UPLAND FARMING SYSTEMS IN THE LAO PDR

Cover: Traditional pig raising in a Lao Soung village, Bokeo Province, Northern Laos. Watchful owners stand by to prevent cross-raiding between feed troughs. Mortality rates of pigs are high.
(Photo: Malcolm Cairns)

Inset: Cattle raising (now with fencing, supplementary salt and mineral blocks) Nong Het District, Xieng Khouang Province. *(Photo: Bounthong Bouahom)*

UPLAND FARMING SYSTEMS IN THE LAO PDR — Problems and Opportunities for Livestock

Proceedings of an International Workshop held in Vientiane, Laos 18–23 May, 1997

Editors: E.C. Chapman, Bounthong Bouahom and Peter Kurt Hansen

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Foreword

TRADITIONALLY, livestock production in the hill and mountainous terrain of the Lao PDR has been a minor component of *slash-and-burn* (swidden) farming systems, centred on the cultivation of upland rice for household subsistence. In the 1990s, however, upland farming systems in many parts of central and northern Laos are changing in response to a complex of factors: firstly, the impact of rapidly increasing populations; secondly, government pressures for the restriction of shifting cultivation; and 'hirdly, as a consequence of new economic opportunities. Livestock production for domestic needs and export has become a current and potential economic opportunity of major importance.

At the 1995 Census, the population of the Lao PDR was 4.57 million and had increased at an average rate of 2.5% per annum between 1985 and 1995. By the year 2000, the population is expected to have doubled (to 5.2 million) in less than 30 years. More than four-fifths of the people still live in agricultural households and about 40% of the population (approximately 1.8 million people) are said to be fully or partially engaged in swidden cultivation. Their concentration is greatest in the mountainous seven northern provinces which comprise 41% of the area of the Lao PDR, but account for one-third of the national population and about 65% of all those families who depend upon swidden cultivation for at least part of their livelihood (Hansen, these Proceedings).

Inevitably, the dramatic increase in population during the past 25 years has greatly accelerated the pressure on resources throughout the Lao PDR, notably on the primary and secondary forests and in the uplands used for swidden cultivation. In a benchmark study by Chazee (1994), analysis of aerial photographs taken in 1981–1982 and 1988–1989 led to the conclusion that the annual cropped area in the Lao PDR under *slash-and-burn* had increased by 73% in seven years, but the total area in fallows had increased by only 5.7%. Based on these data, Chazee estimated that the average fallow period in the Lao PDR had been reduced from 12 years (1981–1982) to 8 years in 1989. He supported these estimates from field observations in several provinces, particularly in the northern region.

In addition to Chazee's work, several other studies of upland farming systems in northern Lao PDR in the early 1990s emphasised the urgent need to offset the deleterious effects of the shortening fallow periods by developing improved fallows. It was expected that these would replenish soil nutrients more quickly and reduce the weed problems associated with depleted soil fertility (Fujisaka 1991; Evenson 1994; Chazee 1994; Van Gansberghe 1994). It was recognised that marked differences exist within the seven northern provinces, but that in many localities rice yields as low as 1.5 t/ha/farm household were commonly experienced, even on the better sites. Such yields are scarcely adequate to meet average household rice requirements and in many instances even lower yields were reported.

The Workshop

The root causes of these problems and their potential solutions were very much the theme of the international workshop on "Upland Farming Systems in the Lao P.D.R.: Problems and Opportunities for Livestock". The Workshop was held 18–23 May 1997 in the Ministry of Agriculture and Forestry, Vientiane, and was organised jointly by Department of Livestock and Fisheries-GoL and the Australian Centre for International Agricultural Research (ACIAR). The main objectives were to:

- Review the experiences of research and development projects engaged in livestock production in the uplands of the Lao PDR.
- Analyse the potentials for improved management and government assistance to upland farmers.
- Make recommendations for current and prospective research and development projects, particularly such that have or could receive support from ACIAR.

The Workshop brought together more than 70 researchers and project personnel with different backgrounds and skills, including some with experience of the intensification of upland farming systems in Vietnam, Thailand and Indonesia. Five participants brought their experience of uplands areas in Cambodia, where attempts to manage livestock diseases and livestock production are only now re-emerging.

The Workshop focused on the technical aspects of livestock development, but many contributions stressed and demonstrated the need to take a farmer-oriented approach to development activities, whether in research, extension or politics. An underlying concern in many discussions was how, where and why a large number of village households, notably so far in Luang Prabang and Xieng Khouang Provinces, are choosing to move into a diversified farming system involving large ruminants (buffalo and cattle) and the raising of pigs, goats, chicken and fish. In effect, these farmers are moving towards permanent-field farming, as an end-point in the transition from a swidden-dominated economy.

The development context

A major consideration in the changes taking place is the income to be derived from livestock. As Laos has moved increasingly into a market-oriented economy in the 1990s, strong domestic and export markets have favoured the selling of buffalo (mainly for meat), cattle and pigs. In consequence, many village households are now obtaining what is to them significant income each year from the sales of 1–2 head of buffalo or cattle, and sometimes a few pigs (see Pravongviengkam, these Proceedings).

Despite these changes, in some other respects the legacy of the traditional subsistence economy remains. Individual households in the uplands usually control only 2–4 ha annually for cultivation, and rely on fallows and communal grasslands for the uncontrolled grazing of their buffalo and cattle. Some village households have no livestock apart from chickens; and, on average, only about one-third of households own cattle and about half own buffalo and pigs. In contrast, however, in some villages, particular households are increasing their holdings of large livestock to 20 head and sometimes more, if dry-season feed resources allow. Clearly, marked inequities in livestock ownership now exist within and between villages and these may well be magnified as production expands.

Coupled with the small herd size and the very casual approach of most upland communities to livestock management at the present time, there is a continuing problem of high livestock mortality, particularly in more remote upland localities. Mortality rates vary considerably from year to year and between provinces, but in a statistically valid sample of four provinces (1994–1995) deaths were reported to be 8–11% for buffalo, as high as 12% for cattle and 19–23% for pigs (MAF 1995). It is not unusual for villagers to report deaths of 70–80% of pigs during outbreaks of disease, with few young pigs surviving. The deaths are commonly attributed to Classical Hog Cholera (swine fever), but usually without laboratory verification.

In this context, where improvements in disease control are desperately needed, the 1997 Vientiane Workshop was extraordinarily timely. It was held at the same time as the Workshop's two sponsors, ACIAR and the Department of Livestock and Fisheries (DLF), were setting up the four-year project (1997–2000), funded by ACIAR, entitled 'ACIAR Project # 9438: Improved Diagnostic and Control Methodologies for Two Major Livestock Diseases in Lao PDR and Yunnan Province, PRC'. This ACIAR-DLF joint project, establishing methodologies for the accurate diagnosis of Foot and Mouth Disease and Classical Hog Cholera, is the first systematic step towards reduction of livestock mortality rates since the existing disease vaccination delivery system was set up in the early 1990s. A short report on progress and plans for this project, prepared by Dr Harvey Westbury and Mr Stuart Blacksell, has been included in this volume (see Appendix).

The assumption that lower death rates can be achieved within the next few years lent force and a sense of urgency to the Workshop discussions of many specific issues and research questions. Prominent among these issues were questions as to how increased numbers of ruminants could be fed from natural or improved fallows, and the likely 'carrying capacity' that would result; problems involved in better livestock management of buffalo and cattle, including fencing; and what might be done to expand production of pigs, goats and chickens once they have a better chance of surviving. In forthright fashion, a number of Workshop participants argued that the existing 'large ruminant bias', as they saw it, should be corrected in coming years in order to help poorer households.

An important outcome of the Workshop was its benefit to the many project personnel who attended from Laos, particularly expatriate staff from donor-assisted projects. They welcomed the Workshop as the first such wide-ranging national meeting providing for close exchanges of field experience, relevant research and ideas for expanding the role of livestock in upland areas.

Finally, the Workshop organisers wish to record their appreciation of the work by many participants who chaired formal sessions, led discussions and acted as discussion coordinators in the field. More particularly, however, all those attending were indebted to the officers of DLF whose dedication to the detailed arrangements and objectives of this Workshop played such an important part in its success. For those from Australia and from Laos' neighbours in Southeast Asia, it provided an impressive illustration of how ACIAR is pursuing systematic collaboration with overseas institutions (in this case the DLF, since 1993), towards achievable goals in the alleviation of rural poverty.

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References

Chazee, L. 1994. Shifting cultivation practices in Laos: present systems and their future. In: MAF, Shifting Cultivation Systems and Rural Development in the Lao PDR (Report of the Nabong Technical Meeting, 14–16 July 1993). Vientiane, Lao PDR, 66–97.

Department of Livestock and Veterinary Services, Ministry of Agriculture and Forestry (MAF) 1993. Cattle Production Systems (Proceedings of an International Workshop 22–24 November, 1993) mimeo., Vientiane, Lao PDR.

Evenson, J.P. 1994. Slash-and-burn agriculture: the continuing dilemma. In: MAF, Shifting Cultivation Systems and Rural Development in the Lao PDR (Report of the Nabong Technical Meeting, 14–16 July 1993), Vientiane, Lao PDR 22–32.

Fujisaka, S. 1991. A diagnostic survey of shifting cultivation in northern Laos: targeting research to improve sustainability and productivity. Agroforestry Systems, 13: 95–109.

MAF, Cabinet Office, Division of Statistics, Planning and Finance. 1995. Livestock Pilot Survey, May 1995, Results. Vientiane, Lao PDR.

Van Gansberghe, D. 1994. The diversity of the shifting cultivation systems in Laos. Preliminary field observations from the Nabong area. In: MAF, Shifting Cultivation Systems and Rural Development in the Lao PDR (Report of the Nabong Technical Meeting 14–16 July 1993). Vientiane, Lao PDR, 98–109.

Organising Committee for the Workshop

Singkham Phonvisay and J.W. Copland (Joint Chairmen)
P. Parisak Pravongviengkham
Bounthong Bouahom and E.C. Chapman (Co-Convenors)

An Editorial Footnote:

The terms 'swidden' and 'swidden cultivation', for a field commonly cleared by burning to facilitate cultivation, have come into scholarly usage since the early 1970s, as preferred alternatives to the pejorative 'slash-and-burn'.

The transliteration of Lao terms (and place-names) into English often presents problems, since there is as yet no standardised system. In the interests of consistency, authors' preferred spellings have sometimes been sacrificed in the published version of the Workshop Proceedings. The preferred spelling followed here, for example, of Luang Prabang, is consistent with the current practice of the Ministry of Agriculture and Forestry, Lao PDR.

LAOS

(Based on the Administrative Map of the Lao PDR, published by the National Geographic Department, Vientiane, 1996)

Opening speech by H.E. Dr Siene Saphangthong, Minister of Agriculture and Forestry, at the Workshop on Upland Farming Systems in Lao PDR — Problems and Opportunities for Livestock

Distinguished guests, ladies and gentlemen

On behalf of the Ministry of Agriculture and Forestry, I would like to extend a warm welcome and congratulations to all participants and guests.

Lao PDR is predominantly mountainous country, rich in natural resource endowments and where more than 80% of its population live in agricultural farm economies practised both in the flood plains and in the uplands. Shifting cultivation has traditionally been a dominant feature in the upland landscape, practised by more than 160 000 families and generating about 17% of the food requirements of the country.

Shifting cultivation has long been practised as a sustainable agriculture in upland areas of the Lao PDR. However, it is recognised that shifting cultivation is no longer sustainable in most upland areas where high population pressure has forced the expansion of shifting cultivation areas. In consequence, there has been considerable encroachment on forest areas and reduction of fallow periods on existing cultivated land. Because of land degradation caused by unsustainable shifting cultivation, people in the upland areas cannot produce sufficient rice for their consumption and are extremely poor.

The Government of the Lao PDR has recognised the negative impact of swidden cultivation. It gives high priority to creating permanent jobs for swidden farmers in order to alleviate poverty and to increase the income of households through the implementation of development programs in different sectors, notably crop production, forestry, irrigation and livestock.

In its national socioeconomic development strategy to the year 2000, the Government plans to replace traditional and semi-traditional farming practices with market-oriented agricultural and forestry commodity production, in association with industrial and services development. This development program will start from the family as the production unit. Land allocation will also serve in poverty alleviation for the people in rural areas, particularly in the uplands.

Among possible alternatives, livestock and fish production can play a very crucial and decisive role in upland farming systems, because these forms of economic activity are recognised as providing a significant amount of cash income and will contribute to a more sustainable livelihood of the people in these regions. Crop and livestock integration is not only common but also inseparable in a rural Lao context. Livestock already contributes about 21% to Gross Domestic Product and is an important component of farming systems.

Livestock production (particularly large animals such as cattle and buffalo) plays an important role in upland farming systems because the uplands are abundant in natural feed resources and water supply and have a lower population density. The application of farming systems that do not jeopardise the environment is the goal that we are looking for. Actions are underway.

Many international organisations have given cooperation and support in helping swidden farmers to adopt a stable land-use system in their efforts to improve their living standards. On this occasion, on behalf of the Ministry of Agriculture and Forestry, I would like to express our sincere thanks and appreciation to these organisations for their generous help.

This is the first time that the Lao PDR has arranged an international meeting such as this on the role of livestock in upland farming systems. This meeting is important for the livestock sector because through discussion the participants will understand and recognise the opportunities and constraints to livestock production in upland farming systems. We are keen to draw upon technical and scientific cooperation to make our programs realistic and capable of implementation. I believe that the outcome of this meeting will serve as a useful guide that can be applied to uplift the livelihood of swidden farmers and so contribute to poverty alleviation.

Before announcing the opening of the meeting, I would like to extend my sincere appreciation to ACIAR for its support of the meeting. I wish the meeting every success. I commend participants to concentrate their efforts on finding appropriate approaches for intensifying production in upland farming systems—approaches that will improve living standards of farmers in upland areas and at the same time lead to environmental preservation.

With this thought, I would like to declare the meeting officially open.

Livestock Sub-sector Policy Framework for Upland Farming Systems

Singkham Phonvisay[1]

IN THE Lao economy, the livestock sub-sector accounts for more than 21% of national Gross Domestic Product (GDP) (1995) with an annual growth rate of 5–7% between 1986 and 1992 and 4.1% between 1992 and 1994. This is considered one of the fastest growing parts of the agricultural sector. However, the type of subsistence agriculture practiced both in upland and lowland areas where the population is increasing is causing serious land and forest degradation, especially in upland areas.

Despite the negative effects of unsuitable farming practices, animal herds are still an important component of existing rural farming systems. In 1995, there were 1.2 million buffalo, 1.1 million cattle, 1.7 million pigs, 0.153 million goats and 11.3 million poultry. It should be remembered that in Lao PDR, as in other underdeveloped countries, the potential uses of livestock and its products are multiple.

These include:

- a buffer and stabilising effect;
- a viable utilisation of marginal areas;
- a short-term asset that can be readily liquidated;
- a capital reserve and hedge against inflation;
- a source of regular income;
- a source of protein;
- input for crop production: draught, manure;
- transport services;
- manure as building material and as fuel;
- employment opportunities in production and in processing areas;
- a potential source of export earnings.

In Lao PDR, livestock and fish-raising provide more than 50% of the total cash income of rural families. In order to improve the livestock sub-sector as a whole, and to promote livestock production as a component of rural development (especially in upland areas where shifting cultivation practices encompass more than 180 000 hectares), a sustainable farming systems approach is necessary to stabilise shifting cultivation practices. At the same time, such a change would lay the foundations for a new way of life for upland people in a new ecosystem.

Policy Framework

As agricultural and natural resource management systems are made up of social, biophysical and economic components, the situation of rural upland areas must be viewed as a whole.

Key specific issues to be considered at this stage of development are:

- extreme rural poverty;
- shifting cultivation;
- UXO (unexploded ordinance) problems;
- poor access to upland rural areas;
- natural resource management and conservation needs (including lands, forests, water and associated biodiversity.)

The government is focussing on participation of the people as a prerequisite for any community-based natural resource management, and the people should be the subjects, not the objects, of developmental initiatives. For this orientation, many key factors and alternatives have been discussed among policy-makers and some have been translated into initial testing programs supporting future permanent employment in upland areas.

These include:

- land allocation;
- cash crops;
- expansion of paddy areas;
- livestock-based farming systems;
- tree planting by farmers;
- joint rural infrastructure development; and
- socio-economic development work.

Agricultural Strategies

Based on and looking for a 'dynamic approach' on how to start with agriculture as a prerequisite for

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performing, step-by-step, a 'new national economic structure', the government is:

- promoting a gradual shift from subsistence to commercial commodity-based production;
- trying to break away from the low capital situation inherent in the vicious circle of under-development by looking for grants and loans, organising an agricultural bank, promoting loans and savings cooperatives, organising mini-credit schemes and improving the marketing links between rural and urban areas;
- trying to concentrate on rural development aiming at reducing poverty and achieving a broad distribution of economic growth. (In upland areas, three special considerations should be targeted—for example, alleviating poverty by bringing people at least up to the minimum poverty line, promoting income generation for permanent occupation, and looking for employment opportunities both in the area or by way of migration to other areas);
- trying to halt the degradation of natural resources by searching for programs to develop sustainable conservation and management and enacting laws concerning land, water and forestry resources.

MAF Mandate and DLF TAP

Taking account of agricultural strategies and nine government priority programs, the Ministry of Agriculture and Forestry (MAF) coordinates three main government priority areas: food security, environmental protection and stabilisation of shifting cultivation practices, and commercial, commodity-based agricultural production. Within this context and because of this responsibility, MAF has extended these areas into six sub-programs:

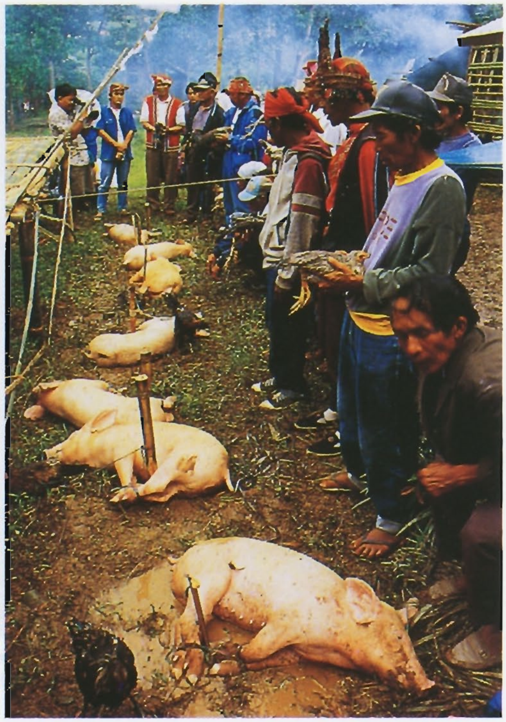
- food security;
- stabilisation of shifting cultivation;
- commercial, commodity-based production;
- irrigation infrastructure;
- research and extension;
- manpower development.

The Department of Livestock and Fisheries should be responsible for developing its own objectives and activities, called TAP (Technical Action Program), to support four major priority areas—food security, shifting cultivation, commercial production, and research and extension. The upland farming systems approach should be used as a pragmatic guideline for TAP in stabilising shifting cultivation.

Despite a lack of concepts and experience, a test action program was developed. Starting from the profile of a smallholder family household economic and herd balance indicator that could promote income and permanent employment, the process planners used participatory rural appraisal (PRA) and rapid rural appraisal (RRA) techniques to assess results. These were used to develop an annual activity program based on technical support services from researchers and extensionists involved in overall implementation procedures.

Four main working processes should be followed each year, i.e., planning, supervision, monitoring, and evaluation. As well, personnel involved in credit support, research, extension and regional authority, along with representatives of smallholders, should bring a high degree of responsibility and consensus to their efforts to coordinate activities and to evaluate results.

Livestock in Upland Farming Systems: the Regional Context



SACRIFICES of pigs and chickens are practised by many ethnic minorities in the uplands of Southeast Asia. (Photo: Malcolm Cairns)

JAVANESE farmer feeding *Tithonia diversifolia* to his goats, as the staple roughage. Twice each day family members walk the one kilometre distance to cut profuse *Tithonia* thickets along the river bank. (Photo: Malcolm Cairns)

LARGE communal swiddens of Lua' and Karen in northern Thailand. This practice makes it easier to keep wandering livestock separate from the area being cropped during that season. Each field hut marks a different household's allocation. (Photo: Malcolm Cairns)

LONG distance droving to market of buffalo and cattle is common in the uplands of Laos, northern Vietnam and southwest China. In this instance, a mixed group of buffalo and cattle was being walked from upland country north of Mengla City (Xishuangbanna Prefecture, Yunnan Province, PRC) to the Mekong River port of Guanlei, for shipment in Lao boats downriver to Laos, Myanmar and finally by truck into northern Thailand. (Photo: E.C. Chapman)

Roles and Limitations of Animals in the Farming Systems in Southeast Asia: Field Observations and Experiences

Suchint Simaraks[1]

Abstract

This paper describes physical, biological and socio-economic factors related to diverse farming systems in Southeast Asia, with animals as a component. The shifting roles of animals in farming systems relate to sustainability. Crops and livestock (including fisheries) are classified according to resources and topography. Under each classification, the interaction of livestock with other components, in terms of whether they are complementary or in conflict, are discussed. The systems are classified as water-based and rain-fed. Water-based systems are further subdivided into rice-fish; fish pond-livestock while rain-fed systems are classified as crop-cattle or crop-buffalo or both, crop-swine, crop-poultry. General constraints, such as diseases, as well as specific constraints, are discussed. Future roles for livestock in farming systems are suggested.

THE CONTEXT of this paper relates not so much to livestock as such, but to the various combinations of factors that livestock interact with, such as cropping, off-farm matters, and wide topographical variations. Systems vary in lowland and upland areas and can appear at times interchangeable, e.g., in some upland areas, there may be some flat land on which lowland systems can be practiced. Instead of presenting the roles of livestock in different farming systems in different areas of countries, various factors which determine differences in farming systems will be classified and discussed, and a presentation of the types and locations where the systems are being practiced will be given.

Determination of Farming Systems

Factors involved in determining farming systems that usually include animals are listed as topography, cropping, animal raising, resource availability, and socio-economic.

Topography

For this purpose, topography can be classified generally according to elevation as either lowland or upland, and further classified as undulating or steep slope (mountainous). This classification is not entirely rigid, because in some areas they are mixed. Lowlands are usually flat, but may be on top of mountains or between mountain ranges. Different elevations, combined with differing resources, influence various agricultural practices, resulting in different systems. Lowlands may have surplus water resources whereas uplands or mountainous areas may not. Elevation, to a certain extent, influences the different types of crops grown. Different climates or microclimates at different elevations are important in determining the different kinds of vegetation that can be used as resources by farmers. Lowland areas in Yunan may have a different climate from that of lowland areas in Lao PDR. Along with land elevation, soil types in each area also determine types of crops and productivity.

Cropping systems

Cropping systems are influenced by various physical and socio-economic factors, varying from slash and burn systems to short-term rotations, from mono cropping to very complex multiple cropping (Cue et al. 1990; Douangdara et al. 1991; Gillogly et al. 1990). Cultural practices also vary. As an area has more linkages with external development, cropping systems move towards mono cropping, and rotation times become shorter. Markets and marketing factors

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have an increasing influence on farmers' decision-making. However, most farming systems in Southeast Asia are rice-based, either wet or dryland rice cultivation. Other crops are mostly field crops. Horticultural crops are sometimes associated with markets, but are mostly for home consumption.

Animal raising

Animals are usually an integral part of farming systems in Southeast Asia. However, as external markets exert more influences on these systems, animal raising is becoming less important. Specialised animal production is increasing as traditional animal raising practices shift to more intensive systems and are more dependent on external inputs. With a combination of labour shortages (in some areas) and farm mechanisation, the need for an animal component in these systems is declining. In traditional systems, livestock can be sustained with minimum inputs, whether they are chickens, swine, cattle, buffalo or fish. By-products from crops (mainly rice straw) and from animals (mainly manure) are interchangeable within a system but this exchange declines as the market economy becomes intensified.

Resource availability

Resource availability is influenced by topography, climate, soil fertility and genetic material. However, resource availability does not wholly reflect actual use of any particular resource. Accessibility and utilisation of resources by households play important roles in the systems of farming and the socio-economic status of each household contributes to accessibility and utilisation of resources. Infrastructures such as irrigation or road systems facilitate changes in farming systems and resource use.

Socio-economic factors

The move towards a market economy and linkages between farms and the market cause changes in farming systems. However, in small areas market influences are not only area-specific but also link to supply and demand at international level (globalisation effect). In any particular area, economic differences between families also leads to adoption of different farming systems.

Labour availability in terms of quality and quantity, ritual, belief, religious restriction, ethnicity, tradition, etc. all exert influences on farming system practices. Socio-economic influences on these practices becomes more obvious at household and community levels.

Variations of these factors can be observed throughout the Southeast Asian region. Combinations of them produce diverse and complex systems, even though most of them are rice-based. Moreover, the systems change over time particularly in the areas where globalisation is strong. As this occurs, the role of livestock also changes.

Shifting Roles of Livestock in Farming Systems

Traditionally, native or introduced breeds of animals are integrated into the farming system and have a wide range of roles (Figure 1). Animals can serve as a source of draught power for land preparation and weeding, for transportation and manure generation, or as a source of high quality food, social status, pleasure, ritual activities or even safety (geese, dogs).

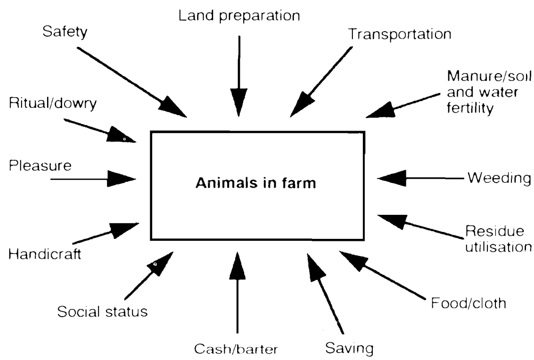

Figure 1. General roles of animals in farming systems.

In different areas, the importance of particular roles or particular species of animal differs. As external influences become stronger and the roles of animals in farming systems become less important, the sustainability of farming systems is weakened. Replacement of animals in farming systems increases the use of non-renewable resources and dependency on external inputs (Table 1). Animals are replaced by mechanisation, chemical fertiliser, manufactured goods, debt and unfair loan terms when immediate cash is needed. Without animals to maintain or increase farm productivity, inputs from external systems are needed. So productivity that formally depended on such factors as climate and farm management would then be effected by fluctuations in these external inputs such as price or availability in the marketplace. Individuals who can access external inputs would be better off to maintain productivity. The overall result will be wider variation in the economic status of individuals, thus weakening the system and the whole community (Figure 2).

Table 1. Shifting roles of animals in farming systems.

Roles of animals	Replacement	Resource uses
Land preparation	Mechanisation	
Transportation	Mechanisation	
Fertility	Chemical fertiliser	
Weeding	Chemical control	
Residue utilisation	Waste	Non-renewable
Food/cloth	Processed, manufactured	
Saving	Debt	
Cash/barter	Loan system	
Handicraft	Manufactured	
Social status	Consumer products	

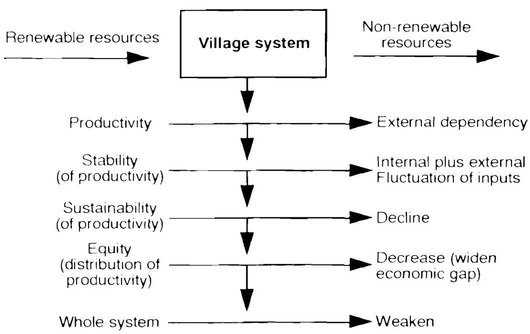

Figure 2. Effects of shifting from renewable to non-renewable resources for crop and livestock and production.

Patterns of Farming Systems with Livestock as a Component

It would be beyond the scope of this paper to cover all of the farming systems and livestock roles in detail. However, they can be grouped or sub grouped by different criteria such as species of animals, socio-economic status, resource availability etc. Here, the main criteria for classification is arbitrarily categorised by topography and main resource availability. Socio-economic variations and locations will be discussed under these classifications (Table 2).

Water-based systems

Rice-fish system

Water-based systems are found mainly in lowland areas, but can also be found in many parts of the upland areas. The simple and traditional fishpond is a central focus of integration and is a low input rice-fish system observed widely in northeast Thailand and in various parts of Southeast Asia. When the water in a paddy field recedes, native fish are collected in small ponds, usually at the lowest corner of the paddy field. Productivity depends to a large extent on the native stock of fish, the level and duration of water, and the fertility of the paddy field. However, native fish stocks are declining due to over-harvest, environmental degradation and chemical pollution from pesticide use.

However, this system has been studied and improved in recent times. Ponds have become bigger, cultured fish have been introduced, and residues from crops, livestock manure and termite mounds are now used as feed for fish stocks. To increase productivity, the system has become more dependent on external inputs such as fish feed. In areas where labour migration has occurred or family planing has been effective (as in the case of Northeast Thailand) labour availability may be a constraint. However, cultured fish can replace the diminishing native fish as a protein source for local people. Besides serving as a family protein source, it can also be bartered for labour exchange and/or for rice. Farmers have indicated that theft is a problem because fish ponds are situated away from the villages.

Fishpond-livestock systems

The introduction of intensive livestock raising (mainly poultry and swine) to the fishponds made the systems more complex (Cuc et al. 1990). Livestock contribute manure to the ponds and reduce the cost of fish feed, but increase the dependency on external resources such as breeds of animals, feed, and veterinary care.

While the increase in productivity through this diversity had the potential to make the system sustainable, observations in Thailand indicated that the livestock component in this system did not make much profit in many cases. The number of livestock in relation to the size of ponds was still a problem, because too many livestock pollute the fishponds. In different locations, the need for livestock manure may differ due to variations in water quality. The need for quality labour also increases as the systems become more complex, and as they become more commercial, the animal component as a contributor

Table 2. Summary of roles and limitations of animals in farming systems in Southeast Asia (field observations and experiences).

Systems	Characteristics	Roles	Limitations	Location
Water-based				
Rice-fish	Traditional, low input, native fish stock, subsistence, lowland and also upland	Fish as family protein source, for labour exchange, increase rice yield, bartering etc.	Low productivity, native fish stock declining due to environmental degradation	Widespread
Improved rice-fish	Cultured fish introduced, more inputs as feed and feeding, semi-subsistence lowland, also upland, duck can be added	As above, sometimes sell, etc.	Dependent on external fingerlings (initially), feed resource, more labour needed, duck may conflict with fingering	Widely introduced in Thailand, Philippines, China, Vietnam, Lao/PDR
Fish pond-poultry or swine	Complex interaction, increase external dependency, may require more labour, semi-commercial to commercial	Help sustaining other activities, reduced cost of fish feed, human food, saving, manure as fertiliser etc.	Required better management, animal component usually not economically profitable, external inputs needed, in some communities household must stay out of the village (socially lonely), theft	Widely introduced in Thailand, adoption is still limited, observed in Vietnam, China, Philippines
Upland rainfed				
Crop-cattle or buffalo or both	Mostly traditional, low input, high initial investment, simple to complex management, strong interaction with crop or forest	Draught, saving, status, food, manure, bartering, use of crop residue, transportation, rice insufficiency etc.	Feed availability, land holding, labour, mechanisation, cropping systems, forest, etc.	Common in Southeast Asia, declining in Thailand.
Crop-swine (1)	Traditional low input, subsistence, free grazing caged or tethered, strong link with rice by-products	Food, ritual, rice insufficiency, manure, status, crop residues bartering saving etc.	Forest area, natural vegetation, cropping, theft, rice mill, belief	In remote areas of Southeast Asia
Crop-swine (2)	Introduced breeds, linking with rice mill, external inputs commercial	Mainly income generation, crop residues, status etc.	High input requirement, rice production and rice mill, management, experienced labour, cropping, market dependent	Widespread in areas accessible to market
Crop–poultry (chicken, ducks, geese, turkey)	Traditional, low input, small in number, seasonal fluctuation in number, subsistence	Food, bartering, saving labour exchange, crop residue, ritual, pleasure	Not first family priority, with some exceptions	Widespread
Crop-goats	Traditional, low input, may link to belief in some areas	Mainly food	Conflict with cropping	Lao, Vietnam, Malaysia (not widespread)

Note: — Most of the systems are rice-based, cash (field) crops are usually part of the systems. The home garden is a common practice.
— Disease is a common limitation.
— Fine tuning of different systems in different communities.

to the family food source becomes less important. Farmers prefer to sell livestock for cash.

While these systems are widely used in the region, information on whole farm economic analyses are still lacking. Adequate water resources are a pre-requisite to much wider adoption but fish diseases in some species can be a problem.

Biogas production from livestock manure is possible, but practice is limited.

