton area ha	Opium growing area	Total cultivated area ha	Fallow area ha	Total cultivable land area
Total Family	LAO LOUM	46	*	54.000	0.000	7.000	5.000	3.000	5.290	80.500	297.000	377.500
Land holding size/Fam	LAO LOUM			1.174	0.000	0.152	0.109	0.065	0.115	1.750	6.457	8.207
Total family	HMONG	340	*	283.400	80.200	328.100	34.500	0.000	89.080	901.500	4323.300	5224.800
Land holding size/Fam	HMONG			0.834	0.236	0.965	0.101	0.000	0.262	2.651	12.716	15.367
Total family	KHAMU	140	*	195.000	0.000	64.000	15.000	10.000	36.120	303.800	1859.200	2163.000
Land holding size/Fam	KHAMU			1.393	0.000	0.457	0.107	0.071	0.258	2.170	13.280	15.450
TOTAL FAMILY	LAO PHONG	28	*	18.000	0.000	10.000	2.000	10.000	4.676	44.000	456.000	500.000
Land holding size/Fam	LAO PHONG			0.643	0.000	0.357	0.071	0.357	0.167	1.571	16.286	17.857
Average Land holding size/Fam				0.939	0.146	0.708	0.101	0.052	0.227	2.339	11.972	14.311

THE LAO-AMERICAN PROJECT AND SHIFTING CULTIVATION

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1. OVERVIEW

Swidden agriculture has only become apparent as a problem within the last 20-30 years as increasing population and decreasing primary forest areas have sparked a global awareness that swidden agriculture is no longer a viable, sustainable technology in most areas. Laos is no exception, although in most provinces the downward spiral of environmental degradation leading to an ever-decreasing carrying capacity in the face of ever-increasing populations --¬this deadly spiral has just begun.

The basic question then is, can this be stopped and if so, how? But this question and any answer must be put into the context of an extremely dynamic environment - socially, economically, politically and environmentally. At best, even a successful partial solution will take decades to have a significant impact country-wide. Unfortunately, successful examples of changing swidden farmers to a more sedentary, sustainable farming technology are few and far between, in spite of over 20 years' work in this area.

Swidden agriculture in its many forms is a land management technology that takes advantage of small populations inhabiting large, often mountainous, land areas. With increasing populations, more labor intensive and land efficient land management techniques become possible. They key is to find ways to optimize managing the resources at hand in a more productive manner and then educating farmers about the advantages of these techniques. And especially educating the young people. Most children of swidden farmers will probably grow up to be swidden farmers themselves. And unless they are exposed to different ideas about farming early on and consistently thereafter, they will follow their parents way of doing things.

I would suggest then that part of the job of this conference is to discuss successful alternative farming technologies to swidden agriculture. The other part is how best to extend these technologies to adult farmers and how these ideas might be incorporated into primary and secondary school curriculums.

2. INTRODUCTION

The purpose of this paper is to provide a very brief description of the Lao-American Project (also known as the Houaphan Project), its objectives, and some of its activities as they relate to shifting cultivation.

The Houaphan Project is an integrated rural development project with a target area of two districts (combined population of roughly 37,000) in Houaphan Province in Northeastern Laos. The primary objective of the project is to eliminate commercial opium production in the target area by the end of the six year, $8.7 million project. A secondary objective is to increase the irrigated rice paddy available to local farmers by 300+ hectares and to preserve the remaining forest areas, although the latter is not officially noted in the original project document. Project components include: Three mini-hydro-electric/irrigation dams for increased paddy rice production and rural electrification, a new road in each district (total length of 150 km) to provide villagers with easier market/services access, agricultural extension to increase production and yields of livestock and crops, health extension to increase basic knowledge of primary health care at the village level and to provide better services at the district level.

The project has three centers, each manned by 6-8 lao extension agents with some formal education in horticulture, forestry, construction, irrigation and animal husbandry. However, most of their training has been on the job.

3. PROJECT STRATEGIES

The Lao-American project is using four strategies in attempting to reduce swidden agriculture: developing paddy land for swidden farmers, increasing yields of extant paddy land, extending new crop varieties that may be used as permanent crops in swidden fields, and developing cattle-, buffalo- and rice banks as sources of village credit so that villagers may make capital improvements on their land and/or diversify their incomes.

Developing paddy land for swidden farmers has been successful, but depends on the availability of flat land with water available within a reasonable distance for irrigation. This type of land is limited in quantity and this option will be available to less than 20 project villages. There are two different approaches to developing paddy land. The most successful to date has been to help villagers develop the local streams in their area, providing technical advice and tools to dig irrigation ditches, build gabion weirs and paddy dikes and level fields. This is very labor intensive, especially in the first couple of years when the land must be graded and dikes built. It takes a good extension effort, leadership on the part of the extension team and village headman, and repeated follow up to keep the momentum of paddy development from faltering. It is often tempting for the villagers to revert to their easier, less labor intensive swidden-habits. To prevent this, the project provides incentives in the form of draft animals, tools and technical advice in addition to frequent visits to the village to discuss the long term advantages of forest conservation.

The second approach to paddy land development is the development of inter-village irrigation systems. This entails construction of relatively large dams and lengthy irrigation canals. In the project area, successful completion of the three dams will ensure water supply to over 300 hectares of mostly new paddy land. It also raises the possibility of second crops, such as soybeans or sesame, being grown in the paddy fields during the off season.

Increasing yields of extant paddy land is a useful option, as many farmers who have limited areas of paddy land must also grow upland rice. However, this strategy applies only to those farmers who already have access to paddy land. To date, our project has been unsuccessful in the effort to increase rice yields due, in part, to the land tenure situation which is described in detail in part 5, Socio-Economic Conditions.