Rain-fed systems

Most upland areas are rain-fed and although all the systems are rice-based, rice insufficiency is a common problem. One of the important strategies for rice insufficiency is animal raising which, under rainfed systems, is multi-purpose (Amarathithara et al. 1991; Cuc et al. 1990; Douangdara et al. 1991; and Gillogly et al. 1990). Seasonal rainfall variations limit productivity especially in the dry season. Soil infertility, limited availability of communal land and land holding size are other constraints to both crop and livestock production.

Native and traditional pig raising sometimes conflicts with home garden activities, especially when forest nearby is limited. However, manure from pigs is mostly used as fertiliser in home gardens (Figure 3). Whisky distillation fits well with pig raising when residue from distillation is fed to pigs (Figure 4). The often observed practice of boiling pig feed may increase firewood resource competition with other activities. Pigs are occasionally used for home consumption and also for various ritual activities. Rice bran and sometimes broken rice from traditional rice milling are also used as pig feed. Pigs are let loose, confined or tethered depending on intensity of cropping and accessibility to forest (Figures 4 and 5). However, the introduction of small rice milling machines confined pig raising only to the few families or their relatives who owned the rice mills. Pigs and whisky are sold or bartered for rice. If rice bran is limited by rice insufficiency, low and cheap quality rice is bought from markets to make whisky. This strategy changes cheap resources into more value-added commodities such as pigs or whisky. These systems are observed in many areas of the Southeast Asia, although less frequently observed in Thailand now. Introduced breeds need more feed input and management, especially veterinary care. Therefore, only those few families who can afford rice bran and formulated feed from outside of the system have them.

Traditional cattle and buffalo raising can be observed in the whole region although some communities have either cattle or buffalo and others have both. Much depends on the levels of utilisation, management skills or traditions (ethnicity) of the local people. If the areas are close to forests, the animal raising systems are usually low input (Figures 3, 4 and 5). The animals are let loose in forests to graze and breed, and are retrieved only when needed. After harvesting, paddy fields are turned into grazing land, especially where the forest area is limited. Rice straw is a main feed during the dry season. Animals are used for draught power and they can be used for other purposes such as saving, bartering goods, food, or for rent. Manure is used as fertiliser for paddy fields or the home garden. Increased crop production has extensively limited grazing areas and mechanisation has further reduced the number of animals. Small landholdings also limit bigger herd sizes. This scenario has been observed in Thailand.

A special caution should be given about development of this kind. Biogas production from manure is still not widely adopted. In northeast Thailand where numbers of buffalo and cattle are falling greatly, there is a special need for buffalo in cassava or sugar cane plantations where they are used for weeding between rows of crops where small walk-after tractors cannot do the job. To raise buffalo or cattle, high initial capital is needed and forage crop production for these animals is very limited in practice, except for dairy cattle in some areas in Thailand and in Malaysia. More research on forage crop production is needed, especially on-farm research. Replacement of cattle and buffalo by machines is still limited in Lao PDR, Vietnam and Cambodia.

Goats are found in Lao PDR (introduced from Vietnam), Malaysia and the southern parts of Thailand where Muslim communities exist. They are raised and consumed on special occasions. Goats are hardy and easy to raise but sometimes compete for crops.

Diseases

Diseases limit livestock production and are prevalent across the whole region. Field observations and studies in Lao PDR and Thailand and studies on chicken vaccination (Srila et al. 1989) found that the low rate of acceptance of vaccination is not due to lack of education but to lack of accessibility, the timing of vaccinations (conflict with other important farm activities), the priority of other farm activities, retrieving animals from the forest, and vaccination after the outbreak of disease.

Other limiting problems

Theft, access to markets and services, and market structures can be factors limiting the role of livestock in farming systems.

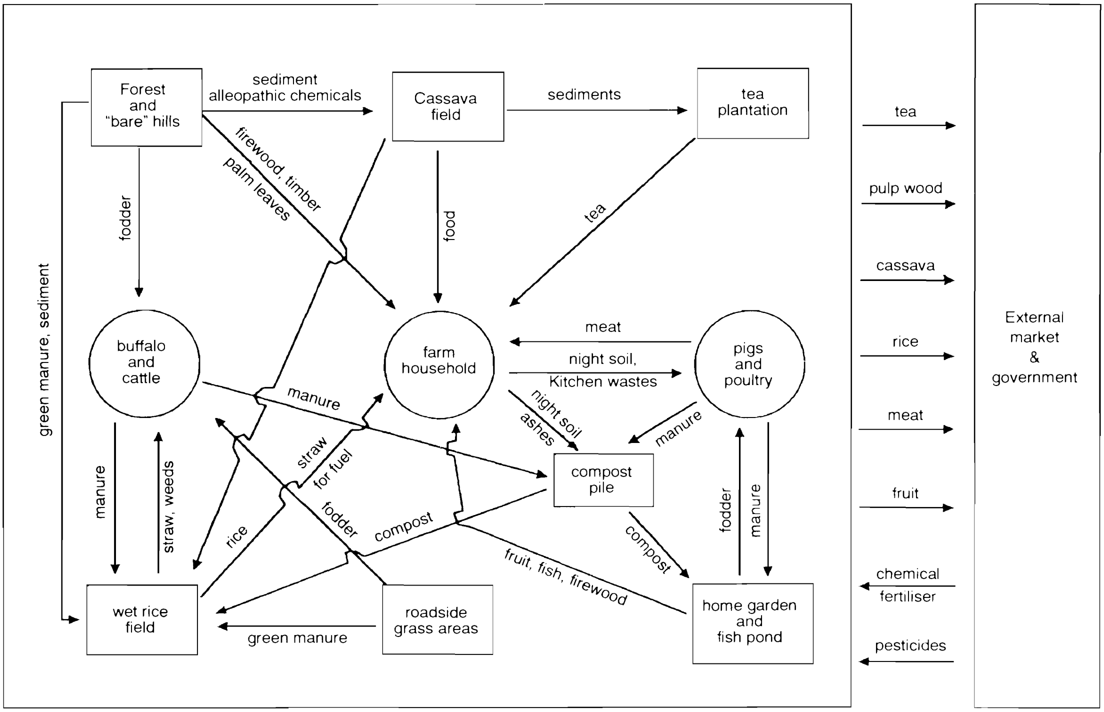

Figure 3. A typical household agroecosystem in the Midlands, Vietnam (Cuc et al. 1990).

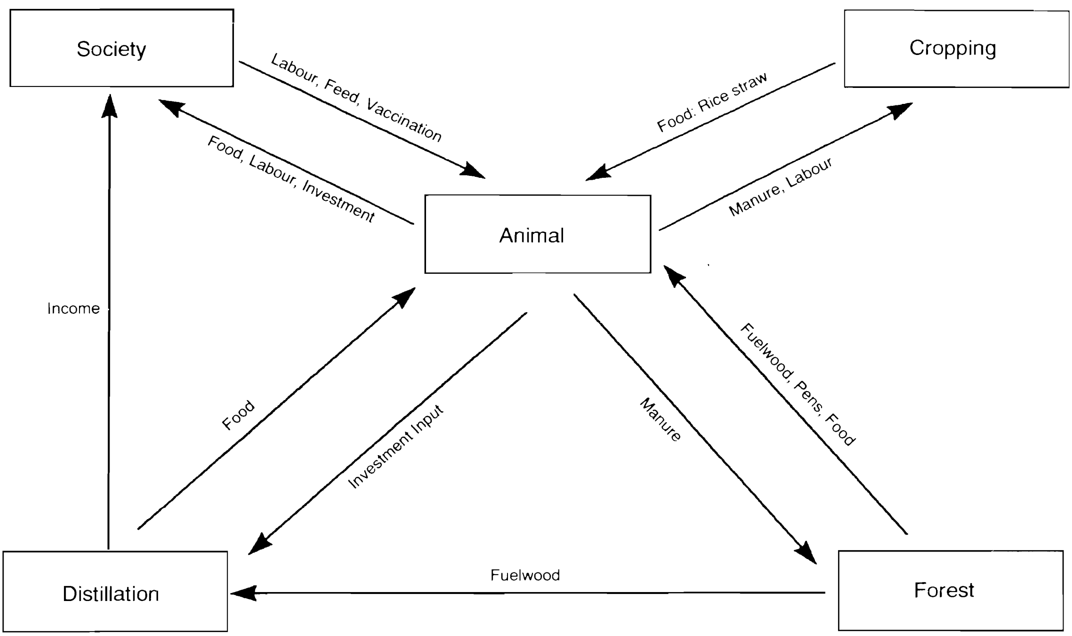

Figure 4. Relationships between animal husbandry and agroecosystems, Ban Sang Hai (Gillogly et al. 1990).

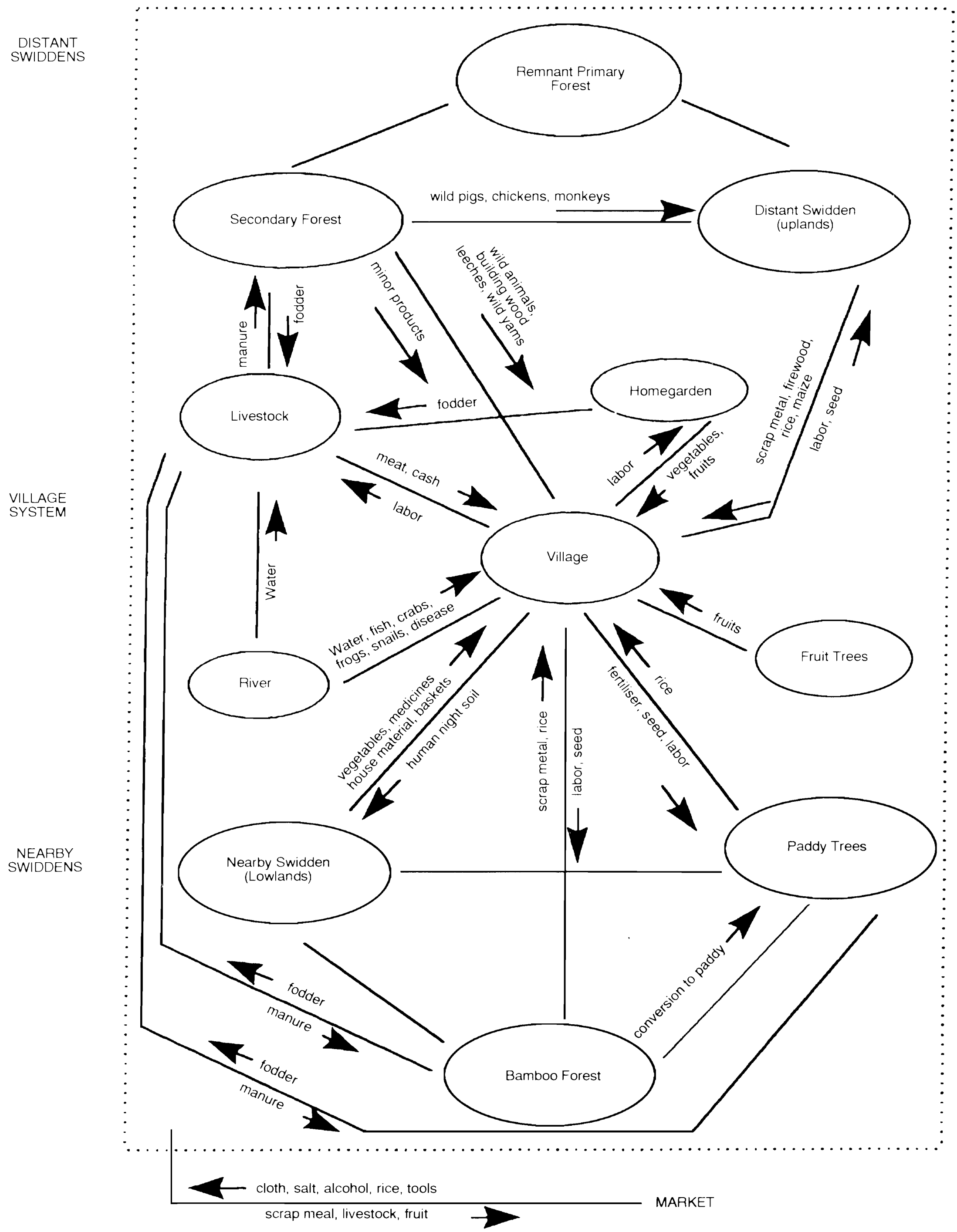

Figure 5. Village resource system of Ban Houay Loua No. 2, Sepone District (Douangdara et al. 1991).

Future Role of Livestock in Upland Farming Systems

As each country becomes more market-oriented, poultry and pig production will be the first to be taken up by the private sector. The key to sustainable upland farming should be maintenance of soil fertility. Soil fertility declines because of exportation of renewable resources, cultural practices, soil erosion, and forest degradation. Integration of crops and livestock where manure can be used in combination with nitrogen-fixing crops can sustain soil fertility while at the same time the nitrogen-fixing crops contribute as fodder for livestock. To service annual cash needs, crops may be planted rotationally with nitrogen-fixing crops. Animal manure can be used to produce biogas, while slurry can fertilise soil. This system can also reduce environmental pollution by reducing uses of chemical fertiliser because rotational crop systems can reduce certain crop pests, thus reducing pesticide applications. However, the design and means of adoption of such a system needs further research, both on-station and on-farm.

References

Amarathithada, L., Cairns, M., Gillogly, K., Menzies, N. and Pravongviengkham, P.P. 1991. Swidden Agriculture in an Area of Limited Land Availability, Ban Alang Nyai: Swidden Agroecosystems in Sepone District. SUAN Regional Secretariat, Khon Kaen University, Khon Kaen, Thailand, 90–92.

Cuc, L.T., Gillogly, K. and Rambo, A.T. 1990. Agroecosystems of the Midlands of North Vietnam: A Report on a Preliminary Human Ecology Field Study of the Three Districts in Vinh Phu Province. Occasional Paper No. 12. Environment and Policy Institute, East-West Center, USA, 120–127.

Douangdara, O., Fahrney, K., Hadikusumah, H.Y., Khambounhouang, B., Phayvanh, T.E., Rambo, A.T., Sidavong, B. and Vien, T.D. 1991. Agroecosystems of the Lao Theung Community; Ban Houay Loua. Swidden Agroecosystems in Sepone Distgrict Savannakhet Province. SUAN Regional Secretariat, Khon Kaen University, Khon Kaen, Thailand, 44–64.

Gillogly, K., Charoenwatana, T., Fahrney, K., Panya, O., Namwongs, S., Rambo, A.T., Rerkasem, K. and Smuthupt, S. 1990. Two Upland Agroecosystems in Luang Prabang Province, Lao PDR: A Preliminary Analysis. SUaN Secretariat, Khon Kaen University, Khon Kaen, Thailand, 68–72, 104–107.

Srila, S., Phalaraksh, K., Subhadhira, S., Suphanpeset, K., Ratanapanya, S. and Oparttrakoon, S. 1989. Farmers' Reactions to Chicken Vaccination Program: A Case Study of Muang District, Khon Kaen Province and Pak Khad District, Nong Khai Province. Farming Systems Research Project, Khon Kaen University, 54–59.

A Livelihood Systems Approach to the Sustainable Development of Upland Farming Systems

Harvey Demaine[1]

Abstract

This paper does not pretend to address the specific issues of livestock development as a component of shifting cultivation development in the Lao PDR. The author has only second-hand experience in development of upland shifting cultivation systems through his ongoing supervision of the doctoral studies of a senior member of the Lao Department of Livestock and Fisheries and is certainly not a specialist in livestock. His experience is mainly in lowland rainfed agricultural development and the paper seeks to offer some perspectives from that experience to the context of the Lao uplands. As pointed out by Jodha (1991), the two systems share many of the characteristics and problems of the so-called Third Agriculture in being 'complex, diverse and risk-prone' (CDR) (Chambers et al. 1989). The paper takes as its starting point a belief in the value of the Farming Systems Research and Extension approach as a basis for the sustainable development of these CDR systems. This is the assumption being followed in the above-mentioned thesis studies and which appears to be a more sophisticated approach to the development of the uplands. In addressing sustainability issues, the paper stresses the ecological dimension of the term, and ends by discussing its institutional context, and the need for development approaches to be implemented by governments of developing countries, not through the artificial means of foreign aid projects. In this regard, the author draws on the experience of the Asian Institute of Technology (AIT) Aquaculture Outreach Program (AOP) of which he is co-ordinator.

Farming Systems Research and Development

IT IS NOW generally accepted that traditional approaches to agricultural development involving the transfer of standard packages of technical recommendations derived largely from on-station research to a broad spectrum of farmers through conventional manpower-heavy extension services have failed in many regions of Asia. This is at least partly because such regions are characterised by CDR agriculture in which farmers are faced with fragile and unstable environments in which the livelihood of the family depends on the adoption of complex survival strategies involving a variety of different enterprises. The reductionist scientific method with its separate disciplines (and within them separate commodity specialisations) faces problems in dealing with such complexity and recommendations for technical improvement in one specific commodity area are often rejected by farmers because they do not fit in to the whole farm system. The environment also varies over remarkably short distances in a way that is difficult to replicate on the research station. Thus, even if the conditions on the research station do broadly correspond with those of the farmers' situation[2], strategies developed for one area may be quite inappropriate for another area nearby. This is particularly the case in upland areas where such considerations as slope aspect add to the diversity.

The Farming Systems Research (FSR) approach to agricultural development has sought to address this problem. It seeks to identify different types of farming systems and their problems as a basis for

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[2] In fact, as Chambers and Jiggins (1987) have pointed out, this is often not the case. Research stations in CDR areas often create 'artificial' conditions even in physical environmental terms so that experiments can be carried out within a fixed time frame.

technology development and transfer. These 'type' systems form what are known as 'recommendation domains' for which a particular technical package is designed. It is important to realize, however, that the key variables which distinguish recommendation domains from one another operate at two scales, not just at the scale of the individual farm production system, but also the (sub-) regional resources system which forms the broad context in which the individual farm operates.

The Search for Recommendation Domains

A paper by Lightfoot et al. (1993) serves to emphasise the need for two levels of analysis. The paper illustrates the movement in the farming systems approach over time. This began with a continuing focus on specific commodities, although taking into account the wider on-farm system; as such, it allowed the commodity specialist to claim to be following a farming systems approach. The second step was the move to a more holistic approach dealing with the whole farm and the interactions between the main sub-systems. This has spawned a good deal of recent work in farm modelling, first among agricultural and then among resource economists (bio-economic modelling) with a view to optimising the use of on-farm inputs in integrated agriculture. This approach has been particularly favoured by those concerned with the overuse of agricultural chemicals under the 'green revolution' technology package[3] and has led to the emergence of such terms as 'low-external input agriculture' (LEIA) or 'ecological agriculture'. This approach maintains the narrow focus on the farm production system, which in LEIA is seen essentially as a closed system (Figure 1a, 1b).

The third step in the evolution of the farming systems approach widens the focus. It recognises that the farm production system is traditionally only one element of livelihood, that farmers also utilise resources outside of their own farms in the surrounding natural environment. Specifically farmers in CDR systems use forest and natural water resources to gather a host of materials for food, fuel, construction materials and other equipment and medicine (Figure 1c). Use of forests for fodder is, of course, a major issue that will be dealt with elsewhere in these Proceedings. As farming systems have intensified and become more specialised in lowland areas, especially in irrigated areas, the importance of these resources in the household livelihood system has declined and thus agricultural development specialists have tended to lose sight of them.

In the context of aquatic resources, intensification has tended to destroy the habitat of natural fish. However, in CDR areas they often remain of considerable importance. In a quite different CDR area

[3]Although this is rarely a relevant issue in the third agriculture, where environmental instability makes such applications highly risky.

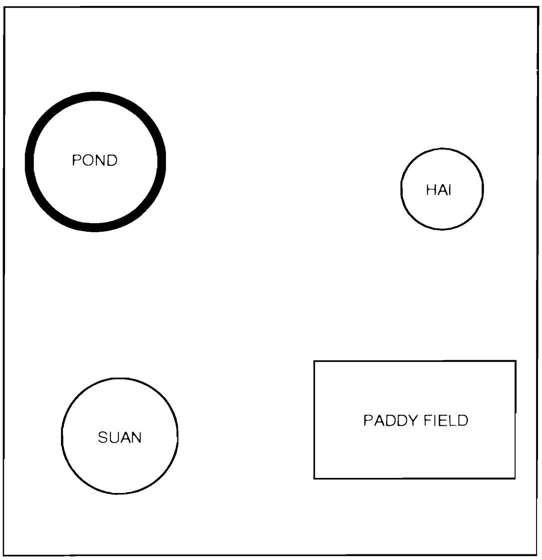

Figure 1(a). Commodity focus in farming systems.

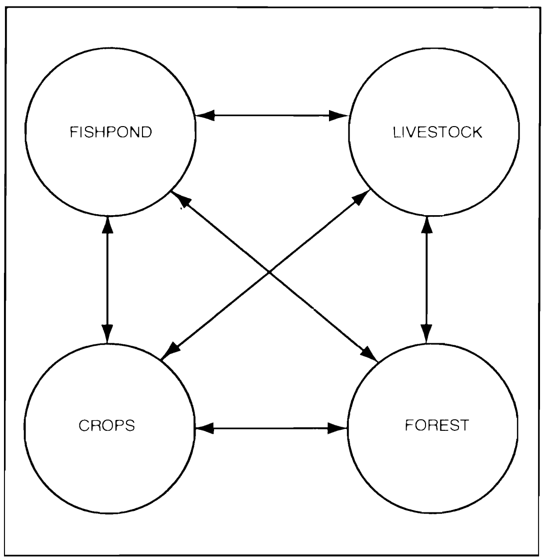

Figure 1(b). Whole farm focus in farming systems.

(adapted from Lightfoot et al. 1993)

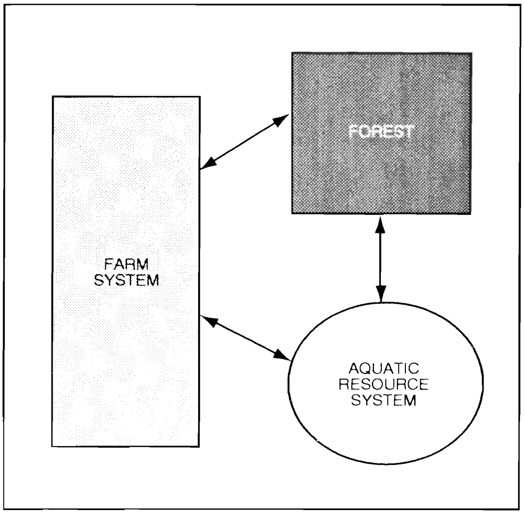

Figure 1(c). Resource systems approach to FSRE.

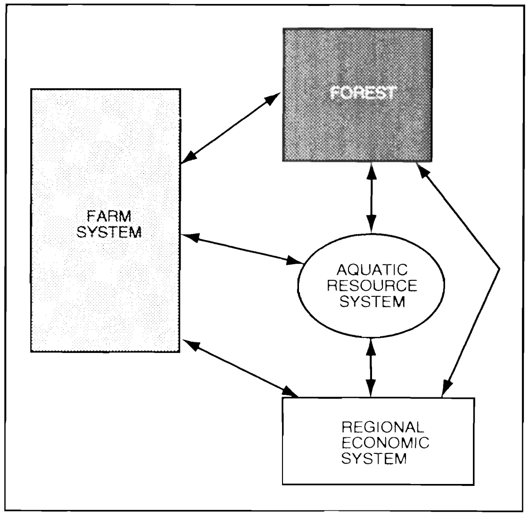

Figure 1(d). Livelihood systems approach to FSRE.

to those being considered here, wetlands, agricultural development has consisted of drainage of problem soils, usually acid-sulphate, for rice or other cash crops. In fact AIT's research in southeast Cambodia has begun to question this in relation to its effect on fishing. Families in this region may catch as much as one tonne of fish in rice fields and trap ponds in a year of good rainfall. Attempts to develop aquaculture in such circumstances are largely a waste of time and illustrate the problem of the commodity-oriented, closed-system FSR perspective.

Traditionally in the farming systems research literature, the emphasis at the regional scale has been on agro-ecological zonation, stressing the physical resource elements in the farming system (Conway 1985), although many studies have failed to include this key contextual element, so that they have been of limited value for extrapolation into the wider development framework. However, even this is increasingly recognised as being an inadequate basis. The fourth and most recent perspective (Figure 1d) in farming systems sets resources assessment in a much wider framework, including such social and economic factors as market access, alternative employment opportunities and local implementation of national policy measures. In this view, the emphasis is not so much on the farm, as on the family as a management unit, which takes advantage of whatever opportunities are available, be they on-farm or off-farm. The approach thus looks at livelihood systems, not farming systems per se.

The project that the author manages, the AIT Aquaculture Outreach Program, serves to illustrate the problems associated with the narrower natural resource systems perspective. The AOP began its work in northeast Thailand in 1988 on the assumption that low-cost aquaculture would depend on the availability of on-farm resources for inputs into the farm pond. It thus adopted four distinct study areas seen to be characteristic of the main agro-ecosystems of northeast Thailand as defined by Khon Kaen University (1987). However, while attempting to recognise natural resource potentials, the project failed to understand key socio-economic variables that affected aquaculture. Thus, in the area of apparently greatest potential for aquaculture, in the Huay Luang irrigation area, the proximity to Udorn Thani city with its off-farm employment opportunities and the presence of several agri-business enterprises promoting high-value short-term cash crops combined to limit the interest in low cost, but relatively high labour input and low (and slow) return aquaculture.

The situation in northeast Thailand has become more extreme in this regard over time. Since the AOP began, the Thai economy has entered a prolonged period of rapid economic expansion which has drawn labour, especially young people, away from the agricultural sector on a permanent basis. Almost no part of the country is insulated from the influence of the growth of the urban-industrial sector. Fewer and fewer families derive their total livelihood from agriculture, particularly as subsistence expenditures have increased. Thus enterprises offering the limited returns of the original aquaculture package are of little interest except as a stepping stone. The project has increasingly moved towards higher input technologies offering higher returns for less labour (a fast-food strategy).

The key issue in the definition of recommendation domains is of course the recognition of the variables which define them. Obviously, the forces which affect agriculture in the rainfed lowlands of northeast Thailand are not the same as those which influence the uplands of Laos, but the variables may be similar. Although people think of those uplands as isolated, this is a relative term. Already it is clear from the periodic markets springing up along Route 1 in the north of Luang Prabang province that there is considerable market access in some areas and the northeast Thai case serves to illustrate the dynamic of the situation. As improved highways across Indo-china are being constructed, the previous isolation will be broken down and new livelihood opportunities offered. However, the process of improvement of access is not necessarily a positive one. Along with improvements in opportunity, may come threats to livelihood. Developments in northern Thailand offer a clear enough warning of this in the form of competition from external economic forces for use of land and water resources.

It is clear then that differential accessibility remains a key variable in the recognition of recommendation domains in upland areas. From the work already carried out by Mr Parisak Pravongvieng-kham, others appear to include the population — natural resource balance, provincial land use policies level, obviously variables such as land resource and, possibly, ethnicity, although there is evidence that differences in practices among ethnic groups just as much reflect resource availability in different agro-ecologies and that such differences disappear with the movement of population to other ecologies. At the farm base, labour availability and family development are key factors, at least partly explaining socio-economic status as a further key variable. These issues will not be described in detail, except for a comment on the differential impact of provincial land use policies. National policies towards restrictions on the use of forest land and resettlement seem to be implemented with considerable variation from province to province in the Lao PDR. Where implementation has been strict, such policies artificially limit the resource systems available to communities and individual families, effectively removing one or more elements in the resource system.

The Livelihood System Mix in Upland Agriculture

What does this framework mean in terms of the existing systems of upland agriculture in the Lao PDR? Figure 2 attempts to illustrate that in the

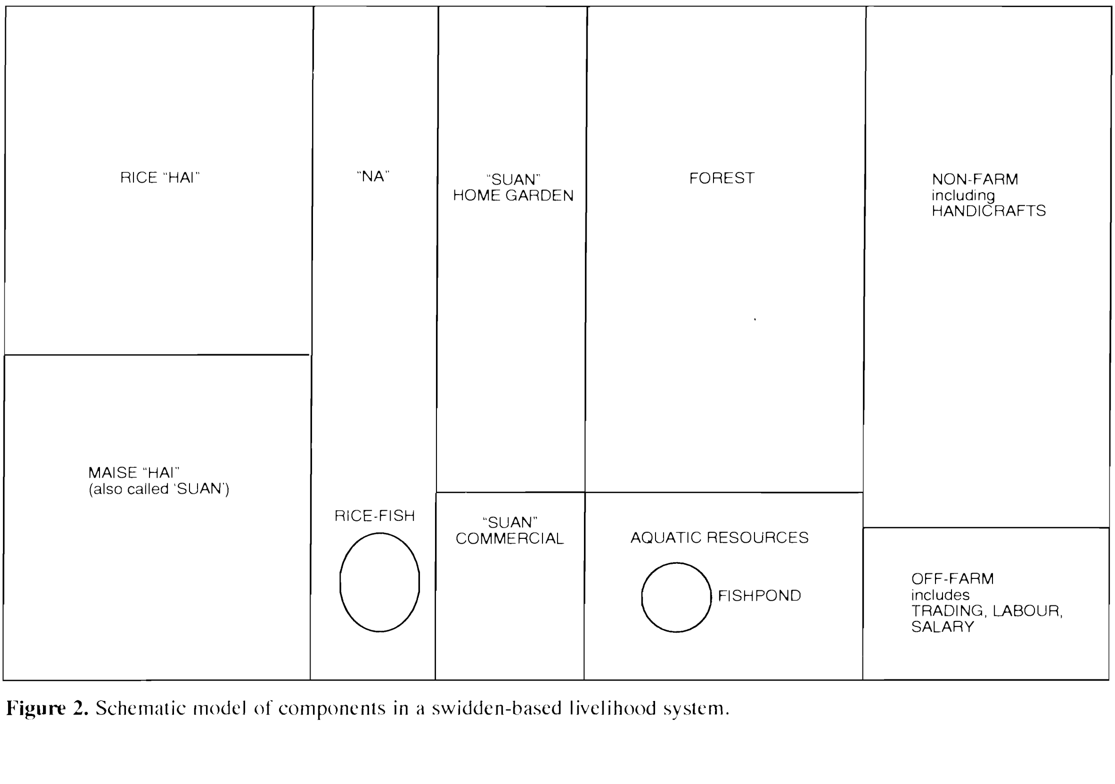

Figure 2. Schematic model of components in a swidden-based livelihood system.

upland areas, at least in northeastern Laos, swidden livelihood systems may be composed of a variety of enterprises, the presence or absence of which depends on the complex of factors discussed above. The model in the illustration mixes land and non-land resources, and a conspicuous deficiency is the absence of livestock. This, it is assumed, depends on the availability of land resources to supply fodder for grazing or from crop wastes (and on market access). These may be derived from several of the other sub-systems, especially the 'hai', the 'na' or paddy field and the forest. Mr Parisak (these Proceedings) elaborates on the relative contribution to livelihood of these enterprise systems in the various parts of northern Laos. Suffice it to say that the Figure does reflect that the upland systems are much more complex than most people had assumed and intervention which changes or removes one part of the system has important implications for the whole.

Search for the Appropriate Technology

The recognition of the different recommendation domains is only the first step in the farming systems approach to agricultural development. On the basis of analysis of the situation of the different systems, prospective development interventions have to be assessed. In the case of a specific component sub-system, such as livestock or aquaculture, as has been seen, a possible outcome of such an assessment is that there is little or no development potential and sector specialists should be willing to accept this.

One indication of potentials is the prior existence of a particular enterprise and an important outcome of the farming systems research approach is that more attention is being paid to what farmers are already doing and what they already know. The importance of indigenous technical knowledge (ITK) as a starting point for agricultural development is now widely accepted, as is the fact that farmers are engaged in their own experimentation and are making changes to their systems in response to changing circumstances. Arguably, careful monitoring of these adjustments by researchers may be equated with the implementation of on-farm trials for technology testing and verification and possibly more practical where the proof of the technology may take several years.

In recent years, the term 'indigenous technical knowledge' has been criticised as placing too much emphasis on the technical aspects of agriculture. It is now being replaced by a more neutral 'rural people's knowledge' which serves to draw greater attention to the fact that adaptations to the fragile environments in CDR systems were never purely technical, but also managerial. Thus, alongside strategic choices of crop variety and planting times, communities in fragile resource areas also developed safety net mechanisms in their social structures (labour exchange networks, flexible access to land rights, flexible debt repayment mechanisms). These mechanisms extended to strict regulations on the use of open access or common property resources. In swidden cultivation, this traditionally involved a great deal of flexibility in allocation of land according to available labour resources in any particular year, even to the extent of allowing other communities with greater needs to work village land. Specialists in technology assessment have highlighted this in their subdivision of the components of a technology into hardware (the tangible technology itself) and software (subdivided into three components of humanware, orgaware and infoware). They argue that these components need to be in balance for the successful adoption of a technical innovation.

Esther Boserup in her classic thesis, The Conditions of Agricultural Growth (1965), argued that traditional agricultural communities were able to respond to conditions of growing population density by making adjustments to their systems. This could take place in a variety of ways: exogenous responses such as expansion of cultivated area and migration; or endogenous responses through improvements in technology and management. From the evidence of Mr Parisak's study, both types of adjustments appear to be underway in the shifting cultivation systems of northern Laos. New enterprises are being added to the systems as suggested above, but at the same time endogenous adjustments are taking place which are moving from an extensive, non-regulated type of system to more controlled movement of land use managed by local (village and commune) authorities. In doing so, they may be offering important opportunities for such enterprises as livestock rearing and aquaculture.

An important advantage of careful assessment of these adjustments is that system improvement is likely to be easier if it involves only limited changes from what is already happening. Studies of adoption of innovation have stressed the importance of this characteristic in successful innovations, as well as the importance of interpersonal relationships in their diffusion. This has been at the heart of the argument that technologies which are appropriate in the sense of having been proved to fit into a farmer's system can be disseminated rapidly from farmer to farmer without heavy extension inputs. The AIT Aquaculture Outreach experience appears to be supporting this view[4].

The major question in relation to these indigenous adjustments in the system, however, is their sustainability. Jodha (1991) has spoken of adjustments in upland agriculture in the Himalaya, which are actually hiding a steady downward spiral in system sustainability, mining resources in the short-term with potentially disastrous consequences in the medium. He has termed them 'hidden' adjustments because they are not immediately obvious to the casual visitor; careful research is required to identify them and their consequences. It may be in this context that external technical assistance can make the biggest contribution to improving the productivity of the systems already being followed.

Implementation of the Approach

Farming systems research approaches are frequently criticised as impractical, because they involve such painstaking research at both the situation analysis and on-farm testing stages of the process. Much, however, depends on the methodologies used. The system analysis does require initial intensive research, but once key indicators to distinguish the different systems and the key factors in their operation have been identified, it should be possible to classify the broader context and reduce the burden of specific information collection. It must be understood also that any pilot interventions should be clearly set in the specific recommendations domains or 'type contexts', so that these become a potential model for similar areas and communities. In using the term 'model' in this context, it is important to understand that it is used not in the sense of 'ideal', (Thai-Lao : *sombuun baep*), but rather in the sense of 'example' (*tua yang*) which can be replicated in other areas if successful.[5]

An important dimension of this replication is that it can be done without the assistance of a foreign aid project, by the Lao authorities themselves. It is important to bear this in mind right from the start of the implementation of the approach, but is encouragingly something that is well understood in the Lao PDR. In the AOP, the initial attempt to establish a project with a separate field research team, much as had been used in Thailand, was roundly rejected by the Department of Livestock and Fisheries for an approach in which personnel worked in close association with the Provincial Livestock Section. This has proved extremely beneficial in identifying what is indeed possible in the farming systems approach and where capacity needs to be developed. It has also served to confirm some earlier views that a good deal of understanding of the local situation does exist at the local level (but usually in unwritten form, which needs to be formalised)[6] which can be the basis of both recognition of systems and the development trends within them. As the initial portfolio of Rapid Rural Appraisal made clear[7], ITK/RPK is not confined to farmers, but then many local 'officials' are also farmers.

Challenges

The issue to be faced in advocating an expanded farming systems or livelihood systems approach to the sustainable development of upland areas in Laos is to develop the appropriate methodological tools for analysis, both of the existing situation and of the sustainability of the technical and managerial adjustments being made in the upland systems by local communities in the face of new pressures. Hopefully, both AOP and Mr Parisak's studies are leading researchers in this direction.

Such tools have to be usable by provincial and district staff of the Ministry of Agriculture and Forestry and not only of the Department of Livestock and Fisheries. If this is to be the case, of course there needs to be solid conceptual understanding of the need for a systems approach to the problem of upland development throughout the Ministry, persuading people that this is not overturning the training of a lifetime, but contributing to improving the focus of that training. This is a task which will require training at all levels from policy makers to field workers and in a variety of modes for different groups according to their situation. The author believes that there is the will in the Lao PDR to take on this challenge.

[4] Innovation studies also suggest that complex innovations requiring group decision may be much less acceptable than simple innovations aimed at individuals. In that changes in management of shifting cultivation require group decisions, it may be more difficult to accept these and diffuse them to other communities. Of course, this depends on the integrity of the community in question.

[5] The writer is grateful to Mr Ted Chapman for pointing out the confusion sometimes created by the use of the term 'model'.

[6] The writer is grateful to Mr Nick Innes-Taylor, AOP Program Manager in the Lao PDR, for this observation.

[7] One of the problems that has emerged in the use of non-formal survey methods is that too much emphasis has been placed on the knowledge of one particular group, the farmers.

References

Boserup, E. 1965. The conditions of agricultural growth: the economics of agricultural change under population pressure. Allen and Unwin, London.

Byerlee, D. 1987. From adaptive research to farmer recommendations and extension Advice. Agricultural Administration and Development, 27, 231–244.

Chambers, R. and Jiggins, J. 1987a. Agricultural research for resource-poor farmers. Part I: Transfer-of-technology and farming systems research. Agricultural Administration and Extension, 27, 35–52.

Chambers, R. and Jiggins, J. 1987b. Agricultural research for resource-poor farmers. Part II: A parsimonious paradigm. Agricultural Administration and Extension, 27, 109–128.

Chambers, R., Pacey, A. and Thrupp, L-A. (eds). 1989. Farmer First: Farmer Innovation and Agricultura Research. Intermediate Technology Publications, London.

Conway, G.R. 1985. Agroecosystem analysis. Agricultural Administration 20, 31–55.

Jodha, N.S. 1991. Sustainable agriculture in fragile resource zones: technological Imperatives. Economic and Political Weekly (Quarterly Review of Agriculture), 26, 13.

Khon Kaen University. 1987. Proceedings of the 1985 International Conference on Rapid Rural Appraisal. Faculty of Agriculture, 2–5 September 1985, Khon Kaen.

Lightfoot, C., Prabhu Pingali and Harrington, L. 1993. Beyond romance and rhetoric: sustainable agriculture and farming systems research. Agricultural Administration (Research and Extension) Network, July 1993, 27–31. Overseas Development Institute, London.

Shifting Cultivation Development in Northern Laos

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Abstract

The Government of Lao PDR aims at a rapid reduction in shifting cultivation through land allocation, the promotion of permanent types of land-use, and through socioeconomic development. This policy may be justifiable considering the social, environmental and production problems associated with shifting cultivation in most of the country. However, the development efforts are constrained by the mountainous topography, the undeveloped infrastructure, the limited market demands and processing facilities, the poverty of most shifting cultivators and by the lack of a suitable extension system. Many technical recommendations are not suited or adequately modified to the highly heterogeneous environment, socioeconomic conditions and land-use potentials in the shifting cultivation areas. Development plans and their execution will therefore need to be flexible and diversified, and will often require further testing and analysis, preferably involving farmers and local extension staff. The success of these efforts will also depend on social progress, especially in improved education, slower population growth and opportunities for non-agricultural occupation.

THE TOPIC of this conference is the role of livestock in upland farming systems in Laos. This theme necessarily is closely related to the Lao authorities' aim to stabilise shifting cultivation, which is the main upland farming system in Laos. The development strategy contains seven components: apart from the improvement and expansion of the livestock sector, these are land allocation, promotion of permanent cultivation, expansion of paddy production, tree planting, infrastructure improvement and social development. This paper will assess the potentials of and constraints on these strategy components for shifting cultivation development in Lao PDR.

Shifting Cultivation in Laos

Shifting cultivation is the dominant cropping system in the uplands and mountains of Lao PDR. As many as 300 000 families are fully or partially engaged in shifting cultivation, equal to about 1.8 million people or 40% of the population. Assuming that each family plants about 1.5 hectares per year, the shifting cultivation area used annually would be around 450 000 hectares. The total area in the shifting cultivation cycle is difficult to assess, but may be 2–2.5 million hectares, equal to about 10% of the area of Laos.

The Northern Region includes seven provinces,[2] which account for 41% of the area and 33% of the population in Lao PDR. It is a predominantly mountainous region with only small areas of flood plains and larger river valleys. Permanent upland cropping and paddy farming are therefore secondary to shifting cultivation and about 65% of the shifting cultivators in Laos live in the North (Suvanthong 1995). Upland rice constitutes 65% of the total rice area in the north, compared to a national average of 31% (NSC 1997a). The prevalence of shifting cultivation has greatly contributed to the reduction of the current forest area,[3] which is only about 36% in

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[2] The seven provinces are Phongsali, Luang Namtha, Bokeo, Udomxai, Luang Prabang, Houaphan and Xaignabouri. The two other regions in Laos are called the Central and the Southern Regions. Note that official statistics usually include Xieng Khuang Province in the Central Region.

[3] Current forest is defined as areas suitable for forest production and having a tree cover with a crown density of at least 20%.

the North compared to 52% and 58% in the central and southern regions, respectively (NOFIP 1992).

Improving agricultural production is particularly difficult in the North because of the hilly topography, the often steep slopes, the small potential for paddy cultivation, and the limited infrastructure and market access.

The population of Laos consists of 66 officially recognised ethnic groups, many of which contain several subgroups (Chazee 1995). Laos' many ethnic groups are often divided into three main ethnic categories: Lao Loum (lowlanders), Lao Theung (midlanders) and Lao Soung (highlanders). The Lao Loum consists of the Lao or Tai speaking, mostly Buddhist groups and accounts for about 60% of the population (NSC 1997b). Although most Lao Loum farmers are engaged in paddy farming, a large proportion practices shifting cultivation. The Lao Theung and Lao Soung groups make up 30% and 10% of the population, respectively (NSC 1997b). In general, they are more dependent on shifting cultivation than the Lao Loum groups, but the land-use is very diverse and ethnic stereotypes often prove misleading (Roder et al. 1991; Hansen 1995).

Most shifting cultivators remain subsistence producers of upland rice, but commercial production of other crops is expanding in areas with adequate infrastructure and market access. In most places, the fallow periods have become critically short during the past 20–30 years; the main causes being population increase, government restrictions, and competing land-use objectives, as well as the concentration of people around urban centres and in areas with road and river access. This pressure on land has led to soil degradation, the proliferation of weeds and pests, lower yields and a greater demand for weeding. Many shifting cultivators are therefore experiencing increasing poverty and uncertain prospects, and are among the most disadvantaged groups in Laos. Few farmers would opt for shifting cultivation if alternatives were available, and, where this is the case, farmers have readily modified their land use.

Today, shifting cultivation in Laos is largely based on the cyclical use of young secondary vegetation, although limited encroachment in older forest still takes place in isolated areas. However, over the years, shifting cultivation has considerably reduced the forest area to the detriment of timber resources and natural habitats. Where shifting cultivation is intense, accelerated erosion and changes in the water discharge may impair water resources for irrigation, hydropower and domestic use.

Because of these environmental and socio-economic problems, the stabilisation of shifting cultivation is a major priority of the Lao Government. The development strategy (DoF 1997) includes:

- land-use planning and land allocation;
- promotion of permanent cash cropping;
- expansion of the paddy area;
- expansion of livestock production;
- tree planting by farmers;
- infrastructure development; and
- socio-economic development work.

This report discusses the possible role of these strategy components in stabilising shifting cultivation in Lao PDR. Some main potentials, constraints and recommendations are summarised in Table 1. Much of the analysis is based on findings of the Shifting Cultivation Research Project in Luang Prabang during 1991–1997 (Sodarak et al., these Proceedings).

Land-use Planning and Land Allocation

Land tenure in shifting cultivation areas of Laos is traditionally acquired by bringing unclaimed land under cultivation. Until recently, land was abundant and therefore rarely a limited resource that required extra-local control. The authorities, moreover, had little interest (or capability) in regulating farmers' access to land. With increasing population pressure and competing land-use objectives — especially forestry, irrigation and hydropower generation — the authorities have decided to regulate the acquisition of land. This is done through village-based land allocation schemes that entail:

- demarcation of village territories;
- demarcation of forest areas for conservation, watershed protection and production;
- allocation of agricultural land to individual households.

Although the authorities would ideally like to promote permanent land-use, it is realised that shifting cultivation currently is the only realistic option for many farmers. Cyclical shifting cultivation with up to three years' fallow is therefore promoted in many areas, especially in the North.

The land allocation procedures and regulations vary between provinces and between projects, but shifting cultivators are usually allocated up to four plots of land. The plot sizes depend on how much land the household can manage with its available labour resources and production form. In practice, one to two hectares are allocated for annual use per family, or about four to eight hectares for a four-year rotation.

Where population densities are high, land allocation has not necessarily shortened the field rotations, which are already down to 3–5 years. In such areas, farmers have often been positive towards land allocation, as it helps solve land disputes within

Table 1. Potentials and constraints on main development components in shifting cultivation areas of Laos.

Development initiative	Potentials and benefits	Constraints and problems	Recommendations and remarks
Land allocation.	Secure tenure and resolution of land disputes. Control of forest encroachment. Control of land grabbing. May increase farmers' interest in soil conservation and land development.	Severe limitation on land access, which leads to lower productivity and sustainability. Requires quick adaptation of new technologies. Land allocation is time consuming and needs regular monitoring and revisions. Legal and administrative regulations not yet fully developed.	Use flexible criteria based on local conditions. Technologies must be developed that can ensure reasonable productivity and sustainability under short fallow rotations. Extension and other support should be given concurrently with land allocation.
Permanent (cash) cropping.	Higher farm incomes. Basis for industrial processing and for export income. Smaller imports from abroad. Better possibilities of crop diversification crop rotation and labour utilisation. Less pressure on the forest.	Quality seed, suitable varieties, information and extension recommendations greatly lacking. Limited access to markets and processing. Need of alternative source of rice at reasonable price. Lack of capital to invest. Increased erosion problems. Greater demand for commercial fertilisers and pesticides. Environmental and health risks from pesticide use. Greater risks and more unstable income levels.	Adaptive research to screen and modify technologies to suit local conditions. Test and promote appropriate soil conservation and fertility management measures. Credit and extension to facilitate adoption of appropriate technology. Further liberalisation of internal and external trading.
Paddy production.	Higher and more sustainable rice production. Work load less than upland rice production. Encourages stable settlements. Paddy fields are an economic resource and possible collateral.	Expensive and time consuming to develop irrigation facilities and terraced fields. Lack of suitable land, especially in the North. Paddy and irrigation potentials are usually over-estimated. Threat to the limited areas of remaining wetlands and swamp forest.	Encourage gradual farmer-lead expansion through credit, extension, legislation and community development. Improve the planning and designs of irrigation schemes. Realistic goals must be made depending on local conditions. Develop and promote alternative dry season crops.
Livestock raising.	Increased farm incomes. Relatively stable prices and independence of infrastructure. Basis for processing and export income. Use of natural pasture, open forest and waste products. Manure produced for crop production. Integration with conservation farming.	Low area productivity, slow growth, and high morbidity and mortality rates. High investment and slow return rates on large ruminants. Encroachment in arable fields causes crop loss and conflicts, and limits farmers' interest in non-traditional cropping systems. Negative environmental impact through burning of natural vegetation, over-grazing, large area demands, and risk of interbreeding and disease transmission to wild animals.	Expand vaccination and other veterinary services. Provide credit to farmers with realistic opportunities of repayment. Assist communities in developing regulations on the livestock production. Develop and promote improved feed production systems. Make pasture grass and legume seed more readably available. Conduct further studies on the causes of the high mortality. Conduct further studies on local and supposedly improved management practices.

Table 1. Continued. Potentials and constraints on main development components in shifting cultivation areas of Laos.

Tree plantations.	Higher farm incomes with less work. Basis for processing and export income. May utilise steep land unsuitable for agriculture (but usually does not!).	Plantations occupy agricultural land. Returns often too late for farmers. Farmers sell use-rights to investors. Normally requires road access to nearby processing facilities. Lack of improved and locally tested provenances. Inadequate management applied in plantations and orchard.	Identify additional plantation species. Local testing of provenances. Establish seed production and distribution facilities. Clarify regulations on land tenure and transfer of land. Develop improved agro-silvo-pastoral systems. Develop and promote management recommendations.
Infrastructure development.	Facilitates commercial land-use, improved government services and general economic development.	May cause disruptive social and economic change. Concentration of people along roads may increase land conflicts, land grabbing and local population pressure. Excessive erosion and land slides along the roads. Opens forests for exploitation. Very high costs for construction and maintenance. Rural roads are often ill designed or constructed.	More budget allocation for maintenance, and development of local capacity to construct and maintain rural roads. Land allocation and environmental protection schemes implemented concurrently with the road construction to protect the forest areas and regulate land grabbing.
Improved education, health service and other social development.	Improved living standard. Decreased rate of population growth. Facilitates alternative occupation of farmers.	Quality and extent of public services very low in rural areas. Most public resources are spent in cities. Low expectation to the performance of staff. Little motivation and prospects for staff in remote areas. Conditions particularly difficult for female staff. Girls receive less education than boys.	Higher priority to development in upland areas and remote districts. Human resource development for district staff. Better incentives for staff to work in remote areas (allowances, long holidays, travel costs). More emphasis on public awareness and community development. Increased gender sensitivity in public administration.

and between villages. However, where long rotation periods are still in use, land allocation reduces farmers' land access and is therefore less likely to be adopted and adhered to.

A four-year rotation is probably unsustainable in most areas, unless farmers rapidly adopt conservation measures, crop rotation, fertilisers, improved fallows or other techniques that can replace the positive effects of long fallow periods. Technology development, testing and extension are consequently needed, concurrent with land allocation.

Local conditions will determine the possibilities of both short-rotation cyclical shifting cultivation and permanent cultivation. The main factors are probably:

- soil fertility;
- slope conditions;
- the rate of forest regeneration;
- the crops being produced;
- market access; and
- the possibilities of mechanisation and soil tillage.

Because these conditions vary from one place to another, it may be argued that field rotations longer than four years should be permitted in some areas. This may include areas of low soil fertility, high erosion potentials, or areas with high reliance on subsistence upland rice production.

A flexible approach can also be recommended for the type of land allocated for agricultural purposes. In 1992, the Ministry of Agriculture and Forestry decreed that agricultural land, including land for shifting cultivation, should have slopes of less than 23%, should be more than 300 metres from water courses, and more than 100 metres from roads. However, implementation of these regulations proved impossible in many places because of the lack of gently sloping land and because the best agricultural land often lies adjacent to roads and watercourses (Sipadit et al. 1997). Thus, while criteria for classification of agricultural land are needed, they should take the local conditions into account.

Permanent Upland Cropping

Replacement of shifting cultivation by permanent field cropping is promoted through extension and land allocation schemes. Cash cropping has expanded rapidly in places with access to roads, markets and processing facilities. In such areas, the transition from shifting to permanent cultivation is often eased by the already degraded state of the shifting cultivation system. Thus, low yields and high labour requirements cannot justify the extra labour and taxation associated with field rotation. Permanent cultivation of cash crops, such as maize, soybean, cotton, and cassava, is likely to increase due to improved market access and infrastructure, the ongoing economic liberalisation and the increased use of tractor ploughing, pesticides and fertilisers.

Under suitable conditions, permanent cash cropping may be advantageous to farmers as they can expect higher incomes, better use of their labour resources, and better possibilities of crop diversification and crop rotation. Permanent cash cropping may also reduce the pressure on the forest, be the basis for a processing industry, provide export income, and limit the import of agricultural products from abroad.

Permanent upland cropping usually means the full or partial replacement of upland rice with cash crops since upland rice yields usually drop sharply when the same land is cropped for more than one or two years. The promotion of cash cropping is therefore also seen as a means to reduce shifting cultivation. However, cash cropping is realistic only in areas with reasonable road and market access. In much of the country, farmers are therefore compelled to practice shifting cultivation to obtain a reasonable subsistence rice production.

The prospects of permanent field cropping are also limited by high erosion risks, low inherent fertility, low productivity, and by weed problems. While traditional shifting cultivation could limit such problems through the positive effects of the fallow periods, other measures must be taken under permanent cultivation. Such methods may include crop rotation, the use of fertilisers and pesticides, soil tillage, and soil conservation methods. Regrettably, adoption is constrained by the need for extra labour and capital, by the lack of awareness, and by the unsuitability of many technologies promoted by projects. Some measures may also have negative consequences, such as pesticide pollution and increased erosion from intense soil tillage.

Unless appropriate soil conservation methods are adopted, permanent cultivation of sloping land will cause more erosion than shifting cultivation. Slope criteria should therefore be stricter on permanently farmed land. If gently sloping land is not available, shifting cultivation or improved fallow systems are probably the best form of arable cropping.

Poverty restricts farmers' opportunities to adopt cash cropping because they lack investment capital and are unable to wait for long-term returns. New technology also contains an element of risk, which particularly poorer farmers are not prepared to take. Richer farmers are thus better able to adopt new technologies and to take advantage of the emerging market opportunities. Increasing polarisation consequently takes place in many rural communities, with growing gaps in income levels, social standing, and influence.

Paddy Farming

Paddy farming in Laos prevails on the plains along the Mekong River and its main tributaries, particularly in the central and southern parts of the country. The North accounts for only 18% of the national paddy area (NSC 1997a), since land suitable for paddy cultivation is scarce in the largely mountainous region. With the increasing pressure on shifting cultivation, more farmers attempt to acquire paddies, as these usually give higher and more sustainable yields with less work expended. Paddy fields are, moreover, an economic resource and potential collateral. As an alternative to shifting cultivation, paddy farming causes less forest destruction and encourages stable settlements.

The promotion and adoption of paddy farming in shifting cultivation areas is, however, constrained by the scarcity of suitable land, and by the high investment of capital and labour for constructing paddies and irrigation facilities. Furthermore, considerable time often lapses from the initial planning to the completion of paddy and irrigation systems, in many cases around 10 years. Long-term credit schemes may be useful by enabling farmers to devote time to constructing paddies and irrigation canals.

Another concern is the frequent overestimation of the potential paddy and irrigated areas. The reason seems mostly to be the lack of proper ground checking, and may be also the desire to conform to the authorities' ambitious development strategies. Consequently, local development plans and strategies are often unrealistic, and many paddy and irrigation schemes turn out to be very expensive per hectare because plans could be only partly implemented. Sometimes irrigation schemes aimed at providing alternatives to shifting cultivation merely improve the water supply to existing paddy fields, while few or no new paddy fields are constructed. Improved planning, evaluation criteria and staff training are thus needed in many places.

Paddy production is generally preferable to shifting cultivation from an environmental protection point of view, but an important exception may be paddy development in threatened lowland environments, such as swamp forest and wet lands. Large-scale irrigation schemes may also affect fish migration, although larger rivers are rarely dammed.

Cultural bias and lack of knowledge are often stated as important constraints on shifting cultivators' adoption of paddy farming. However, such constraints seem far less important than those mentioned above, and there are many examples in Laos of unaided adoption of paddy farming once people have the resources and motivation to do so.

Paddy production may be improved through irrigation facilities, by introducing dry season pulses or cover crops, using improved rice varieties, and by intensifying the pest, weed and fertility management. Such technologies are usually simple to introduce, but may need local testing.

Animal Husbandry

Animal raising is important in the upland farming system for food, income, saving, transport, ritual use, and for utilisation of waste products and fallow vegetation. In many shifting cultivation communities animals provide the income needed to cover rice deficiency and the purchase of market goods. An advantage of animal raising is its relative independence of road access, which makes livestock production one of the few alternatives to shifting cultivation in remote areas. Another advantage is that farmers can choose to sell animals when cash is needed and the price is satisfactory. This partly explains the relatively high price stability compared with many cash crops. Fodder production can also be incorporated in the crop rotations, hedgerows, ley farming, and plantations, which can make such undertakings more realistic to farmers (Hansen 1997, these Proceedings).

The livestock sector offers good opportunities to help farmers, particularly through vaccination, veterinary services, advice on improved management, and through credit schemes. Such activities have already been tested in many places and are cheap to implement. The main problems in animal raising in the upland farming systems are high mortality, low productivity due to disease and low fodder quality, and the high initial investment for purchase of large animals.

Disease problems often occur in epidemics, which may wipe out most, and sometimes all, pigs and chickens in a village. Cattle and buffalo disease outbreaks are usually less severe, but the economic loss can be substantial due to these animals' higher value. Promotion of livestock production should be accompanied by veterinary regulations and services, including vaccination. Promotion of vaccination is, however, constrained by difficulties in maintaining the cold chain, insufficient organisation in the villages, and by the death of animals from other causes, which makes farmers believe vaccination is ineffective. Prevention and treatment of diseases are also constrained by the lack of qualified field-based veterinarians. More training is needed of field-based staff and village volunteers in diagnosing and treating diseases.

Low fodder quality severely limits the growth rates of animals in most shifting cultivation communities. Ruminant production is usually based on the free-ranging of animals in young secondary vegetation, such as bush and grasslands. Similarly, pigs are normally raised in a free-range system, supplemented by rice bran, other household waste products and some wild tubers. Larger pig producers are mainly owners of rice mills, or communities with a tradition for double cropping of maize and opium poppy.

While improved fodder production systems and suitable crops have already been identified in Laos, their adoption by farmers is limited by the need of additional land and labour. This is aggravated by the hilly topography in most shifting cultivation areas that makes even simple mechanisation impossible. Furthermore, if livestock production is promoted as an alternative to shifting cultivation (i.e., not merely as a supplement) each family would need larger areas to get the same income as from shifting cultivation. Another constraint may be the need for farmers to revise their approach to livestock production, which has traditionally been based on a low input-low output system.

Where ruminant production is based on open forest and young secondary vegetation, farmers will almost invariably burn the grazing areas to encourage grass production and thereby damage forest regeneration and humus accumulation. Large-scale cattle production may also cause severe overgrazing, especially near water sources, villages, and other places where animals congregate.

A major cause of conflict in villages is the encroachment of animals in the fields. Some villages have introduced regulations or banned livestock ranging. Such problems will increase if stocks are increased and if innovative plant production systems are adopted, e.g., improved fallows, cover cropping, edible hedgerows, tree plantations and orchards.

Tree Plantations[4]

Establishing private tree plantations is a relatively new possibility for farmers in Laos, but has expanded rapidly in many places during the past 3–5 years. This has been facilitated by changes in tenure laws, the depletion of wood supply from the natural forest and the emergence of markets for relatively young trees, such as teak (*Tectona grandis*), *Eucalyptus* spp. and *Acacia* spp.

In Central and Southern Laos, the establishment of pulp and board factories has prompted many farmers to plant industrial tree species such as eucalyptus and acacias. These trees sell at a low price, but the rotation periods are short and the labour requirements are small, especially where mechanisation is possible. However, the lack of processing facilities in the North limits the planting of such species.

In the shifting cultivation areas of Northern Laos, the main plantation species is teak, because it is relatively easy to manage and propagate, grows fast in the early years, and is tolerant to fire. The potential income and economic spin-offs from teak planting are high, particularly compared with current land use. Further expansion of teak is eased by the large areas of degraded forest and by favourable laws and policies. Improvements in the road system will further expand the potential for teak planting.

Teak is usually established in taungya systems, i.e., inter-planted with agricultural crops during the first one to three years. This normally ensures adequate weeding and protection of the teak in the early years. Few farmers would have sufficient labour resources to do this if crops and teak were planted in separate areas.

Until recently, the government strategy has been to promote as much tree planting as possible, but various problems and constraints have become apparent. Thus, the rapid expansion of teak planting during the past five years is to a large extent related to the possibility of selling the 1–3 year-old teak plantations to investors. Consequently, almost all plantations are established along roads, as investors are almost exclusively interested in such land. While selling their plantations can give farmers a high and quick return on their investment, they may eventually lose access to land, especially when land allocation schemes have been introduced.

Another problem is farmers' preference of the flatter land for their plantations, which therefore compete with crop production for the scarce flat lands and push arable farming up on the steeper slopes. However, the use of flat land for tree plantations may result in faster growth of trees and may ease mechanised weeding and harvesting in commercial plantations

When inter-planting with agricultural crops ends after 1–3 years, little management is applied except the slashing of taller weeds and, sometimes, controlled burning early in the dry season. Regrettably, few farmers prune low branches or forked trees, the latter sometimes occurring in more than 50% of the plants. Furthermore, thinning usually takes place too late, often when the trees are 10 to 15 years old. The lack of sufficient management is a major constraint on the growth and quality of trees. There is therefore much scope for improving production through timely weeding, thinning, pruning and fire control, as well as improved propagation methods and the selection of seed sources. However, farmers' incentives to improve the management are low if they intend to sell their plantations.

The expansion of teak planting has led to concerns that teak mono-cropping may lead to devastating pest attacks, especially of bee-hole borers and caterpillars. Furthermore, teak offers little soil protection, and sheet, rill and gully erosion are often seen in older plantations.[5] Casual observations in 15–20 year-old plantations also suggest that little accumulation of organic matter takes place.

Fruit Production

Apart from coffee, which has become an important export crop in the South, fruit production is mostly aimed at subsistence use, and receives little management attention. The limited commercial fruit production is concentrated on the Boloven Plateau and in Vientiane. Attempts have been made by many projects to introduce commercial fruit production in shifting cultivation areas, but adoption rates have generally been low.

Slow returns and the uncertain market are probably the main constraints. The marketing problems are caused by the limited road access and processing facilities, and by the small quantities currently produced, which makes trading and processing uneconomical. Also, most fruit trees are local varieties that often have little commercial value. Further introduction of improved fruit tree varieties is needed, along with local testing in representative agro-ecological pilot areas. The seasonal peak production combined with the lack of processing plants further depresses prices. Finally, staff and farmers lack management skills and extension recommendations.

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[4] This section has largely been taken from Hansen et al. (1997).

[5] This has also been remarked upon by Hedegart (1995) and White (1991).

However, fruit orchards could provide a high area productivity, high degree of sustainability and could generate a reasonable income for the producer. Opportunities to expand commercial fruit production in Laos seem good considering the large fruit import from Thailand and China, and the likely increase in fruit consumption that follows growing urban prosperity. The relatively low income potential of shifting cultivation and the low labour costs will also encourage some farmers to adopt or expand fruit production. Highly variable agro-ecological conditions in shifting cultivation areas may also open up for a varied and seasonally staggered production.

Infrastructure Development

Most villages in the uplands and highlands of Laos lack roads and have limited access to markets, which greatly limits the land-use options available to farmers. Thus, further infrastructure development is a prerequisite for most of the development initiatives discussed. Road development usually leads to considerable land-use changes, independent of other interventions. Improved market access has probably been the most important single cause of the astounding change in the highlands in Northern Thailand during the past 20 years. Establishment of roads also improves access to public services in education, health care and agricultural extension.

Because of these advantages, settlements often concentrate along roads, which may lead to more land disputes, land grabbing, and agricultural expansion on unsuitable land. Road construction is also frequently followed by uncontrolled logging and by forest encroachment by farmers. Land allocation and land-use planning schemes should therefore be carried out concurrently with road construction to protect the forest areas and regulate the acquisition of agricultural land.

A basic constraint on road development is the high construction and maintenance costs. Moreover, roads are often ill designed, which leads to rapid deterioration, excessive erosion, land slides, and to pollution of nearby watercourses. It is also sometimes stated that roads may help control logging, opium production and migration, but usually roads have the opposite effect.

Because of the significant impact of roads, the development strategy should distinguish between areas with and without road access and modify development efforts accordingly. For instance, where road construction is unattainable, traditional or improved shifting cultivation may be preferable, at least until alternative production systems have proven viable.

Social Development

Although Laos is still relatively thinly inhabited, the population density is already critical in most uplands since shifting cultivation requires large areas for field rotation and little land is suitable for arable cropping. With the current annual population growth of 2.5–3%, most shifting cultivation communities will soon need to adopt new production systems, non-agricultural employment and family planning measures. Thus, better health and education facilities are needed, but such services are constrained by inadequate budget allocations, limited staff motivation and career prospects, and by inadequate training and facilities. Nevertheless, social development efforts may well have a bigger impact on shifting cultivation stabilisation than that of agricultural and forestry development.

Conclusion

Shifting cultivators in Northern Laos are under pressure to modify their land use because of population growth, declining natural resources, and government regulations on land access. In areas with good road and market access, many changes have taken place in the past 5 to 10 years, e.g., adoption of new cash crops, establishment of farmer owned teak plantations, and increased livestock production. These changes have been possible through infrastructure development, economic liberalisation, and the general economic progress.

However, in most of the Northern Region, a rapid transformation of shifting cultivation seems unrealistic considering its scale, the poverty of most shifting cultivators, the mountainous topography, the current institutional capacity, and the undeveloped market, infrastructure and processing industry.

Some technologies promoted by projects or by the regular extension system have proven technically inappropriate, socially unacceptable, dependent on road access, or suitable only on gentle slopes. Furthermore, some alternative land-use practices, especially permanent arable cropping, may be more prone to accelerated erosion and fertility decline than shifting cultivation. Shifting cultivation partially restores soil fertility during the fallow periods, and limits erosion through minimal tillage, maintenance of a favourable soil structure, and through the distribution of erosion over a larger area. From an environmental point of view, shifting cultivation may also be preferable to the types of cash cropping that use large amounts of pesticides.