The project has introduced one new crop and several new cultivars to the project area. The new crop is arabica coffee (catimor f6 cultivar), which has potential as a component in a sedentary upland cropping system. New cultivars include apple, grape, peach, pear, lynchee, lamyai, soybeans, mulberry and rice. We are experimenting with pigeon pea and citrus as a shading inter-crop and hope to try Grevillea robusta also (when we can get some seed. If any participants have access to Grevillea robusta seeds, please contact me). The other fruit cultivars have been grafted onto their native equivalents in the project area and also represent future components of a sedentary cropping system, but these fruit varieties will not be in significant production for several years. In short, there are a lot of possibilities, but no proven successes so far.

Finally, our project sponsors village cow- buffalo- and rice banks as a source of village credit. It is project policy that any inputs requested by villagers not be given away, but that the villagers are charged a price in rice which is then put into a villager-managed rice bank. The cost of cows and buffalo requested by villagers is also returned to the village rice bank, to be used as a source of credit for the villagers. Although this does not directly address the problem of swidden cultivation, it does provide the villagers credit, which in turn may help villagers diversify their incomes and decrease their dependance on swidden agriculture.

4. ECOLOGICAL CONDITIONS

The• project area is very mountainous, with valley bottoMs at 800 M and mountain tops nearing 2000 meters. Karst outcroppings are common in the northern reaches of Viengtong District. The climate should be considered temperate/subtropical, with cool season lows of close to, or occasionally dropping below, freezing. If freezing temperatures last more than a few days or occur several times over the course of one cool season, (as occurred in 1992/3) damage will occur to sensitive crops such as coffee, bananas and guava. Nights are cool, even during the hot season, and morning fog generally obscures the sun until midmorning. Rainfall averages roughly 1,100 mm per year. The soils range from "din som" acid soils in the mixed grassland/pine forests of Hua Muang district to sandy loams with good organic matter content and limestone parent rock in some areas of Viengtong District.

The primary forest areas may be considered a giant ecotome where subtropical evergreen forest species mix with temperate deciduous forest species and local microclimates determine which types are predominant. These areas are under continuing pressure from swidden cultivation and expanding populations. Small to medium sized streams are common and many flow throughout the year. However, local deforestation has resulted in a more seasonally-influenced stream flow, according to many villagers. There are no lakes or ponds in the project area, but marshes and springs exist, including one hot spring.

"Sat ba" or forest animals, still exist in numbers significant enough to make deer and wild boar meat fairly common, although much coveted. A large expanse of beautiful, primary forest along the Houaphan-Luang Prabang border may serve as a reserve for these animals and help to populate the surrounding area. A villager living near this "reserve" near Muang Son, in northern Viengtong district, was recently fined 350,000 kip ($500) for killing a tiger. The fact that the villager was actually fined is an encouraging sign.

5. SOCIO-ECONOMIC CONDITIONS

There are several ethnic groups which inhabit the project area. The lao loum, or lowland Lao, are predominant in the project area, with over 50% of the total population. Included in this group are Tai Dam and Tai Daeng villages. Lao Tung, the midland Lao also make up a considerable portion of the population. Sometimes included, incorrectly, in this group are the Lao Pong, generally thought to be Khmer-derived, and found in only a few locations in Laos. Several Lao Pong villages are found in Hua Muang district. The average population of villages in the two project districts is 185, compared to 260 for the other four districts of Houaphan Province. The provincial capital has electricity three hours per day supplied by a diesel generator. There are no other towns or villages with what could be considered reliable electrical supplies, but small .5 Icy Chinese-made low head hydroelectric generators are becoming increasingly popular in the area. Some villages have installed over a dozen. They are used to provide light - two to four bulbs depending on water flow.

Road access is very limited. Route one, a paved road from Luang Prabang, transects southern Viengtong district through Muang Hiem, then continues on through Hua Muang as Rt. 6, a dirt road which connects to the capital, Sam Nuea. The paved portion turns south at Hua Phou, roughly midway between Muang Hiem and Hua Muang, and continues on to Xiang Khouang province and to Ponsavan, the capital. Each district has a health station, but health extension services to the villages are minimal. Villagers must travel to the district if they desire medical treatment. For some villagers, this is at least a two day ordeal. Other services, such as schools are also limited. In most cases, if a child is to receive an education beyond the first or second grade levels that are generally arranged at each village, then he/she must travel to the district seats, where the only high schools are also located.

6. LAND TENURE

One of the most important issues facing the villagers and district administrators is land tenure, especially in the valuable paddy land. Paddy land is extremely limited, and with the new government in 1.975 came a system of rotating the paddy land among the users every three or four years. At,the time of conception, this strategy was considered fair, as all users eventually had

some access to the most fertile land as well as the less desirable plots. Unfortunately, this system is also a disincentive to invest labor or money into making the land more productive, as any investments will be then lost in a few years to the next user of the land. The productivity of the land, both paddy and swidden fields, has therefor remained at the same low, albeit sustainable, level for many decades. The.Government is now allowing villages to change this system, and some villages have taken advantage of this, deciding on their own how to divide up the land. This is still in a very early stage, and there are complicating factors, especially at the district seats, where most of the paddy land is concentrated. District officials have been on the receiving end of edicts issued by the central government which authorize return of assets to the individuals who were the pre-1975 owners, if they are still Lao citizens and have proof of ownership. The paddy land was not excluded from this edict, although there were no accompanying suggestions as to how the district officials, who end up having to try to implement these edicts, might go about this. District officials in the project area are understandably unenthusiastic about tackling this problem.