Development strategies and activities need to be flexible and diversified to suit the very variable environments, socio-economic conditions and land-use in mountainous areas. On a regional level, the main factors determining potential land-use improvements are probably the agro-ecological conditions and road access. A diversified approach is also necessary at the individual village level because farmers' capabilities, resources and inclinations usually vary considerably between households. Moreover, further method development, staff training and institutional development are needed, especially at provincial and district level, where actual implementation will take place.

Although most development efforts have taken a technical approach, land-use problems are rarely purely technical, nor are technical problems necessarily farmers' main concern. Other problems equally or more important may be:

- resource access, especially land and capital;
- social problems and poverty;
- market access because of the lack of roads, processing facilities, and consumer demand;
- market organisation and inappropriate import and export regulations, monopolies, and subsidies;
- non-agricultural occupation;
- lack of public services, such as education, health service and public information;
- inappropriate or undeveloped laws and regulations.

Much of the solution to shifting cultivation stabilisation therefore lies outside the agricultural and forestry sectors. While the authorities expect farmers to adopt major changes in their production systems, it seems reasonable that shifting cultivators can rely on the government to provide adequate education, family planning and health facilities, along with a balanced economic policy that expands the manufacturing and service sectors.

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References

Chazee, L. 1995. Atlas des Ethnies et des Sous-Ethnies du Laos. Bangkok, private publishing, 220 p.

DoF (Department of Forestry) 1997. Plan to the year 2000 for stabilising shifting cultivation by providing permanent occupation. Paper presented at the Stakeholder Workshop on Shifting Cultivation Stabilisation, Vientiane, Laos, 6–7 February 1997. Ministry of Agriculture and Forestry and Asian Development Bank.

Hansen, P.K. 1995. Shifting Cultivation Adaptation and Environment in a Watershed Area of Northern Thailand. Communities in Northern Thailand. Ph.D. Dissertation, Department of Crop Husbandry, Royal Veterinary and Agricultural University, Copenhagen, Denmark, 280 + 140 p.

Hansen, P.K., Sodarak, H. and Savathvong, S. 1997. Teak production by shifting cultivators in Northern Laos. Paper presented at the ICRAF workshop Indigenous Strategies for Intensification of Shifting Cultivation in Southeast. Asia. Bogor, Indonesia, 23–27 June 1997, 13 p.

Hedegart, T. 1995. Teak Improvement Programs for Myanmar and Laos. FAO Regional Project Strengthening Re-afforestation Programmes in Asia (STRAP), Field Document No. 3. Food and Agricultural Organisation of the United Nations, 29 p.

NOFIP (National Office of Forest Inventory and Planning) 1992. Forest Cover and Land Use in Lao PDR. Final Report on the National Reconnaissance Survey. Department of Forestry, Ministry of Agriculture and Forestry, 71 p + appendices.

NSC (National Statistical Centre) 1997a. Basic Statistics about the Socio-economic Development in the Lao PDR. State Planning Committee, Vientiane, 129 p.

NSC (National Statistical Centre) 1997b. Results from the Population Census 1995. State Planning Committee, Vientiane, 94 p.

Roder, W., Leacock, W., Vienvonsith, N. and Phantanousy, B. 1991. Relationship between ethnic group and land use in Northern Laos. Poster presented at the International Workshop on Evaluation for Sustainable Land Management in the Developing World. Chiang Rai, Thailand 15–21 September 1991. IBSRAM, Bangkok.

Sipadit, V., Sodarak, H. and Hansen, P.K. 1997. Land Allocation in Shifting Cultivation Areas of Northern Laos: The Experience of the Shifting Cultivation Stabilisation Project 1992-97. Technical Report No. 3. Shifting Cultivation Research Sub-program, Department of Forestry, Luang Prabang, 18 p.

Suvanthong, P. 1995. Shifting Cultivation in Lao P.D.R.: An Overview of land Use and Policy Initiatives. IIED Forestry and Land Use Series No. 5. International Institute for Environment and Development, London, 38 p.

White, K.J. 1991. Teak — Some Aspects of Research and Development. RAPA Publication: 1991/17. FAO Regional Office for Asia and the Pacific, Bangkok, 70 p.

Cattle in Upland Farming Systems: Overview and Case Studies from Indonesia

Lesley Potter and Justin Lee[1]

Abstract

After initial discussion of cattle numbers in Indonesia and their distribution, both historic and modern, the role of cattle in upland farming systems is analysed, using case studies from Nusa Tenggara Timur (W. Timor and Sumba), South Kalimantan and Java. The case studies were selected to contrast the different levels of intensification to be found in the Indonesian archipelago and to emphasise the important cultural role of cattle at village level. While it is concluded that stall-feeding is becoming more common, there are not yet many small cattle owners who are making a reasonable living simply from involvement in the industry. Some conclusions also are drawn about the relative importance of *Imperata cylindrica*, *Chromolaena odorata* and leguminous trees in the cattle-raising equation.

IN THIS PAPER, an attempt is made to assess the role of cattle in some upland farming systems of Indonesia. Although the authors begin with swidden cultivators, upland farming is obviously not restricted to this group, especially in areas such as Java, where population pressure has brought considerable intensification. There is also the frequent combination of upland systems with lowland wet-rice production, which may involve cattle in land preparation.

Raising large animals in swidden systems has in fact traditionally been more for their significance as ritual or prestige, rather than for their economic or dietary importance. Spencer noted that 'the keeping of cattle . . . is not practiced to any extent by integral shifting cultivators themselves, but cattle keeping is often present within the range of territory utilised by shifting cultivators' (Spencer 1966).

Cattle in Indonesia: Historical and Modern Trends

According to recent figures (BPS 1994), there were 11.5 million head of cattle in Indonesia, of which 3.2 million were in East Java, more than a million each in Central Java and South Sulawesi and 750 000 in East Nusa Tenggara. In terms of cattle density per thousand of the human population, East Nusa Tenggara is the leader (229 per 1000), followed by Central and Southeast Sulawesi, South Sulawesi and Bali.

It is clear that cattle-keeping is especially important in the drier 'monsoonal' areas of eastern Indonesia, rather than in the equatorial forest lands. Dayak populations in Kalimantan, for example, have domesticated pigs and chickens and hunted forest-dwelling animals. They did not purposely create areas of grassland, which was more typical of Islamic groups, such as Melayu or Banjarese, permitted by their religion to hunt only deer (Dove 1984a). Wild ruminants such as deer and banteng were attracted to the grasslands (mainly *Imperata cylindrica*), especially after dry season burning encouraged tender new shoots. The grasslands also harboured tigers, which deterred free grazing of domesticated cattle in West Java, and in southern Sumatra up to the late 1930s (Groeneveldt 1936). Buffalo were more resistant to tiger attack.

In eastern Indonesia, with its longer dry season and areas of natural grassland, grazing traditions were more common. Buffalo and horses were the most typical large livestock, with buffalo having an important ceremonial role. In 1900, cattle-raising was confined largely to Hindu Bali, and to Madura and nearby areas of Eastern Java (Hoorn van Burgh

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1900). Balinese originally domesticated the wild banteng (*Bos javanicus* or *sondaicus*), the small red-brown 'Bali cattle', still the most common breed (Leake 1980; Wharton 1968). Also important is the larger white Ongole or Zebu type (Java cattle), originating in India but crossbred with Balinese strains. The modern cattle distributions, however, only date from the early years of this century, reflecting a long-standing Dutch policy of exporting animals from Java/Madura to build up stock in the Outer Islands. The Indonesian Government has continued this policy since independence, with the institution of cattle lending schemes, especially to transmigrants (Asikin 1984).

Cattle and Agriculture in NTT

East Nusa Tenggara (NTT) is one of the poorest and least developed of Indonesia's provinces. West Timor, with the highest cattle population (350 000 +), began to receive its herds only in 1912. They were given exclusively to the rulers or rajas, under what was known as a 'Sumba contract', that required payment for the original small herd of one bull and 10 or 12 cows by the eventual return of the progeny (Fox 1988).

Most of the grazing is still free range, the cattle being owned by the descendants of the rajas, but shepherded by the poorer people. Ormeling (1957) perceived shifting cultivation and cattle-raising in Timor to be in constant conflict. It was obviously necessary to separate the cattle from the farm areas, which meant the construction of strong wooden fences, needing much timber and labour time. Cattle were also believed to cause erosion, although some of the slumping which has occurred, especially in the soft Bobonaro clay, may be due to natural causes. The high mountains around Gunung Mutis contain the largest cattle numbers, with the animals being allowed to range through the nature reserve, producing park-like vegetation, with a sward of low grasses as understorey to the *Eucalyptus urophylla* forest.

Currently, there is government opposition to free-range grazing, with large areas of the upland being placed under the control of the Forestry Department for development as industrial forests (*Hutan Tanaman Industri*), using teak, mahogany and *Gmelina arborea*. This move has brought many complaints from villagers, who perceive their subsistence to be at risk, with declining areas available for food production.

The success story of cattle and intensification in NTT has been the area of Amarasi, on the southwest coast of Timor. In 1938, the local raja and his council ordered the separation of the cultivation area from the grazing area. Further land use zoning was implemented during the 1960s with all fences being eliminated (Metzner 1983).

In the cultivation area, *Leucaena leucocephala*, or 'lamtoro', a small leguminous tree, was sown to a high density (85% coverage) over all fallows (Jones 1983). While one third of the land was then planted to maize for subsistence, much of the remaining lamtoro was cut and fed to tethered Bali cattle, which would thrive on a lamtoro diet. The *Leucaena*, plus the cattle manure, improved the soil, and the micro-climate was also modified, making it possible to grow a variety of bananas and other fruit trees in what was previously an arid environment subject to periodic famine. Cattle could be brought from all over Timor for fattening, and almost all smallholder farmers were able to fatten one or two cows on their land. Despite the attacks on the lamtoro by a psyllid in 1986, the system is still functioning, though there was a severe initial drop in earnings from cattle. Elephant grass (*Pennesetum purpureum*) and king grass (*Pennesetum purpureum* × *P. typhoides*) seem to be the preferred alternatives for grazing.

Unfortunately, attempts to spread this system beyond Amarasi have had limited success. Other tree legumes, such as turi (*Sesbania grandiflora*) and *gamal* (*Gliricidia sepium*) are not as favoured by cattle and their dry season performance are poorer. The Sikka system, based on terraced hedges of lamtoro, was an alternative agroforestry system developed in Flores on steeply sloping volcanic soils, mainly designed for erosion control, but not as well suited to incorporating cattle (Metzner 1982).

One local NGO, Yayasan Geo Meno, has a version of that system adapted to local conditions in which farmers must institute erosion control and establish sufficient cattle feed, using whatever species they prefer, after which they are given a cow to fatten (personal field observations, 1996). One further use of cattle in Timor is on lowland rice paddies, where they run up and down the field and turn it into a mud puddle. Although this is an inefficient method of land preparation, NGO and government efforts to introduce the plough have generally failed.

Cattle in East Sumba

There are more than 200 000 head of white Ongole cattle on Sumba Island: in East Sumba they are mainly found in the mountainous district of Paberiwai and the southern, coastal area of Ngonggi. They are released to wander and graze freely on the extensive rangelands. Here they feed on 'mapu' grasses (*Themeda* sp. and *Heteropogen* sp.), young shoots of *Imperata cyclindrica* and richer grasses growing naturally along watercourses. Livestock are allowed into paddy fields to feed on agricultural residues after the rice harvest or on crops, which are damaged or low yielding. In a high-risk agricultural environment, livestock allow farmers to extract value from crops damaged by drought, wind or pest.

Large livestock are central to Sumbanese culture. Cattle, horses and buffalo are used as brideprice, being transferred from the groom's family to that of the bride during wedding ceremonies. Large livestock are also seen as wealth that can be taken into the next world after death and consequently they are slaughtered at funerals (previously in massive numbers but now in a token manner only).

Generations of grazing have led to a change in the vegetative cover of Sumba's grasslands. Primarily *Themeda* sp. and other short grasses now cover East Sumba, once recorded as having vast fields of Imperata. Stunted *Imperata* mixed with other grasses occupies the highest mountain plateaux (approx. 800–1000 m), while healthy sweet *Imperata* is confined to the far east of the island's uplands, an area settled by human population. The herbaceous weed *Chromolaena odorata* arrived in East Sumba in the early 1980s, but its presence is not responsible for much of *Imperata's* retreat. *Chromolaena* has replaced *Imperata* on the more fertile soils at the forest edge and on newly opened agricultural lands. *Chromolaena*, however, has also found it difficult to establish on the vast eroded rangelands where *Themeda* sp. now dominate. Grazing pressure rather than *Chromolaena* appears to have led to *Imperata's* decline: the carrying capacity of *Imperata* lands appears limited and warrants further research.

Policymakers have been concerned about this extensive method of livestock management in the uplands as it is perceived to lead to environmental degradation, especially erosion. Attempts at reforestation and agricultural intensification have been inhibited because the grasslands are fired annually to promote fodder and it was difficult to exclude livestock from gardens. The government realised that environmental degradation was occurring while cattle-raising only benefited a privileged few.

In response to these perceived problems, government and NGO programs in the 1980s and early 1990s were designed to break down reliance on and preference for large livestock husbandry in the uplands. An attempt was made to instil a greater appreciation for tree crops and improved agricultural activities. The government encouraged physical separation of grazing lands from farming lands, prohibited firing of the grasslands and even encouraged young grooms to plant coconut trees on the land of their prospective bride's family rather than give livestock. East Sumba's largest development NGO, Yayasan Tananua, focussed on agricultural intensification using tree legumes (*Calliandra calothyrus*, *C. tetragonia*, *Flemingia macrophylla* and *Gliricidia sepium*) in an alley cropping system, encouraging farm forestry and the management of pigs and goats.

Government and NGO interventions have been well intentioned in response to genuine environmental concerns. They have, however, underestimated the popularity of large livestock among upland Sumbanese and hence met with mixed success in trying to change the prevailing culture. The current regional administration, headed by a local aristocrat, has developed a more balanced policy, utilising indigenous knowledge of animal husbandry and local forages and Sumbanese cultural motivations. Smallholders are encouraged to plant king grass and elephant grass, while tree legumes, no longer used for alley cropping, provide supplementary fodder. The government is trying to promote stall-feeding by giving introduced Australian cattle to select smallholders and increasing forage availability. The long term aim for Sumba is to allow foreign cattle, which fetch a high price on Javanese markets, to be fattened on the island.

Unlike the position in Timor, official attitudes have softened towards free grazing on the rangelands. While cattle ownership is inequitable, substantial numbers of people are involved in shepherding large livestock, directing them to fodder and protecting them from theft. These shepherds are given food, housing, a small amount of money and in some instances a right to the progeny of the cattle. Shepherds may in future be entitled to receive one of every three calves born as opposed to one in every four as occurs now.

Cattle and Cultivation of *Imperata* Grasslands in South Kalimantan

An area of very extensive 'alang-alang' (*Imperata*) grassland lies on the western slopes of the Meratus Mountains in South Kalimantan. Originally occupied by local Dayak and Banjarese populations practising shifting cultivation, part of this area was settled by groups of Madurese colonists during the 1930s, and later by Javanese transmigrants in the 1960s. The Madurese were specially selected by the Dutch for their upland experience (their island is dry and rugged), and for their cattle-keeping tradition, to assist in fertilisation of the land (*Kolonisatie Bulletin* 1938). Over the past 60 years, they have expanded their holdings very considerably. They now concentrate on bananas and mixed tree crops (such as durian) from the upland fields, with terraced wet rice in the valleys.

Cattle are used to plough the uplands and spend much of their time in stalls, where they are hand-fed.

Near the village, the area of available *Imperata* has greatly declined, being replaced by less palatable weeds, so that feed has to be brought from a distance. Cattle manure is given to fruit trees, but not crops of maize or upland rice, which now require chemical fertilisers and generally yield poorly. The upland fields are showing a serious fertility decline after 60 years of working.

Some families secure their subsistence by opening additional grassland outside the village; others sell bananas to buy rice. Although a few farmers are cattle dealers and have larger herds, most have plough cattle only. Human population increase has resulted in more intensive working of the land, but few have accumulated wealth as a result.

The Javanese farmers turn the sod of the 'alang-alang' with their ploughs, then must wait a month before ploughing again to enable the rhizomes to dry out. After their third ploughing, they are ready to plant. Their land can still be worked on a short fallow system, and their yields are higher than those of the Madurese. Government projects supplying them with cattle enable them to hire themselves out as ploughing teams to the wealthier Banjarese, who do not themselves own cows, but take occasional crops from the grassland, while continuing to farm the more easily worked secondary forest (Potter 1987). As in Timor, government reforestation projects are now restricting access to much of this grassland, which was previously seen as a kind of land reserve by local populations (Brookfield et al. 1995). *Chromolaena odorata*, though present, mainly appears after crops have been taken off the land. As usual, it is highly appreciated by farmers, but hated by cattlemen.

Cattle and Intensification of Agriculture in Java

Studies of the role of cattle in the intensification process in Java (Hefner 1990; Palte 1989; Nibbering 1991) all agree on the basic outline of Java's agricultural history, which saw massive migration to the uplands from the end of the Cultivation System in 1870. The typical long fallow swidden agriculture was gradually modified as a result of population increase and competition for land with estates and reserved forests. While cattle had long been used to plough the Javanese lowlands for wet rice and sugar cane (Elson 1984), their numbers had been lower in the uplands, although some specialised cattle breeding areas did exist and there was seasonal transhumance. However, as land use intensified and fallows were reduced, cattle (and also goats) became vital sources of manure to maintain soil fertility.

At the same time, the area available for grazing declined, so livestock had to be stall-fed. This system created considerable demands for labour, both in spreading manure and in the daily collection of feed for livestock. Cattle were more efficient providers of manure than buffalo, and also easier to keep stall-fed, so the population of buffalo dropped sharply. Although there has been a modern shift to chemical fertilisers, especially in areas growing specialty vegetable crops, cattle numbers have remained high, with moves to improve feed availability through the planting of *Leucaena leucocephala* 'lamtoro', *Sesbania grandiflora* 'turi' and elephant grass.

In earlier times, *Imperata cylindrica* 'alang-alang' was readily available, but this grass is no longer widespread because of intensification and competition from *Chromolaena odorata*. Dove (1984b) describes its deliberate maintenance on steep volcanic slopes so that village livestock may be grazed.

Conclusion

The Java model has taken to the ultimate the system for stall-tending of cattle, which is slowly becoming more characteristic of other parts of Indonesia. Reliance on *Imperata* pasture has been declining as it disappears due to over-grazing, or competition from *Chromolaena odorata* or from alternative grasses. There has been no attempt to improve the quality of the *Imperata* by over-sowing with legumes, such as *Desmodium intortum*, as was recommended for northern Thailand by Gibson (1983).

The tradition of using leguminous trees as cattle feed, which worked so well with *Leucaena*, may now be on the decline, as planted grasses appear to be preferred as substitutes. It seems to be true, however, that many stall-fed cattle are being used to support agriculture, rather than as regular income-earners in their own right. Until they are in the latter position, they will not be perceived, in the Lao situation, as suitable substitutes for a valuable crop such as opium.

References

Asikin Natasasmita, 1984. Livestock credit scheme. South Kalimantan Livestock Development Project (mimeo).

BPS (Biro Pusat Statistik) 1994. Statistical Pocketbook of Indonesia, Jakarta.

Brookfield, H.C., Potter, L. and Byron, Y. 1995. In Place of the Forest: Environmental and Socioeconomic Transformation in Borneo and the Eastern Malay Peninsula. Tokyo, UNU Press.

Dove, M.R. 1984a. Man, land and game in Sumbawa: some observations on agrarian ecology and development policy in Eastern Indonesia. Singapore Journal of Tropical Geography, 5, 2, 112–124.

Dove, M.R. 1984b. Government vs. peasant beliefs concerning *Imperata* and *Eupatorium*: a structural analysis of knowledge, myth and agricultural ecology in Indonesia. Working Paper, East-West Environment and Policy Institute, Hawaii.

Elson, R.E. 1984. Javanese Peasants and the Colonial Sugar Industry: Impact and Change in an East Java Residency, 1830–1940. Singapore, Oxford University Press.

Fox, J. 1988. The historical consequences of changing patterns of livelihood on Timor. In: Wade-Marshall, D. and Loveday, P., ed., Contemporary Issues in Development, Vol. 1., Darwin, ANU, North Australia Research Unit, 259–279.

Gibson, T. 1983. Toward a stable low-input highland agricultural system: ley farming in *Imperata cylindrica* grasslands of northern Thailand. Mountain Research and Development, 3, 4, 378–385.

Groeneveldt, 1936. Kolonisatie van Javanen in het algemeen en in de residentie Benkoelen in het bijzonder. Landbouw, XII, 6, 297–350.

Hefner, R.W. 1990. The Political Economy of Mountain Java: an Interpretive History. Berkley, University of California Press.

Hoorn van Burgh, N.I.W. 1900. Eenige cijfers over Java's veestapel. Tijdschrift voor Nijverheid en Landbouw in Nederlandsch Indie, LXI, Af. 6, 15–22.

Jones, P.H. 1983. Lamtoro and the Amarasi model from Timor. Bulletin of Indonesian Economic Studies XIX, 3, 106–112.

Kolonisatie Bulletin, 1938, No. 2. The Southern and Eastern Sections of Borneo.

Leake, J. 1980. The livestock industry. Bulletin of Indonesian Economic Studies, XVI, 1, 65–74.

Metzner, J.K. 1982. Agriculture and population pressure in Sikka, Isle of Flores: a contribution to the study of the stability of agricultural systems in the wet and dry tropics. Canberra, ANU, Development Studies Centre, Monograph No. 28.

Metzner, J.K. 1983. Innovations in agriculture incorporating traditional production methods: the case of Amarasi (Timor). Bulletin of Indonesian Economic Studies, XIX, 3, 94–105.

Nibbering, J.W.S.M. 1991. Hoeing in the Hills: Stress and resilience in an upland farming system in Java. PhD thesis, ANU.

Ormeling, F.J. 1957. The Timor Problem. A Geographical Interpretation of an Underdeveloped Island, The Hague, Wolters Groningen Martinus Nijhoff.

Palte, J.G.L. 1989. Upland Farming on Java, Indonesia: a Socio-economic study of Upland Agriculture and Subsistence under Population Pressure. Amsterdam, Geografisch Instituut, Rijksuniversiteit Utrecht.

Potter, L. 1987. Degradation, innovation and social welfare in the Riam Kiwa valley, Kalimantan, Indonesia. In: Blaikie, P. and Brookfield, H.C., ed., Land Degradation and Society. London, Methuen, 164–178.

Spencer, J.E. 1966. Shifting Cultivation in Southeastern Asia, University of California Publications in Geography, Vol. 19, Berkeley and Los Angeles, University of California Press.

Wharton, C.H. 1968. Man, Fire and Wild Cattle in Southeast Asia. Proceedings, Tall Timbers Fire Ecology Annual Conference, Tallahassee, Florida, Tall Timbers Research Station, 107–167.

Nepal's Experience in Hill Agriculture

Gopal B. Thapa[1]

Abstract

Nepal's hill agriculture has undergone profound structural changes over the past several centuries, although it continues to be a subsistence type. At the beginning of the 11th century, shifting cultivation-livestock raising was the predominant type of agricultural system in the hills. Later, this was completely replaced by the permanent-field cultivation-livestock raising type of system. This paper presents an overview of the process of change and its major determinants.

Hill Agriculture: Concerned Questions

THE MIDDLE mountains of Nepal, rising from 800 to 4000 metres above sea level, are sandwiched between the low-lying plain of Tarai in the south and the Himalayas in the north (Figure 1). Commonly referred to as 'the hills', the middle mountains comprise about half of the national territory. Despite limited scope for economic activities, caused primarily by mountainous topography, these mountains have been the home of the majority of the population, practicing field crop cultivation-livestock-raising-based agriculture as their economic mainstay for centuries.

Historically, the overwhelming majority of people preferred to settle in the hills, because the Tarai, despite flat topography, was covered with dense, malaria-infested tropical forests, and the mountains provided little opportunity for sustenance because of severe climatic conditions, high altitudes and steep slopes. Despite the rapid hill-Tarai migration, facilitated by the malaria eradication program implemented in Tarai during the 1950s, the hills accounted for about 48% of the total population in 1981. Questions arise as to how 'hill' agriculture could cope with the ever-increasing demands of subsistence farmers that arose from a steadily increasing population, given that the biophysical and socio-economic conditions provided little opportunity to enhance cereal crop yields. This paper seeks answers to these questions and examines the changes induced by this process of adaptation.

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Pre-historic Agriculture

The indigenous hill population in Nepal was mostly tribal until the 11th century, its members deriving their livelihoods from shifting cultivation, locally called *khoriya*, and livestock-raising (Seddon 1988). Upland rice and millet were the staple crops cultivated. Large livestock animals like cattle and buffalo normally kept at lower elevations, were sources of dairy products. Small livestock, like goats and sheep, raised at relatively higher elevations, provided meat and milk. As well, they were the means of transporting goods and commodities, especially for those people practicing transhumance.

Although the population was relatively very small and sparsely distributed, these economic activities, contrary to general belief, could not fulfill even subsistence requirements, because the quantity of field crops produced on small landholdings and with a rain-fed cropping system was too small. A substantial proportion of food requirements was obtained by hunting and gathering from forest resources. This is similar to Laos where as much as one third of shifting cultivators' food requirements came from forest resources (Foppes,1995; Thapa et al. 1996), (Figure 2).

Being isolated physically, socially and economically, the hill people were barred from external impetus for change in their agricultural and other socio-economic practices. Within their region, their small householder size combined with open access to abundant forests, facilitated the continuation of the systems practiced since time immemorial. As a remnant of the erstwhile widely practiced system, in some parts of the hills, *khoriya* is still being practised especially by those farmers whose

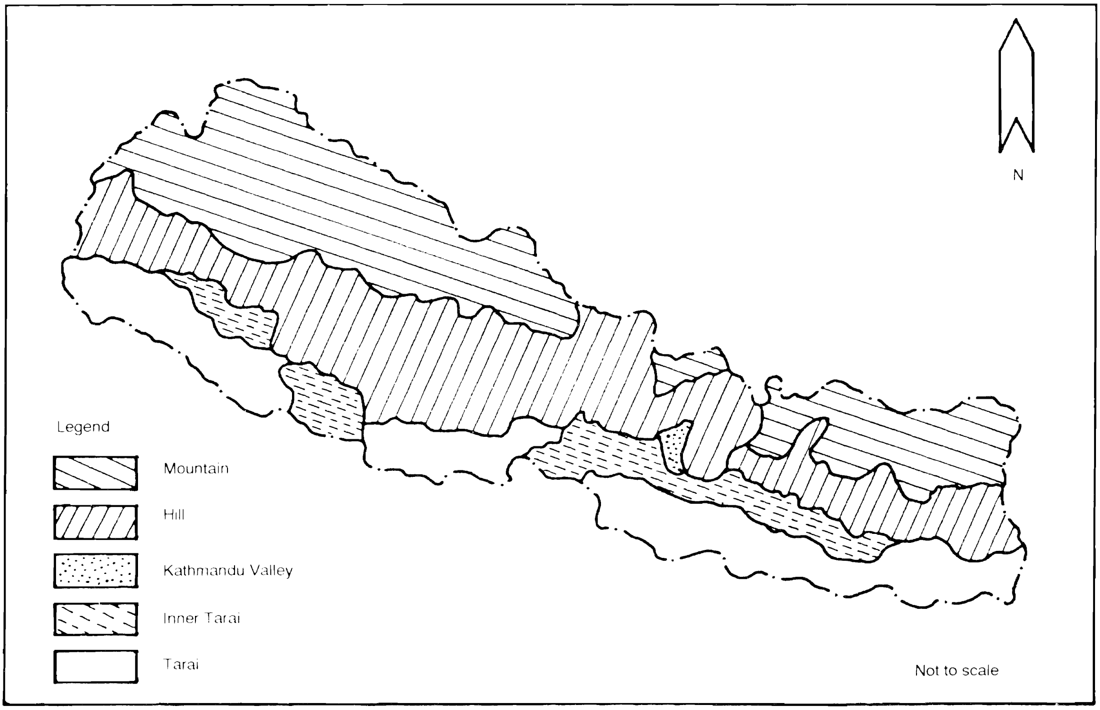

Figure 1. Geographic regions of Nepal.

permanent-field crop production could not fulfill subsistence requirements (Thapa and Weber 1990; Basnyat 1995). This type of practice, in its contemporary form of cultivating fields at an interval of 15–20 years using dibbles, facilitated by low population pressure, was an environmentally salutary activity, because it helped to keep the forest cover virtually intact on the one hand, and controlled accelerated soil erosion on the other.

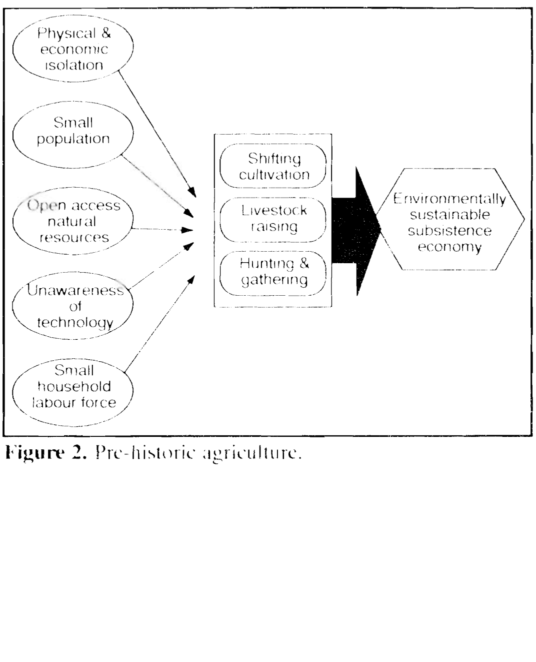

Figure 2. Pre-historic agriculture.

Historic Agriculture

The period between the 11th and mid-20th centuries can be considered as historic, as it saw profound changes in the agricultural system, including an infusion of labour-intensive, permanent-field cultivation practices and cropping intensification. During the 11th century, a large number of Hindu immigrants who had fled India after the Muslim invasion entered the hills with the acquired knowledge of terraced paddy cultivation and the skill of plough-making (Figure 3). These innovations greatly helped to enhance crop production, thereby augmenting the pace of population growth which in turn accelerated the demand for subsistence requirements (Seddon 1988).

With the gradually vanishing scope for the expansion of paddy cultivation due to very high demand for labor for level-terrace construction and very limited land suitable for paddy cultivation, hill people began the permanent-field cultivation of maize on rain-fed lands, including those being utilised for *khoriya* during the early 18th century. In this endeavor, the plough proved to be an important asset that significantly reduced the demand for labor for land preparation. Rain-fed lands locally known as *bari* or *pakho* then began to yield at least two crops of maize and millet per year (Seddon 1988:7), though *khoriya* and livestock-raising still continued to be the two important components of the agricultural system until the 18th century. The open access to relatively abundant forests and rangelands provided the opportunity to keep large herds of ruminants. Besides being a source of dairy products, cattle in particular facilitated to a large extent the expansion of permanent-field cultivation by providing draught power for ploughing, and manure for fertilising.

Institutions, like land tenure and tax systems, seem to have contributed to adoption of permanent-field cultivation and cropping intensification, though not much attention has been paid to exploring their relative roles. Especially after the arrival of immigrants, several petty states emerged in the hills and then all lands were declared state property. However, people could make use of lands by paying tax in cash or kind. There is evidence to suggest that farmers were mostly obliged to render up to half of their total crop production, until the implementation of a more scientific type of land tax system was introduced during the second quarter of the 20th century (Regmi 1978a). This might have contributed to permanent-field cultivation and cropping intensification, as farmers had to produce crops sufficient both for consumption and the payment of taxes (Figure 3).

With an ever-increasing population, despite the out-migration first facilitated by the Anglo-Nepalese treaty of 1816, the addition of maize production could not help to fill subsistence requirements much longer. In an effort to increase crop production, farmers, particularly in the high hills, began to cultivate potato during the period 1866–1876 (Sacherer 1977). In order to facilitate winter cereal cultivation, the government even imposed a ban on grazing over the former rice fields during the 1860s, which could not succeed until the 1920s because of the practice of letting cattle loose in the fields following the harvest of monsoon crops (Regmi 1978b). Between the 19th and the first half of the 20th centuries, farmers also resorted to encroaching into forests located even on steep slopes. This is why even in a small area like the Upper Pokhara Valley, one fifth of the cultivated lands was on slopes with more than 30° gradients (Thapa and Weber 1994). This process was further reinforced by the state policy of encouraging the expansion of agricultural lands through the provision of low tax and tax exemptions pursued until as late as the first half of the 20th century to increase revenue (Regmi 1978a).

Despite state support, the majority of hill farmers could not convert a relatively large area of public lands into agricultural lands, primarily because there was virtually no economic incentive. Besides, the

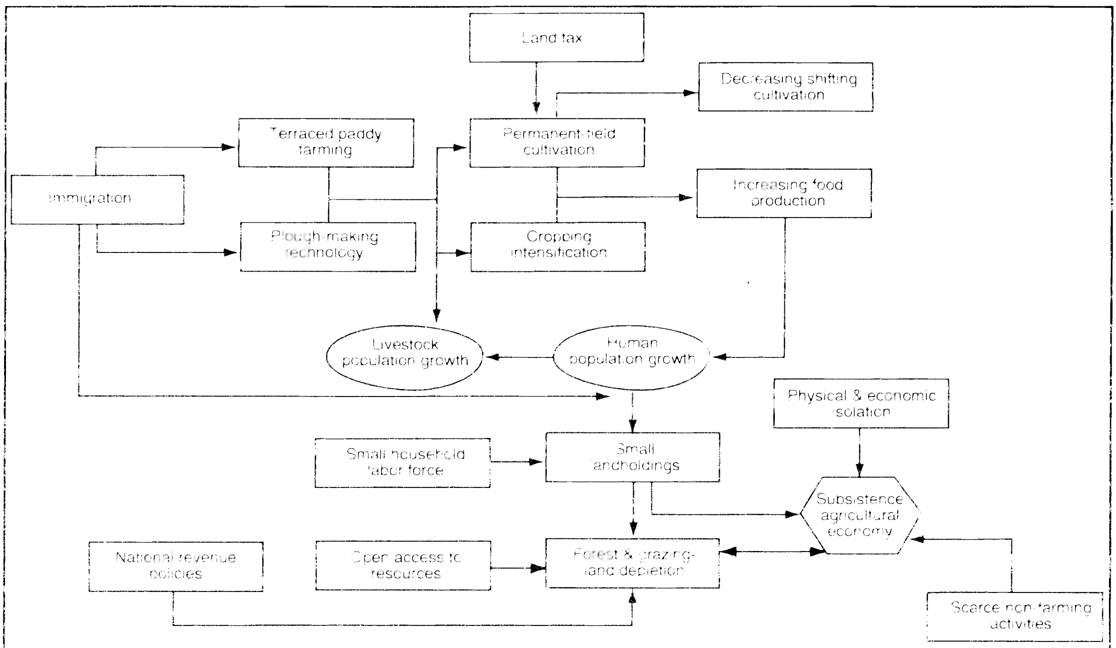

Figure 3. Historic agriculture.

majority of farmers were seldom able to provide the costs of large-scale land reclamation. In the hills, this was, therefore, largely limited to the growing needs of individual peasant families, and it was a highly labour-intensive task (Regmi 1978b).

Contemporary Agriculture

The year 1950 saw the termination of the 104 year-old oligarchic political system that had paid virtually no attention to national development. Following this, successive governments implemented seven Five Year Plans between 1956 and 1990. Cognizant of the dependency of more than nine tenths of population on agriculture, priority was given to developing this sector in all plans. However, the hills could not benefit from this provision, because the government pursued the capital region and *tarai*-biased development policies (Gurung 1989; World Bank 1979).

As a consequence, most parts of the hills still remain inaccessible and are deprived of basic agricultural support services and facilities, including extension services, which, combined with marginal landholdings and scarce non-farming employment opportunities, have prevented farmers from tapping local potentials, namely, forestry, horticulture and commercial livestock-raising (Figure 4). In order to fulfill their subsistence requirements, farmers have continued to practise the traditional agricultural system, characterised by cereal cultivation and livestock-raising. In the agricultural year 1995/96, for example, about 90% of the total cropped area in the hills was under five cereals, namely, paddy, maize, millet, wheat and barley. While only 6% of the cropped area was under assorted varieties of cash crops, 4% of the area was cultivated with pulses. Fruits had occupied only 6277 hectares or 0.4% of the cropped area (ASD 1996).

While cereal crop cultivation has consumed substantial amounts of labour and time resources, it could not fulfill even the minimum subsistence requirements of the majority of farmers (Thapa and Weber 1990), as the landholdings are steadily miniaturising due to the ever-increasing population pressure and nearly vanished scope for further expansion of agricultural land. This explains why a typical farm household held only 0.86 hectare of land in 1981–82 (ASD 1990). The dependency of the overwhelming majority of the population on agriculture, diminishing yields of staple cereals like paddy, maize and

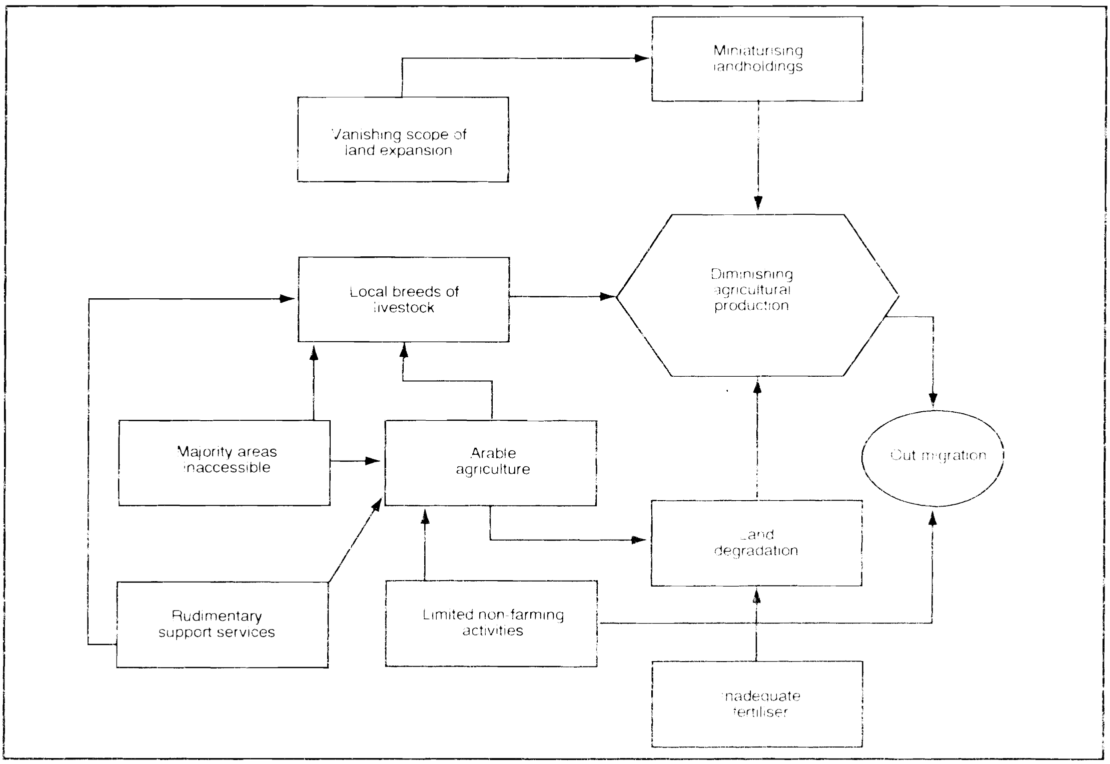

Figure 4. Contemporary agriculture.

wheat (ADB/ICIMOD 1992; Basnyat 1995) caused mainly by poor quality of land, soil erosion, dwindling supplies of manure and green fertilisers, and poor support services and facilities, are other factors preventing the hill agriculture from becoming an economically sustainable activity. Chemical fertilisers are being imported and sold at subsidised prices to increase the yield of cereals. Notably, about 60% of the total 48 679 tonnes of fertilisers supplied to all hill districts during the agricultural year 1995–96 was distributed in only five districts located around the capital city, Kathmandu (ASD 1996). Since the total cropped area amounted to more then 1.5 million hectares during this agricultural year, on average 32 grams of fertiliser would have been applied per hectare of cropped area, if it was distributed fairly.

Livestock, particularly cattle and buffalo, are integral components of the farming system and their number is steadily increasing, though per household herd size is decreasing gradually because of dwindling fodder supplies from forests and grazing-lands. In 1966–67, for example, there were 6.5 million cattle and buffalo in the hills and mountains (Rajbhandary and Shah 1981). Their population had reached 7.6 million as of the agricultural year 1995–96; of which 86% were accounted for in the hills (ASD 1996). Cattle contributed virtually the entire increment in livestock population.

Although livestock get a substantial amount of fodder from farm sources, still their requirements are not fulfilled. In 1980, 3 million tonnes of total digestible nutrients (TDN) were available in the hills, which accounted for only 54% of the total requirements for adequate nutrition (Rajbhandary and Shah 1981). Such fodder shortage, combined with heavy parasitic infestation and inferior breeds, have impinged severely on livestock productivity, thereby limiting their role of facilitating cereal crop cultivation and supplementing subsistence requirements. However, in some locations, particularly around a few urban centres and along highways, and provided with accessibility, credit facilities and other support services, farmers have began to practice commercial dairy farming.

While in most parts of the hills, a cereal cultivation-livestock-raising-based subsistence agricultural system has continued to be the economic mainstay, in some parts it is being gradually replaced by environmentally and economically sound agricultural practices. In Ilam district, for instance, cardamom was an important cash crop until recently. Because of its decreasing yield, diseases and falling price, farmers are now shifting to other cash crops, such as potato and ginger. Likewise, dairy farming, *amlisho (Thysanolaena maxima)* growing and sericulture have become additional promising ventures. All these changes were facilitated by improvement in infrastructure and the provision of support services and facilities (ICIMOD 1995).

Livestock Development: Thorny Issues

With a suitable biophysical environment, livestock-raising can make a significant contribution to environmentally sustainable development of the hills, provided this activity is commercialised. However, there are some dilemmas in regard to commercialisation of this activity.

1. Though without much scientific proof, virtually all studies related to the environment agree that the livestock population exceeds the carrying capacity of the hills. Thus, a recommendation has been made to reduce the livestock population by replacing indigenous, inferior breeds of livestock with highly productive exotic breeds. Even if farmers are provided with appropriate support services and facilities for adoption of exotic breeds, a radical replacement will be socially unacceptable and economically unfeasible as long as lands are utilised for cereal crop cultivation. Indigenous breeds of oxen required for ploughing, are substantially cheaper, need small amounts of fodder and work more efficiently compared with exotic breeds.
2. Confronted with dwindling sources of fodder, farmers have reduced their livestock herds to the lowest possible size required to fill subsistence needs (Thapa and Weber 1990). Thus, further reduction in livestock herd size cannot be expected. If the existing livestock population really exceeds the carrying capacity of lands, promotion of commercial livestock ranching is likely to aggravate fodder supply and environmental degradation.
3. The majority of the hill areas are still inaccessible and provided with only rudimentary agricultural extension services, let alone veterinary clinics. Thus, despite their desires, farmers do not dare embark on commercial livestock-raising.

Conclusion

Evolved as an alternative strategy for survival under a situation of physical and economic isolation, cereal crop cultivation and livestock-raising have been two integral components of the Nepalese hill agricultural system for many centuries. In response to a steadily growing population, this system underwent significant change in terms of area and types of crops cultivated, land use intensity and livestock herd size, but its basic feature, which is cereal crop cultivation-livestock-raising at subsistence level, has not changed in most instances. Both biophysically and economically, the hills are most suitable for commercial forestry, horticulture and livestock-raising, but these potentials have not been tapped efficiently because farmers are entangled in the subsistence agricultural system, due primarily to poor accessibility, facilities and support services, marginal landholdings, and scarce non-farming employment opportunities.

References

Agricultural Statistics Division (ASD) 1990. Agricultural Statistics of Nepal 1990. Kathmandu, 258 p.

Agricultural Statistics Division (ASD) 1996. Statistical Information on Nepalese Agriculture 1995–96. Kathmandu, 102 p.

Asian Development Bank/International Center for Integrated Mountain Development (ADB/ICIMOD) 1992. Nepal: Economic Policies for Sustainable Development. Manila/Kathmandu, 186 p.

Basnyat, B.B. 1995. Nepal's Agriculture: Sustainability and Intervention: Looking for New Directions. Ph.D. thesis, Wageningen, Wageningen Agricultural University, 285 p.

Foppes, J. 1995. Farming and Forest Use Systems Survey and Recommendations for Community Forestry in Sangthong Training and Model Forest. A mission report. Lao-German Forestry Project, Vientiane, 79 p.

Gurung, H.B. 1989. Nepal: Dimensions of Development. Kathmandu, Awarta, 324 p.

International Centre for Integrated Mountain Development (ICIMOD) 1995. Annual Report, Kathmandu, 65 p.

Rajbhandary, H.B. and Shah, S.G. 1981. Trends and projections of livestock production in the Hills. In: Nepal's Experience in Hill Agricultural Development. Kathmandu, Ministry of Food and Agriculture, 43–58.

Regmi, M.C. 1978a. Land Tenure and Taxation in Nepal. Kathmandu, Ratna Pustak Bhandar, 895 p.

Regmi, M.C. 1978b. Thatched Huts and Stucco Palaces: Peasants and Landlords in 19th Century Nepal. New Delhi, Vikas (Not available for checking).

Sacherer (1977). The Sherpas of Rolwaling: a hundred years of economic change. In: Himalaya: Ecologie, Ethnologie. Paris, CNRS; quoted in Seddon, D. 1988. Nepal: A State of Poverty. New Delhi, Vikas, 288 p.

Seddon, D. 1988. Nepal: A State of Poverty. New Delhi, Vikas, 288 p.

Thapa, G.B., Sirisup, S. and Nil-ubo, V. 1996. Sustainable Natural Resource Management in Sangthong, Vientiane Municipality, Lao P.D.R. A mission report. Lao-German Forestry Project, Vientiane, 70 p.

Thapa, G.B. and Weber, K.E. 1994. Managing mountain watersheds in Nepal: issues and policies. Water Resources Development, 10, 475–495.

Thapa, G.B. and Weber, K.E. 1990. Managing Mountain Watersheds: The Upper Pokhara Valley, Nepal. Bangkok, Asian Institute of Technology, 326 p.

World Bank 1979. Nepal: Development Performance and Prospects. Washington, D.C., 123 p.

Shifting Cultivation In Thailand: Land Use Changes in the Context of National Development

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Abstract

Shifting cultivation was the primary mode of production for many people in Northern Thailand for a long time. It was the only means of growing food for most of the people who lived in the mountains. It also provided an essential supplement to wetland rice cultivation. The various forms of shifting cultivation that were described and characterised in the 1960s, however, are hardly recognisable in the 1990s. This paper examines the current situation of shifting cultivation in Thailand and land use dynamics in the context of the country's recent development.

AS A CROP production practice involving the slashing and burning of natural vegetation, shifting cultivation can still be found in northern Thailand, but it is no longer the most important mode of production. Almost no one now lives by shifting cultivation alone. Individual households commonly employ an array of livelihood activities to provide staple food as well as cash income. Land use has been significantly intensified, with wetland rice cultivation, multiple cropping and employment of inputs such as fertilisers, pesticides and irrigation, especially for the production of vegetables and fruit for the growing urban markets. Gathering minor forest products, making handicrafts for sale and livestock-raising are important in some areas. Many people have migrated to the towns and cities such as Bangkok, or overseas.

The change has been accompanied by other internal and external changes and pressures. These include a population increase, a drastic reduction in available land as a result of national conservation policies, increased integration and mobility, and the government's actions to eradicate opium cultivation. In Thailand, the livelihood of many people has improved, but the benefits of 'development' are yet to reach many others. On the whole, national and foreigner-assisted development efforts aimed at improving agricultural productivity have had only marginal success, as exemplified by cases such as upland rice and paddy and terrace development. On the other hand, improvements made by farmers themselves have illustrated that opportunities for increasing land productivity do exist even in remote mountain areas. It only requires somewhat more understanding of local conditions on the part of those who profess to be helping, than has so far been evident.

Historical Background

In the 1960s when the population of Thailand was not quite 30 million, it was estimated that more than one million people were engaged in some form of shifting cultivation (Judd 1964). *Tam-rai* (slash and burn or shifting cultivation) comes before *Tam-na* (wetland rice cultivation) in the terms that cover farming in Thai, *Tam-rai, tam na (Yia-hai, yia-na* in Northern Thai*)*. Shifting cultivation was practised by both lowland Thais and people of the mountains or 'hilltribes'. In just over 30 years, shifting cultivators who were lowland Thais have completely disappeared. Farming by hilltribe 'shifting cultivators' is now totally different from that described in the 1960s. In order to understand and draw lessons from the changes that have taken place, it may be useful to examine briefly these systems of shifting cultivation as they were in the 1960s.

Shifting cultivation by lowland Thais

By the 1960s when foreign scientists came to study shifting cultivation in Northern Thailand, wetland

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rice cultivation had appeared to be the dominant production system in the lowlands. Shifting cultivation as described by Chapman (1978) was very much a marginal system for people whose paddy land produced insufficient rice for the annual requirement. However, there was a time when shifting cultivation was actually very much a part of farming for all who were involved in agriculture. Interviews with 'grandfathers' who were farming at the beginning of this century told that *Yia-hai* provided 'off-season' employment in the summer months before the rain, a base for hunting and gathering, and harvests of food crops such as sugarcane, pumpkins, gourds, chilli peppers, beans, sesame etc. Burning the swidden was an important farming skill known to all good farmers, rich and poor (Manu Seetisarn, pers. comm.). So it appears that by the 1960s shifting cultivation had ceased to be of general importance. How this happened, and by what causes, would be subject of other analyses. Relevant to this paper is the fact that shifting cultivation had already declined before anyone took any 'academic' interest.

According to Chapman (1978), more than a quarter of a million people in the lowlands of Northern Thailand were dependent on shifting cultivation in the 1960s. These were farmers who had none to only a few *rai* (1 *rai* = 1600 m^2) of paddy land (Judd 1964; Chapman 1978). Shifting cultivation provided an essential supplementary harvest of rice, despite the fact that return to labour from growing upland rice from swidden fields was only one sixth to one fifth of that from the paddy (Chapman 1978). This low yield per unit of labour was associated with equally low yield per area. In addition to this lower productivity, at about one third of that from the paddy, rice yields from swiddens were also almost twice as variable. Furthermore, yields of other major crops as well as upland rice declined rapidly with repeated cropping of the swiddens (Charley and McGarity 1978).

All of these indicators of poor performance justified substantial efforts and resources to improve the system's agricultural productivity. However, within 20 years to 1980, during which the total population of Upper Northern Thailand had doubled, this system of shifting cultivation by lowland Thais completely disappeared. In hindsight, it is easy to see that all of the technical inputs generated were insufficient to keep the system going. Furthermore, although migration from the northeast to Bangkok had already begun by the end of the 1960s and labour migration from rural to urban areas and even overseas became commonplace by the 1980s (Limpinatana and Patanothai 1982), there was no evidence that the possibility of labour mobility as a solution to the problem of labour productivity was ever considered by those involved in the efforts to improve the lot of the lowland Thai shifting cultivators (e.g., RTG 1985).

By the end of the 1970s, out-migration became common in many provinces of Northern Thailand. The number of those who went overseas was also high in certain areas. For example, a village level survey in Phayao Province showed 17% of those who 'temporarily' out-migrated went overseas (Padermchai 1995). At the regional level, the National Economic and Social Development Board estimated that some 3000–4000 million Baht was sent home by migrant workers from overseas every year between 1987 and 1991 (NESDB 1992).

Shifting cultivation in the mountains

The last frontier of shifting cultivation in Thailand was the northern mountains. The people who live in the mountains largely belong to groups who are ethnically distinct from the majority Thai population of the lowlands. Two basic types of shifting agriculture were practised before 1970: pioneer and rotational types[2] (Kunstadter 1978; Grandstaff 1980).

Pioneer shifting cultivation

This was attributed to the Hmong, Lahu, Lisu, Akha and Yao. In this system, a piece of forest (primary forest if possible), was cleared, burned and cropped, often intensively, with two crops (maize followed by opium) in one year. After a few years the field was abandoned. The village typically picked up and moved to a new site after 8–10 years.

Soil fertility exhaustion and increasing weed problems were generally believed by researchers to be the cause of field abandonment and village relocation (e.g., Kunstadter and Chapman 1978; Grandstaff 1980; Suthi 1985), but there is little concrete evidence. The people themselves told of misfortunes (bad spirits), sickness, and conflicts with other people as the reasons for moving the village (Srisawad 1949).

[2] It is important to recognise that this classification is useful to distinguish characteristics unique to each type. In practice, with rapid land-use changes occurring in the mountains even in the 1960s, it is difficult to identify any particular ethnic group or even village with a particular type of shifting agriculture. For example, even some rotation was already practised by many villages of 'pioneer shifting cultivators' such as Hmong and Lahu (Keen 1978; Walker 1976) and some of these 'pioneer shifting cultivators' had even bought paddy land and became sedentary (Rerkasem and Rerkasem 1995).

Major crops grown were upland rice, maize and opium. The rice, maize and opium swiddens (fields where these crops are grown) are often intercropped with various domesticated species. The 'intercrops', including chillies, egg plants, beans, cucurbits, yams and taros, mustard greens, various edibles, herbs and spices, medicinal and ceremonial plants, commonly number more than 30 kinds in a given field. The Hmong especially were famous for productivity of their swiddens, which efficiently provided year round supply for the kitchen from the combined harvests from the maize, rice and opium swiddens (Suthi 1985).

After several years of clean cultivation the forest regenerates relatively slowly after the field is abandoned. Intensive soil cultivation tends to encourage soil erosion, and this form of shifting agriculture is generally considered to be an unsustainable form of land use (Keen 1978).

Rotational shifting agriculture

Characterised by long fallow, rotational shifting agriculture was formerly practised by Karen and Lua' who lived in permanent settlements. After one season of cropping, the field was 'fallowed' (the forest allowed and encouraged to regenerate) for 8–9 years before it was cleared, by slash and burn, for cropping once more. These people also had the skill for growing wetland rice. Where they could (soil, topography and water supply permitting), paddies, sometimes with irrigation, were developed, often on sediment fans deposited at the base of slopes resulting from long cultivation on the upper slopes. Although settlements were permanent, Lua' and Karen villages 'moved' in another way. As population of a village grew too large families and clans would split off to settle a new village. Although some of these villages have been in one place for more than 100 years, the average number of households in highland communities has remained about 40 since the 1950s (see Young 1962 in comparison with NSC/NESDB 1993).

Because fields were cropped for only one year, forests regenerated quickly after the crop season (Nakano 1978, Nakano 1980, Zinke et al. 1978). Nakano (1978) also commented on the rapid regeneration of fallow species from fire resistant underground roots and stems. When well managed, e.g., at Pa Pae, a Lua' village south of Chiang Mai studied in detail in the 1960s (Kunstadter 1978, Zinke et al. 1978) this is a system of land use that remained productive for a long time without requiring outside inputs.

However, it must be stressed that this 'classical' and successful rotational shifting agriculture was not practised by all Karen villagers. At the same time that the Pa Pae study was carried out, Kunstadter (1978) also looked at the rotational shifting agriculture of a neighbouring village of Laykawkey, which was found to be much less successful. The author attributed the relative success of the two villages to the much stronger communal organisation of the Lua at Pa Pae, which he believed to be essential in the management of the fallow, especially in land allocation and fire control. Other 'unsuccessful' rotational shifting cultivator villages of both Lua' and Karen can be found commonly throughout mountainous districts of Mae Hong Son, Chiang Mai and Tak province (TDRI 1994; Rerkasem and Rerkasem 1995; CARE/HRIP 1992).

Land Use Changes

During the past 30 years, the Thai economy as a whole has seen many changes and, for all practical purposes, the short fallow-short cultivation system of lowland Thais has completely disappeared. There have also been major changes in land-use patterns in the mountains (Rerkasem and Rerkasem 1995; TDRI 1994) which are examined here.

Virtual stopping of voluntary village relocation

By 1990, voluntary village relocation and the setting up of new villages had become very rare. Notable exceptions were forced relocations made by the government, especially in the name of national security during the years of active communist insurgency from the mid-1960s to the end of the 1970s (Kesmanee 1987) and forest conservation policy (Rerkasem and Ondam 1992).

Intensification of land use

Pioneer shifting cultivation has now largely disappeared, but rotational shifting agriculture can still be found. The extensive area where the majority of villagers are still largely dependent on rotation shifting agriculture covers three provinces: Chiang Mai, Mae Hong Son and Tak. The fallow period is often shortened by increased population pressure and restriction on the use of forest land by the Royal Forestry Department. Many fields are permanently cropped, some even growing two, sometimes three, crops a year.

Technology adoption

Along with land-use intensification, technology adopted for increasing productivity included irrigation, and the use of fertiliser and pesticides. Irrigation for wetland rice paddies, which has expanded to cover dry season soybean which follows the rice, has come from the Karen and lowland Thais. Sprinkler irrigation for fruit trees and vegetables has become widespread in the past 10 years or so. Chemical fertilisers, especially nitrogen and phosphorus, and pesticides, for controlling weeds as well as insects, are routinely applied to cash crops.

Commercialisation

From a largely subsistence production, commercial production (vegetables, soybeans, fruits, red kidney bean, purple rice, lablab bean, adzuki bean, barley, potatoes etc.), has spread widely in the highlands in the past 15–20 years. Following closely are a whole range of marketing and credit arrangements offered by buyers. Collecting forest products for sale has become an important income earning activity. The most widespread and largest in scale are bamboo shoots and broom grass, but other products (spice *Xanthophylla lemonia*, 'konjac' or 'buk' *Amorphophallus* sp., false chestnuts *Castanopsis* sp., rattan shoots, palm fruit, kindling (native *Pinus* spp.), wild orchids, various wild mushrooms and honey, etc.) are important in specific areas. Livestock (cattle and pigs) formerly raised for ceremonial purposes, have become an important income earning activity in quite a number of villages.

Cultural and ethnic differences

Long the focus of research on highland land use, cultural and ethnic differences no longer appear to be the major determinant of land-use patterns. Many well-off villages of Hmong, Lahu and Lisu, many former opium growers, pioneer swiddeners, had started to acquire paddy land as part of the settling down process more than 30 years ago (TDRI 1994). The Karen, who were considered extremely subsistence minded, have widely taken up commercialisation.

Mobility and off-farm employment

Many young men and women from highland villages have found employment in Chiang Rai, Chiang Mai, Phitsanulok or even Bangkok. Income from tourism, including production of handicrafts, tour operations, elephant-hire etc. is also beginning to reach down to former shifting cultivators in some areas. However, only those hilltribes who have been granted Thai citizenship are better able to take advantage of off-farm employment opportunities.

Forces Causing Change

Forces causing rapid changes to the agricultural systems in the mountain area of Northern Thailand can be summarised as follows:

(a) Those 'internally' driven:
- Increased population;
- Farmers' felt need to increase productivity and to improve stability of their production.

(b) Those related to government policy:
- Nationalisation and social integration policy (Department of Local Administration);
- Enforcement of forest and watershed conservation and afforestation schemes (Royal Forestry Department);
- Strict law enforcement on illicit opium cultivation (The Office of Narcotic Control Board with co-operation from the Third Army);
- Improved access and transportation, and therefore market opportunities to increase productivity (various development projects, often with assistance from foreign governments and international agencies).

The real reason behind this major change is probably a combination of several above-named forces. When asked why they had settled down, former pioneer shifting agriculture, opium-growing farmers invariably answered that they simply ran out of new forests to clear. This indicates the dominant effect of population growth exerting pressure on the land.

For those farmers who are still dependent on rotational shifting agriculture, the population pressure is very real. The Lua' and Karen have adapted to this pressure in two ways:
- Wherever possible paddies for wetland rice are developed. Often this takes place at the base of the slopes, where erosion from higher up has resulted in a fan deposition of sufficient size (Zinke et al. 1978).
- Most villages invariably complain about the need to clear more land as the village population grows. Even in the old days, when the population of a Lua' or Karen village grew too large to be accommodated by the existing land, a group of families would move off to settle a new village. Karen have lived in the mountain area of Northern Thailand for more than 100 years. The Lua' is supposed to predate the Kingdom of Lanna Thai; celebrating its 700th anniversary in 1997. But there are only a few Karen or Lua' villages with a population of more than 100–200. A new village, expected to grow to a population of about 150 will require a territory of some 100 ha for rotational shifting agriculture with 9–10 years rotation. It has now become virtually impossible to find new land to locate a new village.

In certain areas near the borders, illegal migration added to the rate of population growth. The problem is aggravated by land use restriction imposed by the Royal Forestry Department.

Even among those farmers who were practising the 'sustainable' rotational shifting agriculture, opportunities for more intensive cropping are often perceived, in terms of productivity for the same amount of effort and resource, as a vast improvement over their traditional practices.

Many development projects and programs have claimed to have 'replaced' opium with alternative crops. However, the decline in opium planting did not take place until the Third Army began to send units to physically destroy the crop on a substantial scale in 1985 (Rerkasem et al. 1989). The 1970s and 1980s also saw substantial road construction into the mountain areas throughout the north. Most of the roads through the villages are unpaved, but even these seasonal roads have been instrumental in commercialising many former subsistence activities, i.e., cash cropping, and also the selling of various forest products such as bamboo shoots and broom grass. The network of surfaced roads linking major towns and districts in the region, e.g., Chiang Mai, Fang, Chiang Rai, Nan, Mae Sariang, Pai and Mae Hong Son, together with the link with Bangkok, has also been built up from the 1970s through the 1980s. Several of the roads had been planned and/or built for 'strategic' reasons during the period when threats from communist insurgencies were real.

Coping with the Pressures

The various pressures exerted on the agricultural systems of the mountains (already discussed), supported by wide publicity on land degradation in the mountains of Southeast Asia during the 1980s (Allen 1993), would seem to suggest an inevitability of human and environmental disaster throughout the mountains of Northern Thailand by the 1990s. Papers published in the 1970s and 1980s indeed reported mountain villages on the brink of starvation, in the midst of denuded and eroded mountains (e.g., Hinton 1978; Keen 1978; Cooper et al. 1984). In the 1990s, however, instead of a continuing decline, a very different picture is emerging.

In spite of their diverse ethnicity, agricultural systems of the former shifting cultivators all now appear to be sharing some common outstanding features. The first of these is their highly dynamic nature. As noted previously, former migratory communities have become sedentary. Former 'pioneer shifting cultivators' are now practising some form of rotational cropping as well as cultivating wetland rice. Opium cultivation had declined sharply by the second half of the 1980s. Previously largely subsistence, almost all villages have entered into the market economy to varying degrees. Another common feature is diversity of land-use systems within villages, within farming systems, and even within each field. Villagers living on shifting agriculture alone are extremely rare. Common land-use types and other 'livelihood activities', some old and some new, that are practised in various combinations by individual farming systems are listed in Table 1. Households typically engage in a combination of 6–10 of these activities.

Table 1. Common land-use types/livelihood activities of montane farming systems of mainland Southeast Asia.

Land use type/ livelihood activities	Examples of products/services
Swiddening/rotation	Upland rice (food) Maize, cassava, buckwheat (feed, food) Associated domesticated, semi-domesticated, wild species during cropping/fallow phase (food, feed, firewood, cash) Soybean, taro, ginger, vegetables (cash)
Wetland paddy	Rice (food, cash) Other crops in rice-based cropping systems (e.g. wheat, soybean, garlic, cabbages — cash, food)
Livestock	Cattle, pigs, poultry, (draught, food, ceremonial, investment)
Gardens[a]	Vegetables, fruits, bamboo (food, cash)
Orchards/plantations[a]	Fruits, nuts, timber, rubber, tea, coffee
Agroforestry[a]	Bamboo (shoots, wood), tea, timber, *Amomum* spp. *Cinnamomum cassia*
Forest-gathering[a]	bamboo shoots (food, cash), bamboo (home use, cash), broom grass (cash), mushrooms (food, cash), various greens (food, cash), rattan (food, cash), various wild species (e.g., medicinal, dye-own use, cash)
Handicrafts	Bamboo, rattan and wood works, metal (silver, iron), embroidery (home use, cash), broom making etc.
Trade	Assembling and transportation of various local products
Wage employment	Labour for intensive, high value crops

[a] Some products may come out of any of these types of land use, e.g., tea is found both in plantations and as agroforestry system integrated into natural forests, bamboo (for edible shoots as well as the wood) can be found in home gardens, plantation, agroforestry or from the wild).

These 'new' land use types can be seen as moves by mountain communities and farmers to respond to the various pressures and opportunities already discussed. Improvement in the performance of montane agricultural systems, including effective control of land degradation, has been the result of interactions between these diverse activities as well as their combined effects. The improvement itself, on the other hand, has been possible because of: (i) a set of technological innovations that have either been imported from the outside, transferred from different locations within the region, or indigenously developed; (ii) the presence of communal institutions for resource management; (iii) participation by local communities in resource management decisions. Soil and water conservation, which contributes to sustainable land-use management, is very much integrated into these production technologies.