Those with little or no paddy land make do with "kow hai" or upland rice. The area of upland rice farmed by each family is limited only by the labor available to it. Most of the land used for this purpose has previously been under swidden cultivation, but with the increasing population and, ironically, the advent of the market economy in which rice can be sold as a cash crop, destruction of primary and secondary forests is increasing. The provincial government has given our project permission to grant land ownership certificates to villagers in our target area for both paddy and upland fields. However, without clear land use policies which outline the rights of villagers to local land (vs. non villagers) and enforcement mechanisms to support the policies, granting effective land tenure will be difficult at best.

The Government is making more efforts to limit the unnecessary destruction of forests by fires escaping from the areas meant for upland rice planting by (in some instances) fining those whose fires escape and destroy significant amounts of forest land. Locals are aware that destruction of forests makes the immediate area dryer and hotter, but ask rhetorically, "What else can we do?" Indeed, in present circumstances, their options are somewhat limited. Most project area villages claim rice shortages of 2 to 6 months. Some of this deficit is made up by foraging, some by other food production, such as corn or cassava. Opium is grown by some families, especially (but by no means exclusively) the Hmong as a cash crop and insurance against a poor harvest. Many Lao Tung villagers sell their labor for rice or opium. Other sources of income include sales of livestock, cotton (raw and woven) and silk (raw and woven), honey, and deer and boar meet. Market forces are becoming increasingly significant, even in remote areas as roads slowly penetrate and provide access to villages by merchants.

7. CROPPING SYSTEMS

By far the most important crops are rice and opium and perhaps timber. Benefits of timber harvesting are limited to materials for home construction. Profits from commercial logging in the area have not been translated into better services at the district level. Other important crops include corn, cassava, soybeans, mulberry and pigeon pea. Many other crops are grown, such as cabbage, various mustards, tobacco, peach, pear, banana, guava, citrus and grapes, but are mostly minor contributors to household economies in the area.

The rotation of upland rice fields in the project area is on a 3-4 year cycle. Along the main roads, where many villages are concentrated, the cycle is generally 3 years. Villages located farther away from the main roads may use 4 years. Most fields are cropped a single year, then left fallow. In areas with exceptional soil or where primary forest has been chopped down for the rice field, rice may be cropped two or three years. Most farmers note that, although decreasing soil fertility is a factor, most fields are abandoned due to steadily increasing weed infestations from year to year. It should be noted here that the reason paddy rice is flooded is for weed control, which results in considerable saving of labor and is one reason why paddy rice is such a popular form of agriculture.

The second most important crop in the project area is opium, which fits all the characteristics of an ideal crop: it's high value, low volume, easily transported and keeps well. In many cases, the "market" comes to the village, saving the farmer the problem of transport. It is, however, illegal.

Opium in the project area is generally grown on good, limestone-based soil and often rotated with corn. Some villages will plant their paddy rice fields with opium after rice harvest. A third type of favored location is along valley bottoms next to streams. It is not uncommon in the project area to see whole hillsides planted with opium. In this context, it can be destructive to forests, although of relatively minor importance when compared with upland rice cultivation.

Opium is generally planted in November and then harvested in January or early February. The early leafy stage is eaten as a vegetable, and the dried capsules are split open after harvest to obtain the poppy seeds which are eaten raw and taste like brazil nuts. The capsules are sold in bunches in the local markets, as opium was until very recently.

Most opium fields are also planted with a wide variety of other vegetables and fruit trees. This is also true for swidden rice fields, but to a much lesser extent. As opium fields often have the best soil, the project encourages growers to directly substitute coffee and fruit trees into these fields in place of opium.

8. ANIMAL PRODUCTION

Animal production has perhaps the greatest potential for providing alternative incomes to swidden cultivators. However, animals have not been well-integrated into the swidden agricultural system. In fact, the main impact of animal production in the project area swidden systems is negative in that the fields are extensively fenced with small diameter trees in order to keep the buffalo, cows, horses and goats out. This fencing takes a considerable effort of labor in addition to the destruction of thousands of small trees.

There is potential to better integrate animals into this system by using their manure to increase yields of upland rice or, to use their manure to fertilize a sedentary agroforestry system. If trees capable of supplying forage for the animals are used, then the animals can graze the area, or may be corralled in the field and the forage brought to the corral. Corralled animals also make manure collection on a large scale feasible.

Management of animal production systems is severely lacking in disease prevention, feed management, breeding and manure collection. This is partly due to lack of knowledge on the part of the farmers, but also due to the inaccessibility of vaccines and other government services and lack of a cold chain. As anyone who has ever visited rural Laos can tell you, there is no shortage of manure in the villages and this is a resource which could yield great returns with a little management.

Cows and water buffalo are the most important animals in the project area due to their intrinsic sale value, as a source of protein and role as draft animals. Pigs, ducks, and chickens are also important as conveniently sized protein sources. Horses are used for transport and sold for meat. It is safe to say that almost all animal production in the project area is done the "natural" way-that is, animals graze freely, breed freely and are not vaccinated, although this last factor is changing. Pigs are the sole exception to this rule. The Hmong, Kmu and lowland Lao all feed their pigs, although the Hmong take exceptional care of their swine and will make a boiled com/cassava/soybean mash for them.

Fish rice integration has potential in the project area, but again, rotation of paddy land among the users previously described provide a disincentive to investing labor in this system.

9. CONSTRAINTS, POTENTIALS AND A FEW CONCLUSIONS

It is not difficult to fmd constraints to developing alternatives to swidden agriculture. They are everywhere one looks. Local officials are generally ill-trained and ill-equipped to deal with the challenges presented by swidden agriculture. This in turn precludes dissemination of potentially useful farm management information and/or provision of necessary government services in support of better farm management.