Appropriate technology

Agricultural production technologies that have contributed to the recent transformation of mountain agriculture include:

- wetland rice;
- irrigation;
- alternative high value cash crops;
- rotation and multiple cropping;
- agroforestry;
- gardening;
- orchards and plantations; and
- integration of livestock.

Some elements of these are truly modern introductions, e.g., the adoption of high value vegetables and flowers (TDRI 1994). On the whole, however, most of these can be called traditional technologies that have existed in the region for a long time. Development is often simply a modern adaptation of traditional practices. The transfer of technology has largely been local, i.e., between different ethnic groups or different localities. Many samples are to be found with regard to wetland rice and irrigation development.

Some former migratory pioneer shifting cultivator villagers in Thailand took up wetland rice simply by buying the paddy land, presumably with the silver and gold accumulated during previous good opium seasons, and picking up accompanying management skills along with it (Rerkasem and Rerkasem 1995). But less well appreciated is the need for effective transfer of the skills involved, evident in numerous paddies developed by various 'development' assistance schemes and then abandoned.

There is a similar story of local transfer of irrigation technology. Skills in irrigated agriculture have been in existence in Northern Thailand for more than 1000 years (Sektheera and Thodey 1975). Development in mountain irrigation is more recent, but has also involved transfer of management skills from those with longer experience. A documented example of this is provided in the Lua' village of Pa Pae in the mountains of Mae Sariang, two hours by car south of Chiang Mai in Thailand (Kunstadter 1978). After initial unsuccessful attempts in the 1920s to imitate lowland farmers to develop irrigation, 'foreign experts' (who ethnically were Thai) were hired from the Chiang Mai Valley to teach irrigation techniques. Kunstadter went on to note that in this area the Karen learned irrigation skills from the Lua'. Also Lua' workers were often employed by Karen to build dams, ditches and to level fields, because the former were believed to be more skilled.

Gravity-fed sprinkler irrigation is a 'modern' development that has spontaneously swept the mountains of Northern Thailand in the past 15 years. It has enabled mountain farmers to grow high value crops such as vegetables throughout the dry season and take advantage of the cooler temperatures at higher altitudes, especially during the height of the tropical summer (March–May), to meet growing demands in increasingly rich cities. The potential to help transform mountain agriculture in other countries in the region, i.e., a cross-border transfer, should not be overlooked. The system makes use of plastic water pipes which are cheap, easy to transport and easy to assemble. For individual farmers, management is a simple affair of moving a hose and turning on the tap. Development that involves bringing water from the water source in a main pipe and maintenance and regulation, however, requires a community level of organisation.

Many of the current practices that are now contributing to increased productivity and land-use sustainability have come from the farmers themselves. In Thailand, the agricultural systems that contribute directly to the national economy are all in the lowlands—mountain agriculture is considered too marginal to warrant major research support. Highland development projects (generally with substantial funding from foreign governments) on the other hand, were generally given a mandate that strictly prohibited research.

In addition to filling the gap left by the absence of support from publicly-funded research, farmers' understanding of their own ecological, economic and social environment can sometimes come up with technical solutions to problems in agriculture much more effectively than research scientists, who sometimes still have yet to come to grips with the physical environment of these 'remote' places; and, being mostly from the natural science disciplines such as agronomy or soil science, have little idea of the social and economic context of the farm. This is illustrated in the case of upland rice. For a very long time, it was virtually impossible to increase the yield of upland rice in farmers' fields, so that many papers began to conclude that it was not improvable, e.g., because 'traditional varieties' were not responsive to fertiliser. But finally the discovery that upland rice yield could be significantly increased was made by farmers themselves (see Appendix 1). Numerous abandoned paddies, terraces and 'soil-water conservation' plots (TDRI 1994; Rerkasem and Rerkasem 1995) are other evidence of the introduction of technical solutions without understanding of local conditions.

Communal institution for natural resource management

A decision to adopt any of the above-named technologies depends only partly on individual farmers. The influence of government incentives (e.g., financial support for developing wetland paddies, promises of land ownership titles) and disincentives (e.g., restriction on land clearing and burning) has been important. The role played by communal institutions has, however, been crucial. In Thailand, the official governing structure is reaching into mountain villages only very slowly (TDRI 1994). In general, a village's traditional institution deals with all civic matters, as well as management of common resources.

Although effective communal resource management has been associated with certain ethnic groups more than others, e.g., Lua' and Pwo Karen better than Skaw Karen (Kunstadter 1978; Hinton 1978), recent developments have shown that cultural traits can be over-ridden by strong leadership and successful production systems (TDRI 1994).

In general, village-level management deals with development and management of resources of land, irrigation and forest, which are shared within the village, and sometimes between neighbouring communities. A communal level of organisation is essential when a farmer's private economic goals come into conflict with his/her neighbours, or with the community at large. In most places, the production of high value crops such as vegetables near the village is possible only where the population of free-ranging livestock is very small or there is an effective communal regulation concerning crop damage by roaming animals. For example, in a Karen village south of Chiang Mai, the rule is that during the day it is the responsibility of the owner of the crop to make sure that the fences are cattle-proof, but at night, when the animals should be tied or locked up in stalls, the responsibility for damage is shifted to the cattle owner (Rerkasem and Rerkasem 1995). In Xepone in Laos, although goat-raising was earning some farmers a good income, it may eventually have to be curbed as the community thought the cost to the whole village in terms of fencing and crop damage was too high (Menzies 1991). Cooperation among farmers with adjoining land on the same slope surface could result in much improved soil conservation, if extension of such practices as alley cropping or contour strips, used to slow down runoff and increase water infiltration, could be improved, not on an individual farmer basis, but with groups of neighbouring farmers.

Development of paddy land is generally a private activity, and wetland rice fields are privately owned. Development and management of an irrigation system, however, is a communal affair (Sektheera and Thodey 1975). Communal resource management is not restricted only to those groups who have had a long established traditional institution. A Lahu village of Lo Pah Krai, north of Chiang Mai in Thailand, which had become sedentary and started to practise irrigated agriculture only about 30 years ago, when faced with a succession of dry years, has effectively managed to deal with equitable water allocation among its own population and also negotiated sharing the water with down-stream villages (Rerkasem et al. 1992). Successful vegetable production in the dry season also requires village level organisation for the development and management of the gravitation-fed sprinkler irrigation system mentioned above; and success does not seem restricted to any particular ethnic group (TDRI 1994). Assistance from development projects was helpful when they provided support that strengthened the communal institution.

Local participation in resource management decisions

Although 'local participation' has now become a popular new catch-phrase in development circles, whether it is from an international expert to a local scientist, or a government official to a villager, in practice it is still very much a case of 'you participate, and I will tell you when and how'.

In Thailand, the Royal Forestry Department's program to involve villagers in forest management has included two activities, the forest village and the village woodlot (Ganjanapan 1996). For the first of these, villagers are contracted to plant trees for wages, or do so in exchange for the right to cultivate between the saplings until the canopy closes. In the village woodlot program, tree seedlings are distributed to farmers to plant on any pieces of vacant land around the village, i.e., school and temple ground, roadsides, etc.

Until now, villagers and communities have been able to 'participate' in major land-use management decisions largely only by default on the part of the government. Indigenous technologies and innovations came into use when no real improvements were forthcoming from publicly-funded research. In these instances communities must make their own rules or revise traditional rules to cope with the management of common resources. There is some good in this, as cultural beliefs and values are sometimes more effective towards sustainable resource management, especially when economic development is overemphasised by government policies (for example, see Ganjanapan 1996). Unfortunately, a communal institution without legal or official basis is sometimes limited in its effect.

There are, however, some hopeful signs that the process to incorporate true local participation into the government's policy cycle may have begun in the region. This can be seen in Thailand's effort to enact the 'Community Forest Law'. By November 1995 there were still heated arguments among different groups of advocates, including local communities who are the potential target of the law, concerning major elements, the emphasis, scope and even wording of the law (Ganjanapan 1996). One of the strongest points of contention is whether people should be allowed to live in and cultivate national reserves, e.g., national parks etc. And as of the date of writing of this paper (August 1996), while yet another draft of the law has been ordered, the government's action on forcible relocation of villages out of national reserves has been stayed.

A major practical question that comes back to soil conservationists is how to monitor land degradation if people are to be allowed to live in the reserves. There is an urgent need for some methods to quantify the impact of local land use on the environment. In addition to soil erosion, in certain situations measurements to determine the maintenance of various elements, such as biological diversity and yield of watersheds, will also be needed. In Thailand some 1000 communities now live in these reserves, and so some technologies, as well as capital-intensive methods such as run-off plots, are obviously out of the question. Monitoring tools are needed to enable local communities to evaluate the impact of their own land-use activities, and also to enable government officials to guard against violations.

Conclusion

Using examples from Thailand, this paper has discussed some issues related to the dynamics of mountain land use. From recent Thai experience, it is concluded that farmers, villagers and local communities have been successful in increasing productivity and reducing the risk of land degradation because they understand the interacting human and natural processes involved far better than scientists, development workers and various 'experts'. The paper has deliberately concentrated on efforts that have been effective under various population, socio-economic and cultural pressures, in order to reach some understanding of how land degradation could be slowed down. On the whole, however, there is still a large number of shifting cultivators who have not been able to cope with the pressure of 'development'. Assistance efforts and technical solutions risk being irrelevant unless they are based on an understanding of the highly dynamic nature of local institutional and political processes.

References

Allen, B.J. 1993. The problems of upland management. In: Brookfield, H. and Byron, Y., ed., South-East Asia's Environmental Future: The Search for Sustainability. Tokyo: United Nations University Press and Kuala Lumpur: Oxford University Press, 225–237.

Aneksamphant, C. and Tejajai, U. 1995. Management of sloping lands for sustainable agriculture in Northern Thailand. Thai Jour. Soils and Fertilisers, 17, 168–179.

CARE/HRIP 1992. Highland Resource Integration Project, Final Evaluation Report. CARE — International, Bangkok, 38 p.

Chapman, E.C. 1978. Shifting cultivation and economic development in the lowlands of Northern Thailand. In: Kunstadter, P., Chapman, E.C. and Sabhasri S., ed., Farmers in the Forest. The University Press of Hawaii, Honolulu, 222–235.

Charley, J.L. and McGarrity, J.W. 1978. Soil fertility problems in development of annual cropping on swiddened lowland terrain in Northern Thailand. In: Kunstadter, P., Chapman, E.C. and Sabhasri S., ed., Farmers in the Forest, The University Press of Hawaii, Honolulu, 236–254.

Cooper, R.G. 1984. Resource Scarcity and the Hmong Response: a Study of Resettlement and Economy in Northern Thailand. Singapore University Press, Singapore.

Ganjanapan, A. 1996. Will community forest law strengthen community forestry in Thailand? In: Proceedings of the Symposium on Montane Mainland Southeast Asia in Transition. Chiang Mai: Chiang Mai University, 349–365.

Grandstaff, T.B. 1980. Shifting cultivation in Northern Thailand. Resource Systems Theory and Methodology Series, No. 3. United Nations University, Tokyo.

Hinton, P. 1978. Declining production among sedentary swidden cultivators: the case of the Pwo Karen. In: Kunstadter, P., Chapman, E.C. and Sabhasri, S., ed., Farmers in the Forest. The University Press of Hawaii, Honolulu, 185–198.

Judd, L.C. 1964. Dry Rice Agriculture in Northern Thailand. Southeast Asia Program, Data Paper No. 52. Cornell University, Ithaca, N.Y.

Keen, F.G.B. 1978. Ecological relationships in a Hmong (Meo) economy. In: Kunstadter, P., Chapman, E.C. and Sabhasri S., ed., Farmers in the Forest, The University Press of Hawaii, Honolulu, 210–221.

Kesmanee, C. 1987. Hilltribe Relocation Policy: Is There a Way Out of the Labyrinth? A Case Study of Kam Phaeng Phet. Tribal Research Institute, Chiang Mai, 45 p.

Kunstadter, P. 1978. Subsistence agricultural economics of Lua and Karen Hill Farmers, Mae Sariang District, Northwestern Thailand. In: Kunstadter, P., Chapman, E.C. and Sabhasri S., ed., Farmers in the Forest, Honolulu: The University Press of Hawaii, 71–133.

Kunstadter, P. and Chapman, E.C. 1978. Problems of shifting cultivation and economic development in Northern Thailand. In: Kunstadter, P., Chapman, E.C. and Sabhasri, S., ed., Farmers in the Forest, Honolulu: The University Press of Hawaii, 3–23.

Limpinatana, V. and Patanothai, A. 1982. Handbook of the Nerad Tambon. Northeast Rainfed Agricultural Project, Northeast Regional Office of Agriculture and Cooperative, Tha Phra, Khon Kaen, Thailand.

Menzies, N.K. 1991. The role and consequences of livestock in swidden agroecosystems in Sepone: implications for development interventions. In: Swidden Agroecosystems in Sepone District, Savannakhet Province, Lao PDR, Khon Kaen: Southeast Asian Universities Agroecosystems Network, 122–124.

Nakano, K. 1978. An ecological study of swidden agriculture at a village in northern Thailand. Tonan Ajia Kenkyu (South East Asian Studies), 16, 411-446.

Nakano, K. 1980. An ecological view of a subsistence economy based mainly on the production of rice swiddens and in irrigated fields in a hilly region of northern Thailand. Tonan Ajia Kenkyu (South East Asian Studies) 18, 40-67.

NESDB 1992. Opportunity and Plan for Northern Region Development within the 7th National Economic and Social Development Plan, 1992–1996. National Economic and Social Development Board, Office of the Prime Ministry, Bangkok.

NSC/NESDB 1993. A Directory of Highland Communities and Population 1993. National Security Council and National Economic and Social Development Board, Bangkok.

Padermchai, P. 1995. Labour Out-migration and its Socio-economic impact on the Community in Dok Kham Tai District, Phayao Province. MSc (Agric. Systems) Thesis, Graduate School, Chiang Mai University.

Renaud, F. 1995. Financial cost-benefit analysis using data from the Doi Tung soil-conservation experimental site in Northern Thailand. Presented at the Seventh Annual Meeting of the Management of Sloping Lands for Sustainable Agriculture in Asia Network. Organised by the Thai Department of Land Development and International Board on Soil Research and Management. 16–20 October 1995, Chiang Mai, Thailand.

Rerkasem, B., Rerkasem, K. and Shinawatra, B. 1992. Watershed Development Demonstration Program: A Monitoring and Evaluation Report, Agricultural Systems Program, Chiang Mai University, Chiang Mai.

Rerkasem, K. and Ondam, B. 1993. A Study of the Socio-economic Aspects of a Potential Relocation for Dong Ma Fai. TG-HDP IP, 172, 1–64.

Rerkasem, K. and Rerkasem, B. 1994. Shifting Cultivation in Thailand: its current situation and dynamics in the context of highland development, IIED Forestry and Land Use Series No. 4. 140 p.

RTG 1985. Thailand Northern Upland Agriculture. Thai–Australia — World Bank Project, Royal Thai Givernment, Ministry of Agriculture and Cooperatives, Department of Land Development.

Sabhasri, S. 1978. Opium culture in Northern Thailand: social and ecological dilemmas. In: Kunstadter, P., Chapman, E.C. and Sabhasri, S. ed., Farmers in the Forest, The University Press of Hawaii, Honolulu, 160–184.

Sektheera, R. and Thodey, A.R. 1975. Irrigation systems in the Chiang Mai Valley: Organization and Management. In: Agricultural Economics Report No. 6, Chiang Mai: Faculty of Agriculture, Chiang Mai University, 81–98.

Srisawad, B. 1949. Thirty Nationalities in Chiang Rai. (In Thai, publisher unknown).

Suthi, C. 1985. Highland agriculture: from better to worse. In: McKinnon, J. and Vienne, B. Hill Tribes Today. White-Lotus, Bangkok and Paris, 107–142.

TDRI 1994. Assessment of Sustainable Highland Agricultural Systems, Natural Resources and Environment Program, Thailand Development Research Institute, Bangkok.

Turkelboom, F., Van Keer, K., Ongprasert, S., Suthigullbud, P. and Pelletier, J. 1996. The changing landscape of the Northern Thai hills: adaptive strategies to increasing land pressure. In: Proceedings of the Symposium on Montane Mainland Southeast Asia in Transition. Chiang Mai: Chiang Mai University, 436–461.

Young, G. 1962. The Hill Tribes of Northern Thailand. Ams Press, New York. (Reprinted from Siam Society Monograph No. 1. 1962). 92 p.

Zinke, P., Sabhasri, S. and Kunstadter, P. 1978. Soil fertility aspects of the Lua forest fallow system of shifting cultivation. In: Kunstadter, P., Chapman, E.C. and Sabhasri, S. ed., Farmers in the Forest, University Press of Hawaii, Honolulu. 134–159.

Appendix 1
A Lesson from Upland Rice Improvement

Upland rice is the dominant staple of shifting cultivators, but yields of upland rice have generally been low, less than 1000 kg/ha (Rerkasem and Rerkasem 1994). Improving this productivity has been widely believed to be central to the solution to sustainable mountain land use (Sabhasri 1978). Thus, increasing the yield of upland rice has been the target of many development projects. However, trying to get mountain farmers to 'improve' their upland rice production is probably among the most difficult of agricultural extension efforts. The commonly held belief that fertilisers are not used because they are not cost-effective has been proved with an economic analyses (TDRI 1994; Renaud 1995). But even when they are given fertilisers by development agencies, farmers still refuse to apply them to upland rice. This has been interpreted as due to the lack of response of traditional rice varieties to management, especially fertilisers (Aneksamphant and Tejajai 1996).

The evidence in Thailand that upland rice yield can be increased came from farmers. In 1990, upland rice fields in Mae Hongson began to be pointed out by farmers as 'high yielding', an assessment borne out by the exceptionally high number of panicles per hill and the size of the panicles. The high yields, 2000–3000 kg/ha, were indeed verified in crop cutting surveys (Rerkasem et al. 1992). The upland rice, of traditional varieties, was grown in rotation with cabbages that received heavy doses of chemical fertilisers (mainly N and P). Reports of this residual value of vegetables on upland rice also came from other parts of the north (Turkelboom et al. 1996). For the cause of this improvement, residual fertilisers would be the first guess, but clean weeding under cabbages probably also led to fewer weeds, another pernicious problem in upland rice. Since these first observations, upland rice rotations are now widely seen, with other high input crops, with varying levels of input including soybean and other grain legumes, in many areas of Northern Thailand. Although the relative importance of upland rice to the overall productivity of the farming system has declined, many farmers still grow some upland rice in order to provide a degree of food security, even if only to provide 1–2 months supply (TDRI 1994).

Farmers' appreciation the of residual values of cash crops is now often highly developed. Cabbages and soybeans are commonly believed to be good for the yield of the upland rice that succeeds them, whereas common beans (*Phaseolus vulgaris*, grown either for dry seeds or green beans) are not. Solid agronomic studies to provide definitive explanations of these differences would be useful for large-scale extension efforts.

Livestock Production Development in the Northern Highlands of Thailand

Boonserm Cheva-Isarakul[1]

Abstract

This report reviews livestock production development in the northern highlands of Thailand. In shifting agriculture, the connection between crop growing and livestock is rather limited. During the planting season, cattle are moved to forests to graze. Grazing and browsing areas in many villages are now smaller than ever; consequently, the number of cattle has decreased. However, in many areas, the average body size of native cattle has improved. (For pigs, the three line cross-breed, Native × Mei Shan × Duroc, appears to be a promising breed for fattening). The major constraints to the development of cattle production are the present distribution of cattle ownership, the limitation of grazing areas, dry season feed shortage, as well as disease and parasite problems. The conditions that should be considered for the development of future cattle production are: the migration of villagers from rural to urban areas for employment, the promotion of environment awareness among highland dwellers, the improvement of public communication and feeder roads between rural areas and cities, the decline of international assistance for agricultural development and the Thai Government policy on decentralisation of administrative authority.

IN THAILAND, the development of highland agriculture began in the late 1950s. Several programs and measures were adopted by the Government of Thailand to improve the general living conditions of the highland people, to slow deforestation, to decrease the area of opium production and to strengthen national security.

The King of Thailand, the Governments of Thailand, Australia, Germany, Canada and international organisations provided development funding with major development work in the agricultural sector focused on crop production rather than livestock production, as reported by Rerkasem and Rerkasem (1992), Laongsri (1994) and Seetisan (1995). Since there have been few reports on livestock development, this report aims to review livestock production development, its constraints and future.

Livestock in Shifting Agriculture

In shifting agriculture, unlike permanent agriculture, cattle appear to have no direct role in planting operations but indirectly, are sometimes used to transport crop products. Cattle also have a role as reserve capital—when crops fail, farmers often sell their cattle in order to have cash for family expenses. Small animals such as pigs and chickens are used as votive offerings for rituals to do with crop planting and harvesting, so every family keeps these small animals.

In such an agricultural system, livestock have only a loose connection with crop production. Field crop products, such as shelled corn and paddy rice, are commonly fed to pigs and chickens, but are not available as feed throughout the year as some is sold for cash. Therefore, animals have to depend to some extent on crop residues, by-products and natural feed sources. Although farmers feed rice straw to cattle, they usually store it only for limited periods due to the difficulty of transportation from far away rice fields to homesteads and cattle pens. As well, many farmers believe that highland rice straw is less palatable than straw from lowland rice. Corn stover is generally left standing dry in the field rather than cut and carried for direct feeding or storage, but cattle are allowed to graze edible parts in the field. Because of the system of cattle-keeping in which

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animals are allowed to graze in the forest during the wet season, the gathering of cattle manure is impossible, thus precluding the nutrient recycling through the use of manure as fertiliser, as occurs in some countries.

Livestock Production Development

Livestock-raising in each highland village has changed over the past 30 years. Besides the development efforts of government and non-government agencies, other factors account for the changes. They include the development of roads to the villages, expanded planting areas, population growth and government reforestation policies. However, conventional cattle-raising in which cattle graze freely in the forest is still practised in many areas.

The first livestock development activity aimed to improve the body size of native cattle. Bulls of larger body size and frame, particularly Brahman or upgraded Brahman bulls, were introduced to breed with indigenous cows. However, it was found that pure-bred or highly upgraded bulls could not adapt to the poor highland conditions and suffered from insufficient feed as well as from internal and external parasites. Feed shortage was most serious in the hot-dry season (February – April). Thus, the health of the bulls declined, they had no libido and were infertile. In addition, the bull's body size was too big to service the smaller native cows. However, in areas where bulls of lower exotic breed were used continuously, the average size of local cattle has improved.

Pig improvement programs were similar. Boars were introduced to some villages. However, white color pigs were not accepted while red or black pigs were more popular among highland dwellers. Therefore, the three-line crossbreed, Native Mei Shan Doroc, seems to be the most promising for fattening under highland conditions. In areas covered by reforestation policies, there has been a reduction in cattle numbers, so more families now keep pigs.

Constraints to cattle production development

Cattle ownership

The distribution of cattle among farmers is of primary concern, since poor farmers seldom own cattle, while rich farmers may own big herds, acquired primarily through inheritance. It is difficult for the common highland farmers to buy cattle, as the price of one animal can be as high as the whole family's yearly income from crop production. Many development programs have set up different types of cattle funds in order to alleviate this problem. Cheva-Isarakul (1992) listed different ways of managing cattle funds, observing that successful cattle fund management required good monitoring and good farmer participation and organisation.

Grazing and browsing areas

Government reforestation policies, increased population and the expansion of crop fields have affected the natural grazing and browsing areas of cattle. Recently, some development projects have put an emphasis on the crop-livestock system. The integration of cattle production with conservation on sloping lands, such as alley cropping and grass strip cropping, is recommended. Forages and grasses from the cropping system should be cut and carried to feed the cattle, but the implementation of this practice is still limited. In fact, several research studies have investigated how to use the locally available feed resources more efficiently, but technology transfer seems to be one step behind.

Dry season feed shortage

Animal feed is very limited during the dry season (February–April). Different classes of cattle are affected differently. Adult animals are less affected, some losing weight during the dry season and regaining it when feed is sufficient in the following rainy season. Young animals that are severely undernourished might have retarded growth, late puberty and prolongation of the first calving age. Brooding cows are also affected by malnutrition, resulting in longer calving intervals. Feed supplementation during the dry season is not widely practised, because farmers are not aware of the problem and not willing to pay for the cost of feed.

Diseases and parasites

Haemorhagic septicaemia, foot and mouth disease, and black leg are found in many villages. It appears that cattle crossing from neighbouring countries cause outbreaks of the diseases. *Haemorhagic septicaemia* appears to be an important cause of animal losses especially in buffalo. Vaccination against these diseases is still not recognised by highland farmers as necessary for prevention. Although local livestock officers have provided low-priced drugs for livestock deworming, regular control of internal parasites is not practised.

Outlook for Livestock Production Development in the Northern Highlands of Thailand

The migration of people from highland rural areas to urban areas for employment has had a negative impact on the conventional cattle production system because the system required labourers to tend the cattle. In addition, the cattle's grazing and browsing area is limited due to reforestation programs. Consequently, many farmers prefer to keep pigs rather than cattle. At present, pig-raising provides a better return than cattle-raising, so farmers have been requesting more funds for pig production than for cattle. Therefore, pig husbandry in the highlands should have a larger role as an income generator in the future.

Environmental awareness among highland villagers is now being promoted, especially with regard to forest and water resources. It should be the right time to extend sustainable livestock production. Cattle producers who allow cattle to graze freely in the forest should develop practices to protect forest and water resources. The integration of crops with livestock should be focused, with training programs conducted to bring about technology transfer.

As feeder roads and public communications between rural areas and cities are continuously improved, there is marketing potential for private companies to sell feed, vaccines and equipment for livestock production. Therefore, the private sector should be invited to participate in livestock development programs as well.

The problem of feed shortage in the dry season should be solved. Available knowledge on the improvement of low quality roughage, the preservation of feed as silage and hay, as well as the strategies of feed supplement should be intensively reviewed and evaluated. In order to have effective implementation, farmers should participate in the selection of appropriate technologies.

At a time when international assistance for livestock development is decreasing and the Thai Government's policy on decentralisation of administrative authority has been implemented, it is necessary that the local administration increase its role in village agricultural development. Any efforts to encourage local authorities to support the needs of the villagers on livestock production management should be strongly supported.

References

Cheva-Isarakul, B. 1992. Animal feeds in highland farming systems and cattle fund management in the highlands. Department of Animal Science, Faculty of Agriculture, Chiang Mai University, Thailand 20 p (in Thai).

Laongsri, S. 1994. Historical summary of the development, form and effectiveness of the solutions to the problems of the northern highlands. Paper presented at the seminar on Two Decades of Highland Development, June 20–22, 1994, Chiang Mai, Thailand (in Thai).

Rerkasem, K. and Rerkasem, B. 1992. Evaluation of shifting agriculture in northern Thailand: its social, economic and environmental values relative to alternative land uses. Chiang Mai University, Thailand (mimeographed).

Seetisarn, M. 1995. Shifting agriculture in northern Thailand: Present practices and problems. In: Rerkasem, B., ed., Proceedings on Montane Mainland Southeast Asia in Transition. Chiang Mai University, Thailand, 17–30.

Livestock in the Highlands of Northern Thailand — Reflections on Some Project Experiences

Stephen Carson[1]

Abstract

Various projects with international funding have supported highland development for more than 25 years. Although livestock-raising forms an integral part of the traditional social and economic life of most highland ethnic groups, agricultural development efforts during most of the period up until the early 1990s concentrated on crop promotion. However, more recently, the potential importance of livestock production has been re-assessed and incorporated into development approaches aimed at resource management and sustainable farming systems.

FOR MANY ethnic minority groups living in the mountainous areas of northern Thailand, livestock has traditionally provided an important source of protein and cash income and has been an integral part of certain spirit festivals. This remains true in comparatively remote locations, such as areas inhabited by ethnic Karen which were included in the programs of the Integrated Pocket Area Development (IPAD) Project and the Thai-German Highland Development Program (TG-HDP) from 1991. Baseline information from one area, Mai Hong in Om Koi district, Chiang Mai Province, indicated the importance of income derived from livestock sales, some 72.7% of the total (Figure 1). 'Others' in Figure 1 mainly refers to opium-related income, either from production, trading or as wage labour.

Concurrently, other ethnic groups such as the Lahu in the TG-HDP Nam Lang area, who have generally changed to living in permanent settlements, have been intensifying their livestock production as a means of generating alternative income to opium production. Table 1 (from Orth et al. 1991) shows the importance of income from livestock in Lah villages such as Pang Kham Noi and Bor Khrai.

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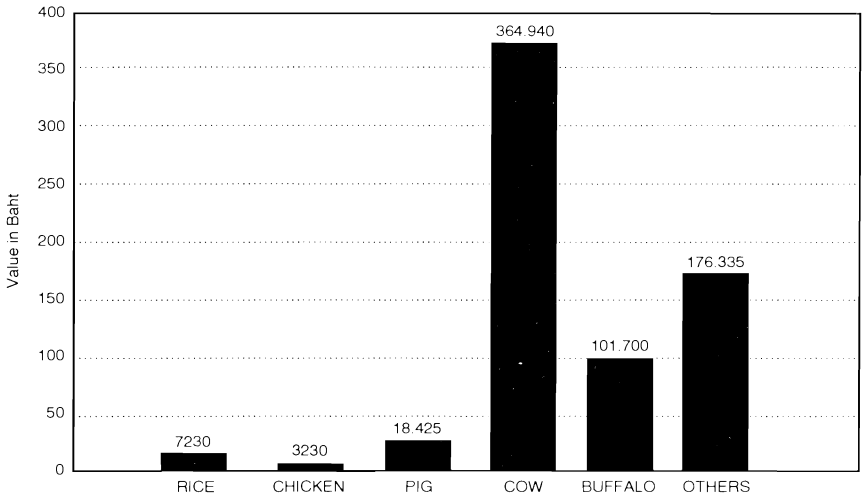
Highland Development Projects

Mainly as a result of an international desire to reduce the supply of opium to the outside world, northern Thailand has been the recipient of a large number of donor-funded projects during the past 25 years. The largest and most enduring highland development project, the Royal Project, was launched by His Majesty King Bhumibol in 1969. Although crop research was the initial priority, more general development services are now provided to some 380 villages from a network of six research stations and 28 development stations. The first project funded by the United Nations (U.N.) was launched in 1973. Successive U.N. projects focused mainly on reduction of the production of opium, initially by specific crop substitution, but later using an integrated, highland-development approach.

Australian assistance in the form of the Thai–Australia Highland Agronomy Project, with technical support from the University of Queensland, began in 1972 to develop better utilisation of highland grassland areas for improved ruminant production. The succeeding Thai-Australia Highland Agricultural Project (T-AHAP) expanded its focus to include the utilisation of local foodstuffs for improved highland pig nutrition (Hoare et al. 1978). More detail of the technical content is presented in Dr Boonserm Cheva-Isarakul's paper (these Proceedings). Suffice it to say that very little adoption of the technology developed by T-AHAP subsequently took place during the 1980s.



Source: Field Survey, Payap University, June 1991. Mae Hong Area, Om Koi district, Chiang Mai Province.
Population: 17 villages; 528 households.
Total income: 671 880 Baht.
Average income: 1.272 Baht/household.
Average income from livestock: 925 Baht/household (72.7% of total).

Figure 1. Income by source — Mae Hong Area.

Table 1. Cash revenue from agriculture by village, Nam Lang Area, 1991.[1]

Village name	Percentage households with agricultural cash revenue	Av. Annual cash revenue per household in Baht		
		From crops	From animals	Total
Nong Tong (Lisu)	60.0	2559	239	2798
Ban Rai (Shan)	84.6	5261	3282	8443
Bho Khrai (Lahu)	100.0	2774	4414	6588
Wana Luang (Shan, Lahu)	82.46	1470	3239	4709
Pha Mon (Lahu)	100.0	2592	1088	3679
Nam Rin (Lisu)	87.5	3897	1075	4972
Tham Lod (Shan)	86.4	2068	1437	3505
Muang Pam (Lahu)	79.2	1240	100	2840
Nong Pha Cham (Lisu)	76.5	2842	1162	4004
Mae Moo (Lisu)	63.6	2693	1006	3699
Ja Bo (Lahu)	90.9	1429	1700	3128
Ya Pa Nae (Lahu)	93.3	2750	1875	4625
Mai Hung (Lisu)	100.0	1214	328	1541
Luk Khao Lam (Lahu)	100.0	1735	3292	5027
Pang Kam Noi (Lahu)	100.0	1649	8233	9882
Huai Hea (Lahu)	100.0	1394	2135	3530
Pha Puak (Lahu)	100.0	1628	4244	5872
Pha Daeng (Lahu)	100.0	1430	2223	3653
Nam Hu Pha Sua (Shan)	100.0	4688	3504	8191
Nong Hoi (Lisu)	100.0	1400	408	1808
Pang Tong (Lahu)	100.0	3295	2636	5931
Cha Sua (Shan)	100.0	2544	2796	5340
Cha Tho (Shan)	100.0	540	696	1236
Average	89.3	2292	2163	4455

[1] Only households with cash revenue from agriculture.
In 1991, US$1.00 = 25 Baht.