Problems relating to farm management can not and should not be isolated from other socio¬economic factors, such as health, water supply, education, local administration, planning

and law enforcement, land tenure and others. These all have an impact on the quality and quantity of farm labor available, market demand and access, and perhaps most importantly, incentives perceived by farmers to improve the management of their agricultural ecosystems to make them more sustainable and productive.

Time is running out. In the project area, swidden agriculture can be sustained only by the destruction of the remaining primary forest and irreplaceable loss of biodiversity. Laos will be fortunate if it is able to preserve any large area of primary forest.

If progress is to be made, farmers must be able to better manage the resources available to them. Agricultural extension and non-formal education services can provide the necessary local training if the administrative structures can be developed and funds located to support this. That's a big "if". Given the present financial situation of the Lao Government, direct training of villagers or development of local extension systems developed on an ad hoc basis by various donors and NGO's may be the only other alternative.

What kind of personnel are needed for these tasks? I would recommend against specialists. Generalists, "community development workers" are needed to understand the wide range of problems which impact on village life. These development workers should be well versed in extension techniques based on villager participation. Project planning, budgeting and management skill would also be valuable. Since there will be many occasions when these community development workers require additional information, it's important for them to have access to or know whom to contact for more specialized information when required.

In the experience of the Houaphan Project, the most valuable characteristics of a development worker are motivation, leadership, a willingness to listen to villagers and a willingness to experiment. These are difficult to teach and are not common commodities in any population, but extension techniques emphasizing these qualities might be incorporated into the school curriculums of Laos, especially in the secondary and technical schools.

EXPERIENCES FROM THE NONG DISTRICT DEVELOPMENT PROJECT WORKING WITH SHIFTING CULTIVATION FARMING SYSTEMS

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1. INTRODUCTION

Norwegian Church Aid (NCA) has been assisting the Nong district of Savannakhet province in the area of community development since 1990. Improved food self-sufficiency has been one of the main objectives of the project. Since the population of Nong often lacks rice for a couple of months every year due to very instable weather conditions, the NCA assistance has been directed towards increasing rice production, both in lowland and upland areas. Introduction of other supplementary food crops has been promoted.

The Nong district is the least populated district of the province. It has a total population of 15675 people distributed over 94 villages on 4000 sq.km. More than 90% of the population belongs to various ethnic groups, primarily of Monkhmer ethnic background. The two main ethnic groups are Mankong and Ta Oy, which constitute roughly 80% of the total population.

Before 1975 most of the ethnic people in Nong were not able to read and write. Due to the promotion of primary education in ethnic villages by the local authorities during the last 20 years, literacy has gradually improved. Today some 60% of the population, mainly women however, are still illiterate.

2. REDUCTION OF SHIFTING CULTIVATION

It is often claimed by the local authorities at the establishment of the Nong district in 1984, that only a small area was under wet-rice cultivation. Some 80 hectares - mainly in the vicinity of the Nong center, where the small Lao Lum population (Phu thai) is living - were under such cultivation. The main agricultural occupation of the people in 1984 was thus the so called shifting cultivation.

Over the last ten years the local authorities in Nong have strived to implement the policy of the government in relation to shifting cultivation. With some financial and technical support from international organizations, the district authorities today claim to have managed to significantly increase the area under wet-rice cultivation. The present land under such cultivation is said to have increased to almost 700 hectares. Thus, it is also often stated in reports that the Nong people have successfully reduced the area under shifting cultivation.

Accurate information and detailed data on the area under and the role of shifting cultivation in the local economy of Nong are however often lacking. For a number of reasons, among which the present uniform policy on shifting cultivation, the agriculture service of Nong actually seems to neglect this farming system in their daily work. Despite its main importance in the cultural life of the villagers and the local economy, little attention is paid to follow up on and improve the farming practices in shifting cultivation.

3. STABILIZED FARMING SYSTEMS

Over the last two years of operation the NCA supported NDDP has tried to address the problems of food self sufficiency in Nong by generally supporting all sustainable agricultural activities

favoured by the villagers. Thus, both upland and wetland cultivation, as well as livestock and fruit-tree promotion have been supported.

In the target villages of the project a number of measures have been undertaken in favour of improved rice cultivation. The objective is not only to establish new wetland fields, but to generally improve yields in all farming systems. The intention of the project has thus been to stabilize rather than abolish the shifting cultivation practices in Nong.

New varieties of rice, improved planting techniques, pest-control etc have been introduced, parallel to the establishment of new wetland rice fields. The result of this work is actually too early to report on, but a few observations can be made at this stage:

- The people in Nong have in most cases responded positively to the introduction of new farming systems, techniques and varieties of rice, but often as a supplement, rather than as an alternative to shifting cultivation.
- Though the area under wetland cultivation has increased from 18 to 90 hectares in a few years time in the target villages, there is still no guarantee that people will continue using these fields for a longer period of time. Problems with weeds, fall in nutrients, etc might result in the early abandoning of such fields, especially since the area for shifting cultivation is not yet that limited.
- Adjustments to new "technologies" are constrained by both social and cultural factors, such as the availability of labour and local traditions. Thus, for example new varieties of upland rice, though they have been shown to yield substantially more than local varieties, are often rejected due to cultural reasons (the linkage between upland varieties of rice and the traditional beliefs, i.e. the ancestors cult).
- Our experiences from Nong show that shifting cultivation is very much connected with the cultural beliefs of the local people. Tradition among the Mankong for example, tells that the family will fall ill if they do not plant their own traditional upland rice species.
- A number of other social and technical constraints are often reported by the villagers to hamper their further adjustment and application of new farming systems, i.e. lack of buffaloes, technical skills, labour, time etc.
- The practice of limiting the land for shifting cultivation, either by setting aside forestry reserves or by other restrictions, might actually result in further ecological degradation in an environment like Nong (denuded by war), as the fallow periods becomes shorter.
- In brief conclusion: for a Development Agency like NCA, with a strong belief in and policy to support "people's participation" there is a need to emphasize the importance of understanding the social and cultural factors in the transformation of cultural factors in the transformation of the shifting cultivation practices, in the dialogue with the Government. These factors are often intertwined with and not easily separated from the technical aspects of shifting cultivation.

4. SOME PERSONAL REFLECTIONS

The policy of the Lao PDR Government in relation to shifting cultivation has been discussed in a number of meetings and reports over the last ten years. As I have had the opportunity to take part in this discussion a couple times since the mid-1980s, I am very glad to note that there is now a progress in this discussion and that we are today discussing these questions along both technical and other lines.

The international research and literature on shifting cultivation shows that it is important to understand the specific and internal logic of traditional farming systems. Attempts to lump them together under categories such as shifting cultivation and to use blue-print development approaches in their transformation are born to fail (compare the discussion on the FMCP proposed by the World Bank).

Shifting cultivation in Laos have been found to consist of complex farming systems, in which most ethnic groups are involved, but with different practices. As indicated by study-teams such as the TFAP it is important not only to make a difference between the systems, but also to address the most ecological harmful systems first in the development of the country.

Shifting cultivation in Laos has actually been found to be increasing in several studies, mainly due to population growth. A study undertaken by SIDA in the early 80s showed clearly that this was also happening in the lowland areas, despite the Government policy. The connection between a pro-natalist population policy and the difficulties to reduce shifting cultivation ought to be discussed more.

In order to counteract the shifting cultivation practices, which is necessary in many areas of Laos, it is important to have a broader perspective on this theme. Shifting cultivation is not mainly a "forestry" or "agriculture" problem, but also linked to health improvement, securing of land-titles and general socio-economic development in rural areas of Laos.

EXTENSION EXPERIENCES FOR INTRODUCTION OF A SYSTEM FOR SUSTAINABLE UPLAND AGRICULTURE.3

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1. INTRODUCTION.

Over the past ten or more years there has been considerable effort in trying to identify agriculture practices that would allow sustainable subsistence cropping on sloping land. Next door in Thailand there are large donor projects that have promoted these technologies to farmers for nearly a decade, but without convincing success. These technologies have been adopted by farmers in particular niches, usually where they have had access to markets and so could include cash crops in the system. In many cases it is the 'non-technical issues' that have played the dominant role in determining farmers adoption and non-adoption of sustainable technologies (Fujisaka, 1991).

Reducing shifting cultivation is a specific goal of the Lao Upland Agriculture Development Project, (LUADP). LUADP is being implemented in two areas; the Northern Area -Vientiane province, selected watersheds in the Feuang, Vang Vieng and Kasi districts, and the Southern Area on the Bolovens Plateau. Shifting cultivation is carried out in these areas in a wide range of environments and conditions. In the northern project area LUADP first tried to consider farmers immediate aspirations for cropping their upland fields, and then identify practices that would meet these, at the same time leading to sustainable cropping. The project also felt that any new technology should achieve results within the first two years. Even if the technologies concerned did not offer an answer for all upland areas in the project, it would then provide other farmers a vision of continuous cropping on upland fields and thereby engage them in the process of trying other, perhaps more demanding technologies.

The paper first gives a brief description of the conditions in the Hin Heup area and the traditional swidden system used by farmers there. It then focusses on the extension strategy that LUADP has implemented on a pilot scale in the Northern project area.

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3 Paper prepared for “Technical Meeting on Shifting Cultivation Systems in Lao PDR.”

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6 The Lao Upland Agriculture Development Project (LUADP) is a World Bank loan project being implemented by the Ministry of Agriculture and Forestry, with technical assistance from the Australian and French government.

2. CONDITIONS IN THE HIN HEUP AREA.

The following is a brief thumb-nail sketch of the conditions in the Hin Heup area. Is does not attempt to be exact or complete. Time limitations prevent this and in many cases exact numerical data is not available.

2.1 Topography.

The Hin Heup area is located astride Highway 13 about 90 km north of Vientiane. The area gains its name from the sandstone escarpment that dominates the area. Below this lies a highly dissected plateau (about 250 masl) of rolling hills and hillocks, (The slopes are relatively short, with slopes up to 45 degrees). The Lik river runs through the area. The small streams that dissect the hills provide a limited opportunity for construction of rainfed paddy. This topography is typical of the country from Hin Heup up to the entrance to the Vang Vieng valley and across to the west where it meets limestone kast systems.

2.2 Soils and Rainfall.

The soils in the area are fine sandy soils with some clay content. When ploughed these are highly erodible. The un-disturbed soil on the other hand tends to cap due to the clay content, allowing poor infiltration and resulting high water run-off. The catchment of the Lik River for example carries a relatively high sediment load, 215 tones/ha/yr. The area experiences heavy rainstorms with intensities up to 70 m.m. per hour, for up to 3 hours at the beginning of the wet season, (Mekong Secretariat).

2.3 Vegetation.

The original forest cover consisted of 'Mai Dtor', 'Mai Daer', and 'Mai Khan Hin'. Either due to logging or swidden agriculture, most of this has now given way to secondary forest and bush fallow. Some of the most common species include, 'Mai Dtiu', 'Mai Sa Fang' (a legume tree) and bamboos. Only in the northern end of the plateau, close to the township of Tar Heua on the bank of the Nam Ngum dam, has the bush fallow degenerated to grass land.