Livestock-Raising — Subsidiary to Crop Production

Highland ethnic groups in northern Thailand are traditional crop producers. Essentially, groups such as the Hmong, Lisu and Lahu use a system of pioneer swiddening to cultivate upland crops, including opium. The Karen and Lawa use a rotational swidden system and irrigated paddy areas in a rice-based system. Livestock- raising is extensive, but with little time or inputs involved. The exception relates to pigs; the pioneer swiddeners grow maize for their swine, while the Karen collect wild banana trunks that they boil and mix with rice bran. Poultry forage freely, while cattle and buffalo graze in forest areas during the wet season and on crop residues following harvest during the dry season.

Highland farmers have clearly considered livestock-raising to be very much subsidiary to crop production. Large ruminants are generally regarded as 'banks' to which minimal care is afforded and which can be drawn from (in the form of sales) when cash is required.

During the 1980s, almost all highland development projects concentrated on extending crops that were alternatives to opium, and on improving food security. A soil and water conservation era followed that promoted measures aimed at achieving a more sustainable cropping system. This in turn has evolved into a more village-wide focus rather than an individual farmer focus, and community-based land-use planning and sustainable farming systems (including consideration of livestock) approaches have now been generally followed for a number of years.

A Reassessment of the Importance of Livestock

During the latter transitions in approaches, the importance of livestock-raising as part of the household economy was reassessed by many development workers. The reasons for this reassessment were many.

- As development services expanded and progress was made in meeting basic needs, village problem census meetings indicated that livestock disease was a major concern in many villages.
- Due to short project cycles, and pressure to achieve tangible and visible results, agricultural development programs tended to concentrate on more progressive (and male) farmers. Poorer households benefited relatively little. In discussions with such household members, improved livestock-raising opportunities were identified as a means to improving their situations.
- Market conditions for the sale of livestock are more stable than for many cash crops that are subject to considerable annual fluctuations.
- The sedentarisation of former swidden farmers increased their livestock-raising opportunities within a community resource management system.

As a consequence, more attention was given to a number of initiatives including:

- the training and equipping of village-level para-veterinarians to be able to recognise and treat a number of common diseases and support vaccination programs carried out by the Livestock Development Department;
- improvement of the cold chain for vaccines from district level to more remote villages;
- establishment of livestock-raising groups (or 'funds') for poorer households (usually cattle) and women's groups (usually involved with pigs or poultry);
- limited breed improvement—Mua San pigs, part Brahman bulls, multi-cross poultry;
- designation of grazing areas, fencing and oversowing with pasture grasses and legumes;
- growing crops for livestock feed;
- commercial pig-raising in a specific location outside the main village;
- emerging interest in stall-feeding of cattle associated with increased land intensity, for example, where grass strips are grown in association with fruit-tree production;

digging small-scale ponds and raising fish.

(Bor Khrai Lahu village, with 36 households in a TG-HDP area in Mae Hong Son Province, ceased opium cultivation in the late 1980s. Since then they have intensified pig production and established a special rearing area some 500 metres from the village. Maize is intensively grown for feeding and the village has become known in the area for the availability of weaner piglets and mature fat animals. In addition, all households own cattle, averaging 12 head per household. Between 60% and 80% of household income is now derived from livestock sales. As well, the village has also become engaged in the harvesting and sale of bamboo shoots.)

It is now quite interesting that 15–20 years after the T-AHAP developed some of these improved systems, they are beginning to be incorporated into more intensive livestock production. This coincides with a general broadening of the economic base of highland communities with an increasing involvement in a range of 'new' enterprises. Most notable of these are vegetables and fruits for marketing and processing, and sales of handicrafts.

Cooperation with Non-government Organisations (NGOs)

The involvement of NGOs has proved quite effective in livestock promotion at community level. In the case of IPAD, the partner was CARE International

(Pothjart 1992). TG-HDP has cooperated with Heifer International and Chiang Mai University. In both cases, the core program was the establishment of cattle and pig funds for poorer households. However, together with local livestock officials, village level para-veterinarians have been trained and equipped, farmers taken on study tours, grazing areas oversown and media produced. Two elements were found to be particularly important:

1. participating villages must have strong community leadership and cohesion;
2. group members must be involved in (or given responsibility for) the selection and purchase of animals for group funds.

Free-range Grazing versus Intensification of Cropping

Many areas have the potential to broaden cropping alternatives, but are limited by uncontrolled grazing, particularly during the dry season. From the household and community point of view, it must be asked if controlled grazing, fencing and stall feeding are viable options. Are the necessary inputs of materials and time considered worthwhile in relation to potential benefits? Crop intensification can include:

- growing a second irrigated crop in rice paddies;
- intensive year-round vegetable and fruit production;
- growing longer duration legumes into the dry season (e.g., lablab bean) in upland fields;
- intensifying fallows (e.g., with pigeon pea).

(Nam Rin, a Lisu village with 62 households also in the TG-HDP area, was early to engage in intensive vegetable production, mainly contract growing of green beans. By the mid-1980s, labour inputs for these intensive crops and difficulty in controlling their animals led the villagers to sell all their 200+ cattle and reduce pig numbers from 300+ to about 100. Pigs are now restricted to stall feeding, which the villagers maintain reduces their strength. However, as soil fertility declines (resulting in the application of ever-greater quantities of chemical fertiliser) and the market for vegetables fluctuates, the villagers are now reconsidering whether to re-engage in cattle raising.)

The collection and utilisation of livestock manures is rarely practised in mountainous northern Thailand, although a trade in manure has developed from lowland feedlots to intensive off-season irrigated cabbage production in some highland paddy areas. However, farmers consider the grazing of crop residues during the dry season important for adding manure.

Overstocking—an Emerging Problem

There may be a danger that continuation of low input-low output extensive raising systems for large ruminants for several more years will eventually lead to problems of overstocking, weaker animals and more susceptibility to disease. The expanding 'bank' concept is fine as long as there is adequate feed available for the growing herds in any given area. However, there are indications in both TG-HDP areas that cattle are increasingly wandering into the land of neighbouring villages. In some cases, these villages have reached agreements and enacted regulations accordingly. Eventually, as the carrying capacity of a given area is reached, there will need to be a more regular 'take-off' of animals. There are signs that this is already beginning to occur, as household income needs increase to continue the education of children and to buy an increasing range of consumer goods.

A Note Concerning National Livestock Departments

Most often, livestock officials are trained well in techniques that are used in countries that have intensive livestock-production industries. However, quite clearly, the livestock-production base and potentials of the largely traditional, often remote upland and highland communities in this region, are very different from such intensive industries. Although, in some circumstances, a change from extensive to intensive systems may appear logical, in practice, experience has indicated that this is likely to be a long and incremental process.

Livestock officials may have avoided the temptations of high technology solutions and put to one side techniques such as artificial insemination, the introduction of full-blood, exotic bulls, hybrid pigs and poultry, silage-making, urea supplementation and dairy production. Instead, they should consider initiating, facilitating and supporting incremental steps such as training village para-veterinarians, expanding vaccination services, and improving the range and availability of locally-grown feeds.

References

Cheva-Isarakul, B. 1991. Livestock Production in Nam Lang and Juai Poo Ling Areas. Internal Paper 141. Thai–German Highland Development Program, Chiang Mai, Thailand.

Orth, M. et al. 1991. Characteristics of Farm Households in Nam Lang. Internal Paper 128. Thai–German Highland Development Program, Chiang Mai, Thailand.

Pothjart, P. 1992. CARE-IPAD Livestock Management Project, Mai Hong area, Om Koi, Chiang Mai. IPAD Internal Report.

Hoare, P., et al. 1978. Thai–Australia Agricultural Project. Fourth Annual Report.

Some Observations on the Role of Livestock in Composite Swidden Systems in NorthernVietnam

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Abstract

Livestock are an important component of the composite swiddening systems employed by the Tuy and other ethnic minorities in Vietnam's northern mountain regions. These complex and relatively sustainable agroecosystems include paddy-fields, home gardens, free gardens, swiddens, forest and livestock as key components. Buffalo provide essential draught power for cultivation of paddy-fields as well as being an important source of fertiliser to maintain rice production in the paddies. Buffalo and cattle are sold for cash. Pigs are important for ceremonial feasting, as a source of cash, and to provide manure for fishponds and paddy-fields. Maintenance of livestock populations is dependent on the swiddens that provide cassava as pig food and, when fallow, serve as pastures for the buffalo. Livestock serve as a vector transferring energy and nutrients from the low productivity hillslopes to the high productivity valley bottoms where these scarce resources are of maximum value to the human population.

ONE OF THE less beneficial products of specialisation in science has been the separation of livestock from crops in agricultural research. This division of labour may be sensible in Europe or North America where farms are commonly specialised in either raising of crops or livestock. It makes less sense in the uplands of mainland Southeat Asia where domestic animals are an important component of most swidden farming systems.

For reasons that remain obscure, livestock are a much less important component of swidden systems in Peninsular Malaysia and insular Southeast Asia than they are on the mainland (Rambo 1982). Malaysian aborigines keep a few chickens and occasionally raise pigs captured from the wild, but these are more pets than economic animals. Among some groups, domestic animals cannot be consumed by the households that raise them although they can be traded to others. Domesticated cattle are unknown although wild cattle — seladang — rely on fallowed swiddens for pasture.

Recognition of the important role played by livestock in the functioning of swidden systems and, conversely, of the equally important role played by swidden farming in the production of livestock, has been slow to emerge. This is due at least in part to an artificial separation of crop scientists and livestock specialists in most research institutions. This workshop therefore marks an important advance in focusing attention on the inter-relationships between livestock and swidden agriculture in upland Southeast Asia.

It has been known since the late 1800s that trade in livestock flowed from the mountain areas to the lowlands in Laos, Thailand and Vietnam. Writing in the 1930s, the French colonial geographer Pierre Gourou reported that the peasants of the Red River Delta had to import buffalo from the surrounding mountains at the beginning of the ploughing season to make up for the perennial deficit of draught animals in the delta (Gourou 1936). This deficit reflected the shortage of pasture in the over-populated plains; a shortage that has persisted to present times (Bouahom et al. 1993).

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Before World War II, buffalo and cattle also flowed from the forested Khorat Plateau of northeastern Thailand down to the Bangkok plains. Although there are many such references to export of livestock from the uplands to the lowlands in colonial era literature, the reasons why the uplands had surplus animals to export do not seem to have been explored in depth. It certainly does not seem to have been recognised that 'shifting cultivation', invariably denounced by colonial authorities as technologically backward, environmentally destructive, and economically autarkic, played a key role in upland livestock production.

Recent descriptions of swidden agriculture that portray this form of agriculture sympathetically as a manifestation of sophisticated indigenous knowledge (e.g., Do Dinh Sam 1994; Le Trong Cuc 1996) devote little more attention to livestock. To the extent that ethnologists have discussed livestock in upland Southeast Asia (Condominas 1977; Izikowitz 1951) their attention has been focused on the role played by buffalo in the ritual lives of the highland peoples, not on the ecological or economic roles of livestock production. Thus, little systematic information is available on the integration of livestock into swidden agroecosystems. In this paper, the authors discuss some aspects of the place of animals in the composite swiddening system practised by the Tay of Tat Hamlet in Da Bai District, Hoa Binh Province in the Da River watershed.

Tay Composite Swidden System

The Tay of Tat Hamlet are what have been called elsewhere 'composite swiddeners' (Rambo 1996). In composite swiddening, households manage simultaneously both permanent wet rice-fields in the valley bottoms, shifting swidden fields on the hillslopes, and exploit wild resources of the forest. Livestock are a critical vector linking these different agroecosystem components into an integrated and remarkably sustainable system. In addition to the Tay, composite systems are found among the Muong of northern Vietnam (Cuisinier 1948), the Shan of Burma and northern Thailand (Durrenberger 1981) and the Hani of Xishuangbanna Prefecture in southwestern China (Pei Shengji, pers. comm.).

The Tay agroecosystem is a complex one. Key subsystems include wet rice fields, home gardens, fish ponds, livestock, tree gardens, rice swiddens, cassava swiddens, fallow swiddens and secondary forest.

Wet rice fields

The wet rice fields are built in a series of terraces rising like steps from the stream in the middle of the valley floor. The flow of water through the paddies is continuous.

Because the fields are kept continuously flooded, ploughing is not usually required. Cultivation is done with wooden harrows drawn by a single buffalo. Each field is harrowed three times before planting. As many as six buffalo will be used at one time in the larger fields. Farmers from several households exchange their own labour and that of their buffalo to do this task.

Manure from the buffalo and cattle, night soil, and green manure are all used to fertilise the paddies. Recently, some farmers have begun experimenting with the use of chemical fertilisers. Manure is collected from the buffalo and cattle that are stabled at night underneath the house. It is stored in large woven bamboo bins until needed and then carried to the fields in pack baskets by the women and children and with shoulder pole baskets by the men. One farmer said that he used 300 kg of manure per crop for a field area of about 1500 m^2. He said this was a higher than average amount because his fields were close to his house. Farmers say they generally have adequate quantities of manure and that use of greater amounts would produce excessive vegetative growth with lowered grain production. Yields average about 2.5 t/ha per crop. Because the area planted to wet rice is small, averaging 0.14 hectares per household, families harvest an average of only 650 kg of rice per year. This is an insufficient quantity to meet their grain needs, so they must make up the shortfall by cultivating swiddens.

Home gardens

Scattered around the house plot are varieties of trees that make up the home garden. Papaya, bananas, pomelo, oranges, guava, jackfruit, and tea are the most commonly-planted species. Some houses also have a small bamboo-fenced enclosure where green vegetables are grown protected from depredations of the free-ranging household livestock.

Fish ponds

Located within a few metres of most houses are one or more small fish ponds with an average surface area of about 100 m^2 and depth of from 1 m to 2 m. Carp and tilapia are the most commonly-raised fish. They are fed cassava leaves, weeds, rice bran, and buffalo and pig manure. Cultivation is not very intensive and productivity is low.

Livestock

Most households keep at least one buffalo and one or more cattle. They are allowed to range freely in a valley that is reserved by the cooperative for use as a pasture. After the swiddens are harvested, livestock are allowed to free-range there. Goats were raised some years ago, but were abandoned because of the destruction of vegetation that they caused. Pigs of the local pot-bellied variety are kept in small numbers, but are vulnerable to disease. Pigs are of great ritual importance, as they are needed by the families of young men for bride payments. Some are free-ranging during the day while others are kept all of the time in small cages in the home gardens. They are fed primarily on cassava roots from the swiddens close to the village and banana stalks from the gardens.

A small number of chickens are kept by most households for feasts and for eggs. Ducks are also raised. Fowl range freely around the houses during the day, but are kept in special bamboo pens beside the house at night. They are fed rice bran and other kitchen scraps.

Tree gardens

Patches of trees are planted on the hillslopes behind houses. Palms, melia, *Aleurites montana* (candlenut) and bamboo are the most common tree garden species, usually planted in pure stands. Melia and *Aleurites montana* are also planted in cassava swiddens where they gradually become the dominant species. Recently, people have also begun planting *Eucalyptus* in old cassava swiddens as part of a World Food Program project.

Swiddens

The Tay distinguish between two types of swiddens — those for cassava and those for rice. The cassava swiddens are sited on the lower slopes of hills near the hamlet where the soil is too sandy and infertile to support rice cultivation. Cassava roots are eaten as a substitute for rice. The roots are also fed to pigs and the leaves used for carp food. Fresh roots and fried chips are sold. Tubers of a type of banana *(Maranta edulis)* are also raised in the swiddens for both human consumption and as food for pigs.

Rice swiddens are cleared from secondary forest on soils thought to be of higher fertility. Rice swiddens are almost pure monocultures although some cucurbits, squash and melons, rice, beans and maize are inter-cropped with the rice. Most of these plants are grown for consumption on the spot when the Tay stay overnight in their field huts to protect their ripening crops from wild animals. Surplus production may be carried back to the village for consumption there.

Households cultivate at least two rice swidden plots at any one time. The average area cultivated each year is about 1.2 ha. Yields are estimated to average 680 kg/ha.

Fallow swidden fields

Following the rice harvest, swiddens become open access pasture for cattle and buffalo from the hamlet. The effect of grazing on forest regeneration has not been studied. Several Tay remarked that efforts to improve management of the fallow period such as enrichment planting of leguminous trees would be difficult because of unregulated grazing.

Forest

Virtually no primary forest survives but the tops of most hills and the channels of watercourses are covered with well-developed secondary forest. These areas are defined and protected by the cooperative. Individuals who clear swiddens in these protected areas are subject to fines and are also compelled to plant trees to speed reforestation of the plots.

Forests are an important source of resources to all households both for their own consumption and for sale. Bamboo shoots are an especially valuable commodity both for household subsistence and as a source of cash. Numerous species of medicinal plants were formerly collected, but supplies are becoming increasingly scarce (Ireson and Ireson 1996). Cattle and buffalo also graze in areas of scrub and secondary forest. Because of the long distance to the settlement, the forest is not employed as a foraging area for pigs.

(White Thai in Mai Chau have been observed to collect wild taro leaves — *giay* in Vietnamese — and grass from the forested mountains surrounding their valley bottom settlement and backpack these down to feed their pigs. They walk for up to five or six hours, rising in altitude more than 500 m, in order to reach the areas of scrub forest where they can collect the wild leaves. Their loaded baskets weigh between 40 kg and 60 kg. Obviously, from the standpoint of energetics, this is irrational because the women expend more calories collecting and transporting the leaves than the pigs gain from their consumption. But pork has a high cash value. Cash is the object, not energy efficiency. The collection of wild leaves for pig feed from the scrub forest on the hillslopes above Mai Chau provides another example of the extent to which many mountain minority people already heavily exploit resources of lands classified by the government as *dat chua dung* — lands not yet in use — [Rambo, unpublished field notes]).

From this brief description, it is evident that livestock are an important component of the composite swiddening system. Indeed, this system could not function successfully without its livestock component. Buffalo provide essential draught power for cultivation of the paddy-fields, as well as being an important source of fertiliser to maintain rice production in the paddies. Pigs are important for ritual, ceremonial feasting, and provide manure for the fish ponds and paddy-fields.

Livestock are also an important source of cash income. At the same time, maintenance of the livestock population is dependent on the swiddens that provide pasturage for the buffalo and cattle and cassava for pig food. Livestock serve as a vector for transferring energy and nutrients from the low productivity hillslopes to the high productivity valley bottoms, where these scarce resources are of maximum value to the human population. This is an important, but little studied ecological function of livestock in agroecosystems in many upland areas in Southeast Asia (SUAN 1987).

Conclusion

Composite swiddening, livestock and the development of sustainable upland agriculture in mainland Southeast Asia

Although some anthropologists continue to sing the praises of swidden agriculture, this traditional agricultural system is no longer viable in most of mainland Southeast Asia. This reflects the dramatic increase in population densities in the uplands and the incorporation of large tracts of forest into protected reserves that are off-limits to swiddeners. The consequent unfavourable shift in the people-to-land ratio has forced a dramatic shortening of the fallow cycle in most rotational swidden systems. Fields that had been cropped for but a single year and then fallowed for 20 years are now cropped for two or three years and then fallowed for no more than four years. Such intensification maintains production in the short term, but results in greatly reduced yields and permanent environmental degradation once the fallow period falls below the minimum time necessary for adequate forest regeneration. Pure rotational swidden systems offer few possibilities for sustainable intensification so that there is an imperative to introduce alternative agricultural systems. Composite swidden systems offer one approach that can help pure swiddeners make the transition to more sustainable alternative modes of subsistence.

Composite swiddening offers a number of advantages over pure swiddening. The wet rice field component of the system, although having a small total area, enjoys a relatively high and stable yield. Because households meet one-half of their grain requirements from their paddies, they can clear a significantly smaller area of swidden fields each year than would be the case if they had to rely exclusively on swiddens to meet their consumption needs. Consequently, the carrying capacity of a given area is twice as great as it is when rotational swiddening is the primary mode of adaptation.

The paddies and the swiddens together create a favourable niche for livestock. Buffalo are essential to maintaining paddy field productivity, both as a source of traction and manure. They also offer one of the few viable cash crops in remote mountainous areas where poor transportation makes it difficult and expensive to carry most goods to market. The fallowed swiddens provide essential pasture for the livestock, allowing their maintenance with minimal additional human labour. An unanticipated side-effect of government efforts to prohibit swidden cultivation and to promote reforestation of hillslopes is the reduction of the area available to graze livestock. In a recent study of Center for Natural Resources and Environmental Studies (CRES) and the East-West Center (EWC) of a rural development project in the provinces in the northern mountains, it was found that farmers value the project because it offered a source of low cost loans to purchase livestock, but were concerned that successful reforestation would eliminate access to upland pastures. Incorporation of trees yielding fodder into the species mix might be one way to overcome this contradiction (Donovan et al. 1996).

Ultimately, of course, composite swidden systems face the same fate as rotational systems, if population density increases beyond carrying capacity. This has already happened at Ban Tat where the population density has increased from fewer than 10 persons per square kilometre in the 1950s to more than 70 persons per square kilometre today. As a result, the fallow period has been reduced to only two to four years, forest regeneration is impossible, yields are falling and environmental degradation is becoming evident. The response of government authorities has been to prohibit clearing of swiddens, but it is impossible to enforce this regulation because the people have no other source for the one-half of their income that would otherwise be raised in the swiddens. Finding ways to increase production on other components of the agroecosystem, notably the paddy-fields, the home gardens, fishponds, and livestock, is one partial solution. Accelerating the rate of regeneration of fallow swiddens, so as to permit a more frequent rotation, is another solution. In the long term, the Tay swiddens might evolve in the direction of the Talun-Kebun system of Java. There, a highly sustainable and very productive system of long fallow swiddening remains an important component of the agroecosystem that supports perhaps the highest population density of any mountain area in the tropics.

Composite swiddening, as exemplified by the Tay of Ban Tat, is a complex and highly evolved strategy for survival that combines crops, livestock and forest products into an integrated system. Composite swiddening is thus an indigenous agricultural technology that is deserving of attention from researchers seeking solutions to the problems of upland development in mainland Southeast Asia. A better understanding of the role of livestock in the functioning of this system is especially needed.

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References

Bouahom, Bounthong, Bui Hua Phat, Cu Viet Ha, Le Van Thu, Le Van Lanh and Pham Xuan Thao 1993. The role of livestock in the agroecosystem. In: Le Trong Cuc and Rambo, A.T. ed., Too many people, too little land: The human ecology of a wet rice-growing village in the Red River Delta of Vietnam. Honolulu: East-West Center Program on Environment Occasional Paper No. 15, 117–129.

Condominas, G. 1977. We Have Eaten the Forest. New York: Hill and Wang.

Cuisinier, J. 1948. Les Muong: Geographie Humaine et Sociologie. Paris: Institut D'Ethnologie.

Do Dinh Sam 1994. Shifting Cultivation in Vietnam: Its social, economic and environmental values relative to alternative land use. IIED Forestry and Land Use Series No. 3. London: International Institute for Environment and Development.

Donovan, D., Tran Duc Vien, Rambo, A.T., Fox, J. and Le Trong Cuc, ed., 1996. Development Trends in Vietnam's Northern Mountain Regions. Unpublished final report of a study conducted for the Swedish International Development Cooperation Agency by the East-West Center and the Center for Natural Resources and Environmental Studies.

Durrenberger, E.P. 1981. The ecology of a Shan village. Ethnos, 46 (1–2): 64–79.

Gourou, P. 1936. *Les Paysans du Delta Tonkinois* (The Peasants of the Tonkin Delta). Paris: L'Ecole Francaise d'Extreme Orient.

Ireson, C.J. and Ireson, R.W. 1996. Cultivation the forest: Gender and the decline of wild resources among the Tay of Northern Vietnam. Honolulu: East-West Center Working Papers, Indochina Series No. 6.

Izikowitz, K.G. 1951. Lamet: Hill Peasants of French Indochina. Etnologiska Studier 17. Etnografiska Museet. Goteborg, Sweden.

Le Trong Cuc 1996. Vai tro cua tri thuc dia phuong trong phat trien ben vung vung cao (Role of local knowledge in sustainable development of high areas). In: Tran Duc Vien and Pham Chi Thanh, ed., Nong Nghiep tren Dat Doc: Thach Thuc va Tiem Nang. Hanoi: Nha Xuat Ban Nong Nghiep: 20–26.

Rambo, A.T. 1982. Orang Asli adaptive strategies: Implications for Malaysian natural resource development planning. In: MacAndrews, C. and Chia Lin Sien, ed., Too Rapid Rural Development: Perceptions and Perspectives from Southeast Asia. Athens: Ohio University Press, 251–299.

Rambo, A.T. 1996. The composite swiddening system of the Tay ethnic minority of the Northwestern Mountains of Vietnam. In: Montane Mainland Southeast Asia in Transition. Chiang Mai: Chiang Mai University Consortium: 69–89.

SUAN (Southeast Asian Universities Agroecosystem Network) 1987. Ecosystem interactions in a rural landscape: The case of the Phu Wiang watershed, Northeast Thailand. Khon Kaen: Khon Kaen University.

Appendix
Animal Production in the Mountain Regions of Vietnam

VIETNAM has a total land area of about 331 041 km^2, a population of about 76 million (1995) and is divided into seven ecological zones (Table 1a).

Table 1a. Areas and populations in the ecological zones.

Region	Area (%)	Population (%)
1. Upland, midland	32.0	17.0
2. Red River Delta	3.6	19.4
3. The Zone No. 4	15.4	13.4
4. Coastal region of centre	13.5	10.4
5. Central highland	16.5	4.1
6. South East Mekong	7.0	12.2
7. Mekong Delta	12.0	21.8

As Table 1a indicates, the upland and midland of the north accounts for 32% of the total area, but carries only 17% of the population. The west highland is 16.5% of the total area, but has only 4.1% of the population. In general, the mountainous regions of the north account for a greater proportion of total area, but only a small proportion of the population.

Vietnam has about 14.2 million hectares of unused land of which about 9 million hectares are bare hills and mountains; the other 5 million hectares represent pastures suitable for the development of animal husbandry.

Between 1991 and 1995, the number of animal herds increased continuously at a rate of between 1% and 8% per year, according to different species of animal. The results are presented in Table 2a.

Table 2a. Number of animal herds, 1991–1995 (thousands).

Year	Buffalo	Cattle	Pigs	Chickens
1991	2855.6	3151.0	12 183.2	80 578.2
1992	2883.4	3193.8	13 881.7	89 704.9
1993	2960.8	3353.0	14 873.9	95 087.2
1994	2971.1	3466.7	15 569.4	99 627.1
1995	2963.1	3638.7	16 307.4	107 958.4

In Vietnam, pork meat supplies 76.1% of daily meals, poultry 15%, while buffalo or beef supply only 8.9% (1995).

The distribution of animal herds is also considerably different between the ecological zones (Table 3a).

Table 3a. Distribution of animal herds according to ecological zones (%).

Region	Buffalo	Cattle	Pigs	Chickens
1. Upland, midland	51.8	18.7	25.6	26.8
2. Red River Delta	8.6	8.7	22.2	23.0
3. The Zone No. 4	22.0	22.5	16.4	25.2
4. Coastal region of centre	4.6	23.0	6.5	6.5
5. Central highland	1.58	10.8	4.0	1.5
6. South East Mekong	6.38	11.9	7.0	10.0
7. Mekong Delta	4.96	4.47	15.0	17.0

Buffalo

The majority of buffalo herds are local breeds, bred mainly for draught work. In northern mountain areas, buffalo herds represent about 52% of the total for the whole country, while in the central highlands, they represent only 1.6%.

Cattle

For cattle, the local breed represents about 85% of the total. The breed is small, giving only a small yield of meat, and is raised mainly for ploughing. The Zebu crossbreed represents about 14.5% of the total herd, and has been improved in stature as well as in meat and milk yield. However, it is found only in the Delta area and the provinces of Zone No. 4. The milking cow herd represents only 0.5% of the total and is found only in Moc Chau (Son La), Lam Dong, suburbs of Ho Chi Minh City and Hanoi.

Pigs

Out of the seven ecological zones, the greatest number of pigs is concentrated in the mountainous area of the north, representing 25.6% of the total for the country. However, pork meat production is concentrated in only two zones, the Red River Delta (26.0%) and the Mekong Delta (22%). The mountainous area and the midlands produce only 18.9% of the total pork meat production for the whole country, because of the low yield of the livestock. In lowland areas, the proportion of crossbred pigs is high and the pig-raising cycle is fast. In the mountainous areas and the midlands, pigs are mainly local breeds, although well adapted to local conditions. However, meat yield is not high, so they are sold after 15 months of growth at about 60 kg. In comparison, pigs in the Red River Delta need only eight months of growth to reach the same weight, and in the eastern zone of South Vietnam, even less than eight months.

Chickens

Chicken husbandry mainly serves the daily food needs of farmers, but as well, considerable incomes can be derived in households in the countryside where domestic chickens account for about 80% of the total country population. Of these, about 26.8% are found in the mountainous areas of the north, but only about 1% in the central highland. Industrial poultry accounts for the other 20% of the country total, but are mainly found in the delta zones and the suburbs of large cities.

General Evaluation

Since 1991, the number of animal herds has increased rapidly, averaging between 1% and 8% per year, depending on the species (pigs 5%, cattle 2.9%, buffalo very low at 0.8%, and chickens 5.2%). Productivity and quality of products are not sufficiently high and differ between ecological zones. For instance, the productivity and quality of products in the mountainous areas and the midlands are lower than for the lowlands.

Investment in science and technology and their effects on animal production and veterinary services is still limited, especially in the mountainous areas and the midlands.

Animal Production in Lao Cai Province 1991–1995

Lao Cai is a province in the high mountainous region of Northwest Vietnam, contiguous with China. Total land area is 804 954 hectares, 84% of which is sloping land, and 2.8% or 22 707 hectares is pasture. The climate is temperate and is therefore suitable for the development of animal and poultry breeds imported from temperate countries. Ethnic groups such as the Hmong, Dao, Ha Nhi and Tay make up about 65% of the population. As with the majority of the other provinces in the mountain area, the economy of Lao Cai is under-developed and lacks a rational economic structure. Agricultural production is the activity, but the general domestic product is only 50% of the national average, with annual budget receipts only 30% of expenditures. Therefore, the State has to provide the other 70% of budget expenditures.

Table 4a shows animal populations and their percentage increase during the period 1991–1995, which is similar to the national average.

Pigs

In 1995, pig numbers in Lao Cai Province reached 185 419, an annual increase of about 4.1%. The proportion of sows was very high at between 20% and 25%, as against the national average of between 12% and 15%. Hybrid pigs and purebred imported pigs represent about 70% of the national pig population, but only between 8% and 10% of the provincial total. So, it follows that the majority of pig numbers in Lao Cai Province are local pigs of low yield. Although production is extensive, pigs bred for meat attain only 30 kg to 40 kg after a year's growth, with sows producing only 6–7 piglets per year.

Buffalo

By early 1995, the buffalo herd had grown to 90 914 at an annual increase of 1.8%. Buffalo are bred mainly to supply draught power; however, in a number of high mountainous areas, the proportion of buffalo deaths from cold weather and lack of food has increased.

Cattle

Compared with buffalo, cattle numbers are small, reaching only 8701 by 1995. However, the annual increase of 8.7% is high due to an increasing market demand for beef in recent years.

Horses

Horse numbers decreased since 1990 at an average annual rate of 4.9%. The main reason was the shift from the use of horses for transportation of goods to mechanical means. A partial improvement in the road system has allowed for bulk transportation of merchandise directly to the villages.

Goats

High market demand has stimulated household goat breeding, producing an average annual increase in goat numbers of 21%, the highest of the livestock under review.

Poultry

Poultry in the province consist mainly of local species that are bred extensively. The quantity of industrial chickens bred by 1995 represented only 5.3% of the total (national average 20%). Experimental breeding of ducks has begun, but by 1995, numbers had reached only about 5000.

Epidemics and Veterinary Services

Epidemic situation

Because of the characteristic shifting cultivation practices of the wandering hill tribes whose animals are left to wander, epidemics appear to be a permanent feature. Outbreaks of cholera, pasteurellosis and anthrax have occurred in Lao Cai, but not Aphtha. Statistics show epidemics killed 461 cattle and 9000 pigs in 1994, and 1163 cattle and 8000 pigs in 1995. No statistics were available for poultry.

Table 4a. Animal populations and percentage increase, 1991–1995.