2.4 Human Settlement.

Two large settlements were in the area for over 100 yrs. However many of the villages located along the road to Vang Vieng and Feuang districts were established during the 1970's. Farm-families relied almost totally on swidden agriculture to produce their rice. Proteins came from hunting forest animals and catching fish from the Lik River and various streams. Few forest animals of any size now remain. Villagers collect broom-grass and banana leaves from the forest for sale. Mai Dtiu coppices well from its stump, and can be collected from the swidden after firing to sell for charcoal makers.

2.5 Production Systems

Farmers use three varieties of rice varying in maturity from 90 to 125 days. No crops follow the harvest of the upland rice. Small areas of corn, cotton, taro and cassava are grown for domestic use. Livestock now plays an important part in the household economy, however livestock only began to be raised in any quantity since the new settlers arrived.

The swidden system practiced by the farmers at the present time can be described by considering the following elements of the swidden system; (a) Rotation Period, (b) Clearing Practices, (c) Cultivation and Seeding Practices.

(a) Rotation Period:

The field is cropped one year only and then allowed to return to bush fallow for three years before being cleared and cultivated again. By cultivating a single year it is possible to seed without tilling the soil, resulting in lower soil erosion. Cultivation only a single year allows bushy, rather than grassy species to predominate in the fallow. This facilitates slashing and burning, and reduces weeding in the next production cycle. However a three year fallow is not sufficient to allow vegetative matter to build up to maintain fertility levels when the swidden is burnt again.

(b) Clearing Practices:

Farmers clear the fields from between March through to April, to allow time for the vegetative matter to dry out. Often they leave stumps of certain trees, such as Mai Dtiu and bamboos. This assists in the establishment of bushy species in the fallow.

(c) Cultivation and Seeding Practices:

The fields are fired from late April to Early May, depending on when the farmers expect consistent rains to begin. Following firing, seeding can be done directly into the ash without any soil preparation. (This compares to areas where upland fields are cultivated successively for a number of year. Weed populations have increased and some cultivation prior to seeding is needed. The cultivated soil is then more susceptible to erosion).

Initially farmers were able to obtain yields of up to 4 tones/ha from their upland fields. This has now fallen to approximately 1 ton/ha. As this has happened, the farmers have begun to extend the area of paddy following the small streams that cut through the hills. Because of the involuted nature of the topography these paddy systems occupy a small area and are totally dependent on rainfall for moisture. This paddy construction will not be sufficient to relieve the pressure on the upland areas. Some farmers have also tried ploughing upland fields to increase their rice production and had improved yields.

3. SELECTION OF A TECHNICAL INTERVENTION.

3.1 Adoption and Non-adoption of Sustainable Technologies

There are many methods of soil erosion control, ranging from, cover crops, vegetative barriers, to mechanical barriers and permanent orchards. Technically, these might all be effective in stopping erosion and permitting SUA. A pay-off sometimes needs to be made between trying to introduce the 'best' or most effective technology, and a technology that suits the needs and constraints of the farmers.

In Thailand, shifting cultivation farmers are not concerned about soil erosion. They consider weeds to be the more important factor limiting their yields, (Bourne 1992). Most of the technologies that projects have introduced there have relied on vegetative control of erosion. The build-up behind these is quite slow and in most cases the fields do not really develop into level terraces, but remain more or less slopping. The main selling point of these technologies is that the technologies will allow them to crop their upland fields continuously without a yield decline. But to the farmers, this does not seem to be giving them anything beyond what they are getting rotating their fields. In addition it will take 3-5 years of consistently implementing the technology for its benefit to become apparent.

3.2 Contour Bunding For Self-Building Terraces.

For extension to make an impact, the thrust of the extension program should assist the farmers in their current aspirations. For instance, Hin Heup farmers in their Village Development Plans gave a high priority to hiring tractors to construct new paddy area. Other farmers were keen for tractors to plough their upland fields as well. While it would be possible to explain to farmers that sustainable agriculture on upland field can help to improve rice sufficiency this would appear to them to be an indirect approach and would not have matched their enthusiasms. Besides this, the image of a continuously cultivated swidden field is novel to the farmers, and certainly not in their current agenda.

Thus the project first tried to find a technology that would have fit farmers objectives, and one that would give a visible indication of success in the first year. The technology chosen was that of construction of contour bunds to form self-building terraces. This was prompted by farmers interest in ploughing their upland fields, and the projects concern at the increase in erosion that this would cause. Briefly described, this technology involves:

- ploughing the soil up-slope, along contours to form a bund

- ploughing cultivated areas down-slope only, to shift soil so that a level terrace would eventually be formed.
- maintaining soil fertility by (a) cover crops, and or (b) farm-yard manure.

The bunds, being physical barriers bear a greater similarity to farmers' desire for new paddy. Thus they have a more immediate appeal than the technologies based on vegetative barriers, (i.e. alley cropping and vetiver grass).

3.3 Criteria for Site Selection.

The project also focused on sites where the effect would be most easily seen;

-sites with slopes <15 degrees.

These slopes could be tractor ploughed, which will therefore rapidly (within 2-3 years) develop into level terraces. These will then be able to be ploughed by buffalo. The use of tractor was considered justified since many farmers in the area were already willing to invest in mechanical construction of new paddy.

- sites next to existing paddy fields.

Farmers already cultivate paddy fields yearly, so the transformation of the upland fields into terraces would be an extension of this area, and thus more appealing than attempting to achieve permanent cultivation on an isolated upland field.

Some comment should be made regarding terracing and contour bunds. It is a technology which has a mixed reputation. In many projects terracing has been the immediate goal, and the terraces have been dug into the hillside. Yields on the soils exposed are poor and thus discouraging. In this case the terraces are formed progressively, so the top-soil moved is no greater than with a normal ploughing operation. The contour bunds which demarcate the terraces and retain water and soil, are in fact fragile and do need to be repaired until they are stabilized. Farmers may not have been prepared to do this when the bunds were not leading to level terraces, or where the bunded fields were not linked to a paddy area.

4. STRATEGIES FOR INTRODUCTION OF A NEW UPLAND FARMING SYSTEM

4.1 Community Based Extension.

The project uses a Community Development approach for extension of all agricultural activities. In the initial 'community preparation' phase, the project EW's enter into a dialogue with villagers to reflect on the main factors in the past that have caused change, and to create a vision of what development will mean for their village. Following this they have formed various committees to be responsible for different aspects of development. The Food and Agriculture Committee, (FAC) is one of these. When the project introduces a new technology, it invites interested farmers to use it on trial and to suggest any improvements. These we have called Farmer Evaluation Trials (FET). In this way, we hope to stimulate farmers into an on-going process of technology evaluation and adaptation.

The introduction of contour bunds followed a study trip with the FAC where this approach was observed. The FAC was interested in the technology but not fully convinced, (the plots visited had only just been prepared for this season). The project offered to provide inputs for one FET in each village for 1 rai of contour bunded land; fencing, fruit tree seedlings and cost of additional ploughing to form the contour bunds.

In accordance with the FET approach, the project did not try to raise farmers expectations, but warned that the plots might not be ideal in the first year. The farmers involved must be ready to maintain the plots for 3 years, and make improvements where they thought the technique was not effective or inconvenient. In the short run-up time to the wet season, 3 of the 4 FAC's in the Hin Heup village 'cluster' found farmers with suitable sites.

While contour bunds are at the heart of this technology, there are other components that are necessary for it to achieve 'sustainable upland agriculture'; following ploughing, farmers must

shape the bunds by hand labour, the new bunds must be repaired if they break, crops should be planted on the bunds to stabilize them, a source of nitrogen is needed from crops on the bunds or farm-yard manure to maintain yields.

4.2 Following Farmers' Concerns

The initial question upper most in farmers minds however, is whether the contour bunds would in fact lead to terraced fields as claimed. Thus until they were satisfied on this issue, the other components were not insisted. Because the slopes are slight, the form of the incipient terraces quickly became clear. Thus the farmers have been quick to repair bunds that have breached after heavy rain. To stabilize the bunds one farmer has planted pineapple and another sesame. These may not be the best crops to stabilize the bunds but do indicate the farmers' commitment to the bunds.

4.3 Paddy/Upland Field Association.

The selection of sites adjacent to existing paddy has had another important effect. Farmers commitment to the bunds is not only reinforced by their desire to achieve new rice terraces, but also to protect their existing paddy from soil washed off the upland field. Thus the farmers are confronted with the immediate problem of soil erosion (not to maintain it on their upland fields, but to stop it from reaching the paddy) and discovering that they can stop this process.

Other components will be emphasized within the next few months as the farmers become confronted by the issues. Since the farmers have had to repair the bunds a number of times, it is now appropriate to suggest they plant more suitable cover crops to protect them. These will include tropical legumes, which will also serve to maintain the fertility of the soil. The issue of soil fertility may take another season to be fully appreciated by the farmers. Thus the whole system may take two seasons to be fully implemented.

5. ISSUES AND PROSPECTS

Being only two months into the first season of applying this technology it is perhaps premature to claim that it is successful, i.e., that other farmers will want to adopt it. At this point the technology looks to be effective, (i.e. the contour bunds are holding up and the terraces are emerging.

There are some problems with the efficiency of the contour bund technology that do need to be considered. Laying out the contour lines with 'A' frames is not that easy on uneven ground. Low sections occur along the contour lines. and where this occurs water accumulates and the bunds are likely to breach. When the bunds are effective a second problem develops that as the ditches behind the bunds fill with displaced soil, additional run-off water will overflow the bunds and begin to cut it back into the terrace.

The fields of the 3 farmers was ploughed using the project tractor. The technique of ploughing in one direction is new for contractors and they will charge a premium. The cost for normally charged for ploughing 1 rai is 10 -15,000 kip. We estimated that contractors would charge 20-25,000 kip /rai to plough fields in 1 direction to progressively form terraces. This is still a reasonable outlay for the farmers in this area. If it is acceptable, local tractor contractors will also need to be educated in the technique of contour bunding and unidirectional ploughing.

The use of contour bunds will not suite all farmers' fields. Fields on steeper slopes and fields some distance from the house will need another technique. But there are significant areas where such terraces abutting onto existing paddy can be developed. If there is a significant adoption of contour bunds by farmers in this particular niche, other farmers, will likely to speculate how they could begin to crop their upland fields continuously. The constraints and aspirations for these fields will be more difficult for the farmers to address. But by the example of the transformation of their neighbors, it is expected that these farmers should be stimulated to examination other technologies. In the mean time, the project is maintaining a close contact with the first group of farmers to support them and catch any problems as they arise. In July, there will be a mid-season evaluation meeting with the farmers and members of the FAC, and an end-season evaluation in October.

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"The Lower Basin Suspended Sediment, Transport and Sedimentation Problems". Report submitted to Mekong Secretariate by P.O. Harden, A. Sandborg Uppsala, Oct.

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LIST OF PARTICIPANTS

A. CHAIRPERSONS

Sayamang Vongsak,	Director of Nabong Agriculture College
John Evenson,	UN Consultant/senior adviser

B. PAPER CONTRIBUTORS / SPEAKERS

John Evenson,	UNDP/DESD Nabong Project Adviser (also chairman)
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Walter Roder,	organiser)
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Laurent Chathe,	Lao-Irri Project (Upland rice)
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Bouahong Phanthanousy,	Oudomxay and Luang Namtha
Andrew Jenkins,	UNDP S/s Irrigation Projects in
Joost Foppes,	Oudomxay and Luang Namtha
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C. SPECIAL GUESTS AND OBSERVERS

Siene Saphangthong,	Vice-Minister, MAF
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Khamkheuane Vannasouk

Dirk Van Gansberghe (Project coordinator)

Sayamang Vongsak (**Chairman**, Director of Nabong College)

John Evenson (**Chairman**)

SCHEDULE OF THE MEETING

Wednesday 14/07

- 9:00 to 9:45 — OPENING CEREMONY of the meeting
  Welcome address by the Director of Nabong College (10 min), Dr Sayamang Vongsack
  Inaugural speech by the Vice-Minister of MAF,
  Dr Siene Saphangthong (20 min)
  Speech by Coordinator of Nabong project UNDP/DESD/LAO/92/017 (15 min), Dirk Van Gansberghe
- 9:45 to 10:15 — Coffee break
- 10:15 to 11:00 — Presentation of John Evenson: "Shifting Cultivation, the continuing dilemma"
  (Senior Adviser of UNDP/DESD project LA0/92/017)
- 11:00 to 12:00 — "Les pratiques d'essartage au Laos - systemes actuels et leur avenir"
  (Laurent Chazee, projet PNUD/FENU de petite irrigation dans les provinces du Nord)
- 12:00 to 12:30 — "Shifting cultivation in Laos and in the Nabong area".
  (30 min. slide show by Dirk Van Gansberghe, UNDP/DESD project LAO/92/017)
- 12:30 to 13:30 — Lunch break
- 13:30 to 14:00 — Presentation (15 min) of Lao-Swedish Shifting cultivation project and discussion (15 min) (By Mr Bouahong Phanthanousy)
- 14:00 to 15:00 — Joint presentations of the NGO Sustainable Agriculture Forum (CUSO-RIFS-MCC-CIDSE-CAA) (By Mr Denis Boutin, Mr Khammone, Mr Khamhiene, Mr Khaothong)
- 15:00 to 15:15 — Coffee break
- 15:15 to 15:30 — Concluding remarks from NGO Sutainable Agriculture Forum (15 min.)(By Sombath Somphone)
- 15:30 to 16:00 — Presentation (15 min.) of Lao-EEC Micro-Projects and discussion (15min.) (By Mr Joost Foppes, with additional comments from Mr Andrew Jenkins)

Thursday 15/07

- 9:00 to 10:00 — Presentation (20 min) of Lao-IRRI project and discussion (40 min) (By Mr Walter Roder and Mr Bouakham)
- 10:00 to 10:30 — Presentation (15 min) of NARC/IDRC Farming Systems Project and discussion (15 min) (By Mr Bounphavanh Kanyavong with additional comments from Mr Viravanh Phannourath)
- 10:30 to 10:45 — Coffee break

- 10:45 to 11:15 — Presentation (15 min) of NARC/French-CCL Cotton Project and discussion (15 min) (By Mr Somnuk Thirassack)
- 11:15 to 12 : 00 — Presentation (15 min.) and discussion (15 min.) on the UNDP Muong Horn Project (By Mr Murli Upadhyay, UNDP/DESD/LAO/88/26)
- 12:00 to 12:30 — Presentation (15 min.) of the Norwegian Church Aid (NCA) programme and discussion (15 min.) (By Mr Rolf Samuelson)
- 12:30 to 13:30 — Lunch break
- 13:30 to 14:00 — Presentation (15 min) of the Lao-American Houaphanh project and discussion (15 min) (By Mr Rex Dufour)
- 14:00 to 14:30 — Presentation (15 min) of UNDCP/OPS/IFAD Xieng Khouang project and discussion (15 min) (By Mr Saypradeth Chounlamany and Mr Seng Khum)
- 14:30 to 14:45 — Coffee break
- 14:45 to 15:30 — Presentation (15 min) of UNDCP/DESD Palavek project and discussion (15 min) (By Mr Leik Boonwaath)

Friday 16/07

- 9:00 to 9:30 — Presentation and comments on selected useful documents for agricultural development in Laos. (By Dirk Van Gansberghe)
- 9:30 to 10:00 — Presentation of the Nabong Agriculture College (slides) and the UNDP/DESD Nabong project .(By Dirk Van Gansberghe)
- 10:00 to 10:30 — Discussions on final recommendations
- 10:30 to 10:45 — Coffee break
- 10:45 to 12:30 — Discussions on methodological aspects in dealing with shifting cultivation systems in rural development (Methodologies presented by Mr Laurent Chazee and by Mr Bouahong Phanthanousy)
- 12:30 to 13:45 — Lunch break and guided tour to the field activities at Nabong college with (By Mr Dirk Van Gansberhe and Mr Murli Upadhyay)
- 13:30 to 14:30 — Final discussions, conclusions and recommendations of the meeting
- 14:30 to 14:45 — Coffee break
- 15:00 to 16:30 — Closing session of the meeting (By Mr John Evenson and Mr Sayamang Vongsack) Drink and snacks with the participants.

MAP OF THE LAO P.D.R.