Year	1991	1992	1993	1994	1995	Increase/yr (%)
Pigs	157 655	168 477	177 071	178 488	185 419	4.1
Buffalo	81 092	83 860	85 359	89 751	90 914	2.8
Cattle	6 213	6 937	7 619	7 766	8 701	8.7
Horses	27 548	27 758	28 140	22 193	22 617	–4.9
Goats	6 915	8 773	9 526	13 659	14 780	20.9
Poultry	761 866	761 617	805 680	900 518	937 755	4.5

Veterinary services

Because the province is mountainous with a long border with China, the business of illegal transportation of animals continues and is difficult to control. This has been a continuing cause of the appearance and spread of epidemics in a situation where only about 35% of domestic animals are vaccinated, despite free distribution of vaccines to about 89 communes. Other factors adding to the situation are that in general people are not very conscious of the potential damage of epidemics, and that veterinarians are generally few, with no high degree of professional skills; the effectiveness of their work is therefore limited.

Conclusion

Animal production remains very important in the lives of the minority peoples of the mountain regions. It is a source of daily food, a means of draught power and fertiliser for agriculture, and has economic value as a source of income for households. However, animal production is based on local breeds that have low productivity. Production remains small scale, with animals left to wander extensively, and with only 35% of the herd vaccinated, epidemics are a recurring problem, causing considerable losses to households. Anthrax, which can be a potential threat to the human population, has not been completely stamped out.

Ratanakiri, Where Cambodia Meets Laos: Livestock Raising in Cambodia's Upland Province

Malcolm Ramsay[1] and Murray Maclean[2]

Abstract

Ratanakiri is a sparsely populated and relatively isolated province of northeast Cambodia. Indigenous ethnic minority communities make up 70% of the population and practise swidden agriculture in the extensive upland areas of the province. Buffalo, cattle, pigs and chickens are integral parts of the upland peoples' life and environment. Annual losses of livestock to infectious diseases are at a high level in the province and reduction of these losses is the main objective of government livestock services, which reached upland communities in the province for the first time in January 1997. They focus on the training and support of village technicians to provide ongoing technical and educational services to their communities.

General Description of Ratanakiri Province

Location

RATANAKIRI is in the northeast corner of Cambodia, bordering on Laos to the north, Vietnam to the east, Stung Treng province to the west and Mondolkiri province to the south. Laos is not accessible by road because of mountains. The Vietnamese border is 70 km by road from the provincial town, Banlung, situated approximately in the centre of the province. Road access to Ratanakiri from Phnom Penh is considered secure only through Vietnam.

Geography

Ratanakiri has an area of approximately 11 000 km^2, located on the western fall of the mountain range that runs through the centre of Vietnam. Two arms of this mountain range extend into Ratanakiri. The highest of the two extends across the north of the province and consists of forested mountains that are virtually uninhabited. On the south of this arm is one of the two rivers that flow from east to west across the province, the Tonle Sesan. South of this river, the second arm of the mountain range extends into Ratanakiri as an undulating plateau of red volcanic soil that extends to Banlung in the centre of the province at 300 metres above sea level. To the west of Banlung are lowlands that extend to the border with Stung Treng. South of Banlung there is a brief expanse of lowlands running down to the river Tonle Srepok, which enters Ratanakiri from Mondolkiri in the south.

Population

Ratanakiri is a sparsely populated province, the total population estimated at 70 000 people consisting of a range of ethnic groups. Khmer and Khmer-Lao communities make up about 30% of the population. The rest of the population is made up of 13 indigenous ethnic groups, the major ones being the Jorai (19%), Kreung (19%) and Tompuan (26%). These groups are all distinct in terms of language, but have in common the culture based on swidden agriculture and animist beliefs.

In general, the Khmers inhabit the lowlands of the western portion of the province, some areas of the Tonle Srepok in the south as well as Banlung town. Khmer/Lao and Lao communities are found on parts of the Tonle Sesan in the north and the Tonle Srepok in the south. The Jorai inhabit areas in the east of the province in the region where the Tonle Sesan leaves Vietnam. Other ethnic groups are found throughout the length of the northern river and central plateau and hilly areas; the Tompuan generally are north east, east and south of Banlung, and Kreung generally north.

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Farming systems

There are three farming systems in the province: shifting upland agriculture *(chamkar)*, paddy rice production *(srai)* both carried out on a family basis, and commercial plantations of rubber and oil palm.

The Khmer Rouge regime promoted paddy rice production, forcing many indigenous communities that had previously carried out only *chamkar* to grow paddy rice. This involved relocation of some villagers to lowland areas of the province or alternatively the draining of shallow lakes and swamps in upland areas to create paddy fields. While many families and villages returned to do *chamkar* in the early 1980s, some remained in the lowland areas to continue paddy rice production and others continued to cultivate small areas of paddy in the uplands.

Animal breeds and numbers

Cattle are mostly the small, yellow, local variety with some larger cross-breeds, and buffalo are all swamp buffalo typical of the region. Pigs are mostly the indigenous (*Gondol*) breed but various crosses can be found (Yorkshire, wild pigs), especially in Khmer villages. Chickens are a small, local type although some villages have the larger, local variety typical of some lowland areas.

Numbers of livestock reported by the Ratanakiri Office of Animal Health and Production should be taken as a rough guide. Actual numbers are probably substantially greater. According to the 1996 reports there are 12 000 cattle, 13 000 buffalo, 24 000 pigs and 65 000 chickens in the province. Very few goats are raised in the province and none are found in indigenous ethnic communities.

Government livestock services

The Provincial Office of Animal Health and Production (OAHP) works under the Ratanakiri Agricultural Department for personnel and administration management, and under the Department of Animal Health and production in Phnom Penh for technical matters.

In 1984, the OAHP began cattle and buffalo vaccination activities in paddy-growing areas of the province (Khmer and Khmer Lao communities) with equipment and supplies from Vietnam. This involved vaccination against *Haemorrhagic Septicaemia*, Foot and Mouth Disease and Blackleg until 1989 when support from the Vietnamese government was withdrawn. Since then, vaccination activities have been sporadic and dependent on the support given to the OAHP by NGOs working in the province. In 1996, the UNDP/CARERE Project provided technical support and funds for the development of human and physical resources of the Ratanakiri OAHP. The project also supported a pilot village veterinarian training program of the Ratanakiri OAHP in both lowland and upland communities.

Livestock of Indigenous Upland Communities

Roles of livestock

The remarkable role of animal sacrifices

At the foundation of upland culture and life are the animal sacrifices which maintain a state of harmony with the spirit world and restore harmony when it has been disrupted. *Sen* is the word in both Khmer and indigenous languages for the rituals to please or appease spirits. White (1995) describes the ritual slaughter of animals and ceremonial feasting which make up *sen* as important social events in village life, contributing to the sense of community and functioning as a traditional system of wealth distribution.

Animals as wealth

Animal sacrifices are for the health of the people and the health of the animals, trees and plants upon which the community depends. As such they are the means for obtaining and securing good health and prosperity. The traditional vestiges of wealth in the community are therefore animals (especially large ones), gongs and wine jars.

Animals for home consumption

Buffalo, cattle, pigs and chickens used for *sen* are always consumed in the village. The only instance of animals being slaughtered other than for *sen* is when an animal becomes sick and is slaughtered and eaten (or marketed) because the owner fears it would die.

Animals for draught power

In the small upland paddy areas of the province only buffalo are used for ploughing, and in most cases single animals. In some villages, elephants are used for hauling timber from the forest and within the village. In other villages, small numbers of horses are kept and used for carting.

Local trading of animals

In the village and between villages

Cattle, buffalo, pigs and chickens are all traded within the village and between villages. Cattle and buffalo are mostly traded for gongs, or other cattle and buffalo. Cattle, buffalo, pigs and chickens are traded for other animals or wine jars, and frequently 'payment' is not immediate.

District and provincial markets

Town traders (slaughterhouse operators or market sellers) travel to the villages to purchase cattle, pigs and chickens. Less frequently, villagers bring their animals in to the town for sale direct to the slaughterhouse operators or town folk.

Marketing of animals outside the province

The extent of animal movements through the province is not easy to determine, since there is no monitoring system. There is some movement of cattle and buffalo to Vietnam and Laos (either through Stung Treng or directly through Vonsai), with the Vietnamese preferring buffalo to cattle. Animals are moved through the forests, not through border crossings. There is, presumably, considerable movement of animals over the Vietnamese border associated with local border trade (trading of animals for gongs and wine jars) as Jorai are found on both sides of the border.

Animal raising practices

Cattle and buffalo

From late December until May-June, cattle and buffalo graze unattended in areas up to 10 km from the village. Owners know the approximate whereabouts of their animals during this period and go to retrieve them at the beginning of the rainy season. Theft of animals during this period does not seem to be a major problem in Ratanakiri.

During the rainy season fences are built and maintained to prevent cattle and buffalo from entering gardens and fields. In other villages the emphasis is on controlling cattle and buffalo with nose ropes, whereby animals are led to grazing areas and shifted two or three times a day, then led back to the village for the night.

Both cattle and buffalo mate freely and many animals seem to calve yearly, probably because of adequate feed and water supply in most areas of the province throughout the year. Buffalo seem to calve mostly in November/December.

Pigs

During the dry season pigs are generally left free to roam and scavenge but are fed rice bran, cooked rice and rice water once or twice a day. The amount fed is often minimal but the owners continue the practice to make sure the pig returns to the house every day. Pigs are given no water by owners apart from that which is mixed with the bran.

During the rainy season, some farmers will take their pigs to their garden houses and raise them in pens or within a fence around the garden house. When pigs are penned, they are often supplied with extra feeds such as sweet potato leaves and tubers, if available.

Male pigs are castrated in only some villages. Most sows mate freely with village boars and sometimes with wild forest boars. Sows seem to have two litters per year with large litters (12–16 piglets) typical of the native *Gondol* breed. Village pig herds have a large percentage of breeding females and young pigs less than 3 months-old.

Chickens

Chickens are free-scavenging during the day time throughout the year, and rarely seem to be fed or watered. Small chicken houses are built at heights of around 1.5 metres, behind or next to, family houses in which most chickens roost at night. Eggs are laid in baskets in these houses. This allows the family to keep some track of their chickens, and prevents attack by dogs, pigs and sivets. During the rainy season, chicken houses are commonly constructed at the garden house, and chickens brought there from the village.

Animal health and production problems

Cattle and buffalo

Generally, cattle and buffalo are found to be in very good condition because of plentiful grazing areas. Annual losses of buffalo and cattle to infectious diseases are very high in all but the most isolated villages. Two syndromes are most commonly described by villagers, both which appear to affect buffalo more than cattle. Based on these descriptions, it is believed that the diseases of greatest concern to villagers are *Haemorrhagic Septicaemia* and Foot and Mouth Disease. No disease prevalence or incidence studies have been conducted in the province and neither have there been any definitive diagnoses or isolation/identification of microorganisms. (The OAHP has identified *Toxocara vitulorum* infection of buffalo calves and suspect this causes significant problems in some villages.)

Pigs

Outbreaks of deaths in pigs of all ages are commonly described by villagers as peaking in the early wet season, but occurring throughout the year. Farmers describe a variety of syndromes, the most common one affecting most animals, making them 'hot' and causing them to die in two or three days. When such a disease occurs in the village, any pig which becomes inappetant is usually slaughtered and eaten. The poor condition of young pigs in most ethnic minority villages, and the free ranging system of management suggests a heavy infestation with internal parasites. Cysticercosis is known by villagers and appears to have a high prevalence in pigs, which is not surprising considering the raising methods.

Chickens

Village chickens appear to die in large numbers (sometimes all the chickens may die) in many villages from the beginning of the dry season through to the start of the wet season. More isolated villages and farmers who raise chickens away from the village experience fewer problems.

Opportunities

Reducing deaths and sickness

Deaths and sickness appear to be the major factors limiting the ability of animal production to serve the needs of farmers in Ratanakiri. In January 1997, the Ratanakiri OAHP began its first activities with indigenous upland villages following the strategy outlined below:

- Identification of villages interested in seeking solutions to their animal health and production problems.
- Participatory assessment of the situation of livestock-raising in the village, and consultation with villagers about opportunities and constraints.
- Selection (by village) and training (by OAHP) of villagers (1 to 3 per village) to become resource people for their village, able to vaccinate, worm and treat cattle, buffalo, pigs and chickens.
- Development of non-formal education methodologies and training materials to enable wider understanding of opportunities and constraints of animals raising.

An experiment to reduce annual animal mortality was begun in March 1997 in four Jorai villages near the Vietnamese border, involving vaccination of cattle and buffalo against *Haemorrhagic Septicaemia*, pigs against Swine Fever and chickens against Newcastle disease.

Increasing numbers of animals

Although the anticipated result of the new OAHP work in upland villages is the decreased mortality/increased survival of village livestock, it is not known what effect this will have on villagers' use of their animals. What will be the increase in sacrifices/village consumption, trading or marketing within the village, with other villages, with district or provincial markets, or even cross-border trading? Or will the main effect be an increase in animal numbers (stocking rates) to a level which compromises the animal health and disease control measures? The OAHP plans to accompany pilot villages through their experience of reduction of livestock mortality until the end of 1998, in order to evaluate the effect on the village and to respond to information needs. This will include the development and use of non-formal training methodologies and materials to encourage community understanding and discussion about the market value and marketing of animals, constraints to animal health and production (e.g., too many animals), management and planning of village animal numbers and the effect of animals on the village environment and human health.

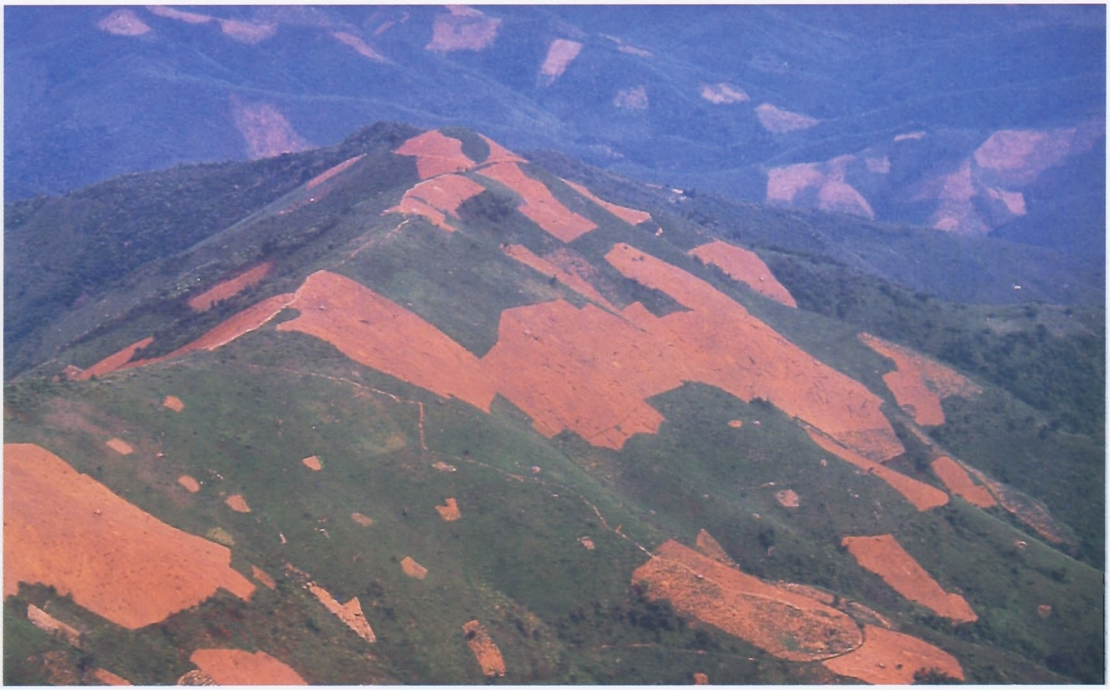
There appears to be great potential to increase the number of cattle and buffalo run in many areas of Ratanakiri Province. Grazing of other species, e.g., goats and deer, could be examined as possible commercial enterprises.

References

Seng Hkum, 1995. Agricultural Sector Study Report, Ratanakiri Province, Cambodia, UNDP/CARERE.

White, J. 1995. Of Spirits and Services, Health and Healing among the hill tribes of Ratanakiri Province, Cambodia, Health Unlimited.

Livestock in Upland Farming Systems of Northern Laos: Changes and Challenges


SWIDDENS cleared and burnt, ready for planting, Pak Beng District, Luang Prabang. (Photo: Peter Horne)


RICE swidden with a two-year fallow field adjoining, Luang Prabang Province. (Photo: Peter Horne)

OVERGRAZED rangeland, Houamuang District, Huaphan Province. (Photo: E.C. Chapman)

IN some localities pressures for the shortening of the fallow period are less severe. In this instance (in Xieng Kho District, Huaphan Province, December 1995) the revegetation of former swiddens suggests a recent fallow cycle of 1 crop year to approximately 8 years fallow. (Photo: E.C. Chapman)

DUNG is becoming an essential input into small areas of rice-fields in shifting cultivation areas. Xieng Khouang Province. (Photo: Peter Horne)

MANY villagers in Xieng Khouang and Luang Prabang Provinces now cultivate plots of napier grass (*Pennisetum purpureum*) for cut-and-carry supplementary feeding of cattle in the dry season. Nong Het District, Xieng Khouang Province. (Photo: Bounthong Bouahom)

LAO Theung farmer using *Bracharia brizantha* to stabilise gully erosion on his swiddens, Luang Prabang Province. (Photo: Peter Horne)

GOAT feeding on a cut branch of *Gliricidia* in a mixed 'Ruzi Grass' pasture, *Brachiaria ruziziensis*, at Namxuang Livestock Research Station, Vientiane. (Photo: E.C. Chapman)

Swidden-based Farm Economies in Northern Laos: Diversity, Constraints and Opportunities for Livestock

P. Parisak Pravongviengkham[1]

Abstract

Swidden farming, centred on the cultivation of upland rice and maize, remains the most conspicuous form of land use in upland areas of the Lao PDR. All too commonly, discussions of 'slash and burn agriculture' in Laos have made the convenient assumption that ethnic differences are critical in explaining differences between upland farming systems. Just as conveniently, the popular three-fold classification of the Lao population into 'dwellers of the lowlands, the middle slopes and the highlands' (Lao Loum, Lao Theung and Lao Soung respectively) reinforces the notion that particular swidden systems are associated with individual ethnic-cultural groups. Such simple generalisations are no longer valid, as this paper will show.

This paper aims to demonstrate the current economic and ethnic complexity of swidden farming systems in four districts of northern Laos where field observations and household surveys (200 households, across all main ethnic groups) were carried out in 1996. Upland rice cultivation remains at the core of the traditional swidden system (*hai*), but there is now marked diversity in resource use and production, in response to many different factors in combination. One major factor comprises differences in physical resources: these include grasslands in some areas; greater opportunities for wet-rice cultivation (*na*) on more gentle slopes; and in some instances the availability of more productive fallows. In addition, differences in population pressure, differences in access to markets and differences in the impact of local regulatory systems have contributed strongly to the economic diversity which is increasingly evident in upland farming systems.

Introduction

IN THE PAST two decades the improvement of farming in the uplands of northern Laos has become a major national objective (MAF 1994; Souvanthong 1995). The loss of forest to 'slash and burn' (swidden cultivation) in the uplands has been a continuing concern, but more recently this has been joined by national and international concerns to alleviate the poverty which is still widespread in rural Laos, particularly in upland areas.

This paper is based on extensive observations in northern Laos, strengthened in 1996 by close field investigations of economic and social conditions in 20 villages (200 sample households) in four districts of three major provinces (Luang Prabang, Xieng Khouang and Huaphan) shown in Figure 1. The villages and their respective ethnic identities are listed in Table 1. Terrain in three of the four districts is dominated by steep slopes rising in elevation to summits at about 1500 m above sea level (ASL), although most of the land surface is between 700 m and 1200 m ASL, with little valley bottomland or gentle slopes. Except on ridges and higher slopes the natural forest cover has been greatly depleted and replaced by secondary forest (e.g., bamboo) and other regrowth, following cultivation. The fourth district, Phoukout in Xieng Khouang Province, is partly an exception because of the extent of grassland on flat and gently sloping land at elevations of 1200 m–1500 m in the upper Nam Ngum basin (Plaine de Jarres) north and west of the provincial capital, Phonsavan.

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Table 1. Selected villages and sample households: districts and ethnic groups, 1996.

	DISTRICTS (ethnic groups in brackets)			
	Luang Prabang	Viengkham	Viengthong	Phoukout
Households (no.)	f = 50	f = 50	f = 50	f = 50
Villages	Ban Thapene (LL)	B. Phousanam (LT)	B. Phoulouang (LT)	B. Poua (5 sub-villages) (LL + LS)
	B. Napho (LL)	B. Phousali (LT)	B. Nathouane (LT)	B. Bong (3 sub-villages) (LL + LS)
	B. Xiengmouak (LL)	B. Houaykay (LT)	B. Vat (LT)	B. Phienglouang (2 sub-villages) (LL + LS)
	B. Longlao (LT)	B. Done (LT)	B. Navieng (LT)	
	B. Nongtok (LT)	B. Viengsay (LT)	B. Pounghai (LL)	
	B. Pano (LT)	B. Houaykou (LS)	B. Soneneua (LL)	
	B. Nongheo (LT)	B. Ombring (LS)	B. Longgouapa (LL)	
		B. Phoukhong (LS)		
		B. Houaythong (LS)		

Note: The major Lao ethnic groups are composed of Lao Loum (LL), Lao Theung (LT) and Lao Soung (LS).

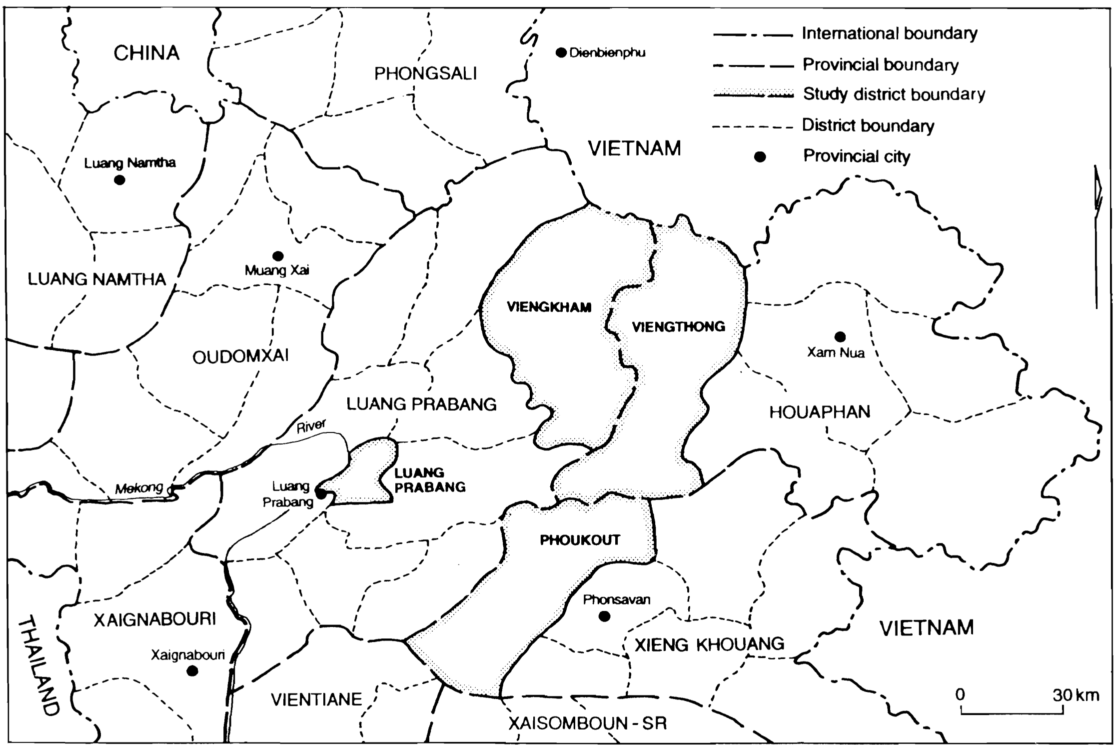

Figure 1. Location of the four-district study area.

Changing Swidden Systems

Traditionally, Lao swidden-based farming systems (*hai:* literally, 'an upland field'), like similar systems throughout Southeast Asia, emphasised the 'rotation of fields rather than crops' (Pelzer 1978; Spencer 1966). It involved the rotational use of forest (often, secondary forest) and fallow land for the production of upland rice and complementary food items such as maize, chillies, other vegetables and livestock.

In Laos, it remains a strongly *rice-driven* system. Rice production is the fundamental economic activity, primarily for household consumption rather than sale; and rice-growing remains a major social activity central to ways of life of the upland people. This remains true, even where the cash value of rice production sometimes comprises only one quarter, or less, of total farm household income. And it remains true across ethnic groups.

Until the past 20–30 years, the wide availability of primary and secondary forest, and long-fallow regrowth, allowed the continuation of established farming practices preferred by different ethnic groups, moderated by the farming skills, management capacity and decision-making ability of individual households and household groups. In this traditional mode of agricultural production, villagers' land-use commonly focused on two different resource areas.

First in importance were the blocks or individual plots selected for the cultivation of rice, maize and other food crops in successive years. Normally, these blocks or plots were not too far from the houses making up the village settlement. Between and beyond was an ill-defined second zone, encompassing former fields being 'rested' in fallow regrowth and relatively unused bushland and forest, extending to the territory of other villages. This second resource zone was traditionally of value for forest products of all kinds, for food gathering, hunting, fishing and livestock grazing. In recent years, this outer resource zone has grown in importance, because of the food resources it provides for livestock (buffalo, cattle, pigs and goats) and because it allows expansion of cash crop production.

In upland Laos, population growth is commonly the salient factor that has prompted changes in swidden systems, but it is not the only factor. With increased contact between villages and the wider community has come the monetisation of village life and increased commercialisation of production. Overall, there has then been a powerful incentive for market-oriented livestock production and for the production of cash crops such as sweet maize, green onions, beans, cucumbers, tomatoes, water cress and many kinds of fruit. Paddy rice is also now widely sold, even by poor households when there is a temporary surplus: for example, poor households experiencing regular rice deficits for up to six months commonly sell some paddy at harvest, because the end-of-year income then allows them to buy basic necessities such as salt, spices, clothes and medicine and to provide payments for schooling and religious affairs.

What is evolving, gradually, is a large set of more diversified and more intensive upland farming systems, increasingly market-oriented. Among the four districts surveyed for this study, the economic transition has proceeded furthest, though in different ways, in Luang Prabang and Phoukout Distrcts. In Luang Prabang, many households now aim to generate cash income from supplementary rice production using small areas of lowland fields (*Na*) and from maize, pigs, chickens, green onions and other vegetables, paper mulberry and rattan, and from the harvest of fish ponds. In Phoukout, on the other hand, the significant grassland resources have encouraged some villages to increase their cattle herds, with additional feed provided from backyard forage.

Upland Rice and Fallow Successions

The emerging changes in upland swidden systems (*hai*) raise critical questions about the sustainability of upland rice production. Ideally, the rice-based swidden system, with its rotational cultivation and fallowing, is relatively sustainable and can be practised with only a minor degree of environmental degradation.

Ideal conditions for the *hai* system of rotational cultivation and fallowing to be relatively sustainable require a low population density. According to Rambo et al. (1990), who was writing on the basis of field studies in Vietnam, ideal conditions there required a population density under 0.4 persons per ha, with no exploitative activities such as intensified cash crop production which might accelerate nutrient depletion and perhaps contribute to the physical deterioration of soils. Another indicator that is widely used to assess the sustainability of swidden practice is the 'R' factor, or cultivation factor (Spencer 1966; Raintree and Warner 1986), although this author prefers to use its inverse, an 'L factor', or 'land-use factor'. Ideally, *hai* fallows in northern Laos should have an L factor over 10–15 years in length to ensure the system's sustainability, in instances where only one year of cultivation is undertaken in a cycle of up to 15 years.

If re-cultivation occurs over a much shorter period, where the L factor is less than 6–7, then the *hai* system is likely to be unsustainable over time, because of poor quality fallow vegetation, rapid shrinking of crop yield, high weeding requirements, acute rice deficits, and increased exploitation of forests and other communal resources.

In this context, it is interesting to compare the L factors reported in the four districts surveyed in this author's research in 1996. From the data in Table 2, it is evident that the estimated ranges of the L factor are quite marked, both between districts and between ethnic groups. In all instances, however, the mean L factor values are below the acceptable base for sustainability (L = 6–7).

The lowest figures, indicating the shortest fallow periods, were found in Phoukout and Viengthong and among Lao Loum and Lao Soung. Even when the maximum L factors reported in these four districts are considered, the maximum in Luang Prabang (5.0) was clearly below the sustainable limit and in Viengthong, Phoukout and among Lao Loum the maxima were still close to the level where unsustainability is to be expected. This clearly reflects the limited availability of fallow land per household, a consequence of high population pressure by the mid-1990s. Land scarcity is also reflected in the low mean fallow lengths for all four districts.

Under circumstances where low L factors are prevalent, it would be expected that the productivity of the *hai* system would have decreased significantly, so that most households nowadays would not harvest more than 1540 kg/ha/year (the national mean in 1995), or about 200 kg/capita/year. In contrast to these expectations, however, the data on mean *hai* yields in Table 3 show that *hai* productivity is considered by farmers to have changed very little in the past 20–30 years across the study area, except in Phoukout and among the Lao Soung. The mean per capita rice yield is still found, in most households, to be equal to or above the national threshold of 200 kg/capita/year (= 1500 kg/ha); and furthermore, yields have even increased in Viengthong District and among the Lao Loum, where the lowest L factors were recorded.

The questions which arise here are, firstly, why such differences in *hai* output occur across the study area, between ethnic groups as well as within ethnic groups; and secondly, why there is no general reduction in *hai* yields over the past 20–30 years, according to household estimates. Why does one settlement achieve higher overall rice output per ha than another settlement located within similar agro-ecological settings? Is it really a consequence of different resource endowments, or are there other crucial determinants that have commonly been overlooked in studies of Lao swidden-based farming systems? The farmers themselves suggest that fallow selection and fallow management have become critical in helping to maintain rice yields, even as the mean fallow periods have declined.

From field observations and discussions with swidden farmers in all four districts it is apparent that farmers now commonly rotate their fields through a well-defined 'manipulation system' of fallow regeneration. Their objective is to promote the growth of the most appropriate fallow vegetation that resources allow, in order to produce the best yield of biomass in terms of quality and quantity. Primary forest and mature secondary forest would be preferred, except that forest cutting as a preliminary to cultivation is prohibited by state and local regulation. The next best fallow vegetation, in the estimation of upland farmers, is *Chromolaena odorata* (or *Eupatorium* spp.). *Chromolaena odorata* has the further advantage that it can be used successfully as fallow cover after two or three successive crop-years, then allowing remarkably early re-cultivation after a further period of 2–3 years (Fujisaka 1991; Lao-IRRI 1991, 1995; Rambo et al. 1990).

Compared with *Chromolaena odorata*, bamboo and much other secondary forest are regarded as inferior fallow cover for swiddening. From farmers' experience in northern Laos, bamboos often occupy inferior soils, produce relatively low quality biomass and, after burning, leave fields difficult to cultivate. In consequence, more labour is required for weeding.

Table 2. Cropping and fallow periods and L factors in the study area.

Range of L Factors	District				Ethnic groups		
	LPB	VKM	VTG	PKT	LL	LT	LS
1. Mean fallow length (in years)	2.3	4.4	3.2	2.1	1.9	3.8	2.2
2. Number of cropping cycles	1.0	1.2	1.7	1.9	1.4	1.2	1.8
3. Mean L factor	3.3	4.7	2.9	2.1	2.3	4.2	2.8
4. Range in L factors	2.0–5.0	1.8–9.3	1.5–7.5	1.5–7.8	1.7–6.7	1.8–10.1	1.5–8.2

Sources: Field observations and household survey data, 1996.
LPB = Luang Prabang; VKM = Viengkham; VTG = Viengthong; PKT = Phoukout.

Table 3. Comparison of the mean yields for upland and lowland rice, expected by sample households in the mid-1990s compared with 20–30 years ago. *Hai* = upland rice; *Na* = lowland rice.

District	*Hai* yield kg/ha	Change per cent	*Na* yield kg/ha	Change per cent	Ratio[1]	Ratio[2]
LPB	203	+2	290	−18	1.43	1.78
VKM	236	−3	0	0	–	–
VTG	348	+9	435	−7	1.24	1.47
PKT	174	−22	302	−1	1.73	1.37
Ethnic Groups						
LL	295	+3	377	−24	1.27	1.54
LT	250	+6	320	+11	1.27	1.21
LS	198	−14	147	+2	0.73	0.62

1. Ratio of *Na* to *Hai* at present.
2. Ratio of *Na* to *Hai* in the past (20-30 years ago).
Sources: Survey data in 200 households of the 4 districts, 1996. The household estimates of changes in yield over the past 20–30 years should be taken as indicative only.

Grassland and *Imperata* bush fallows are the last choice of farmers. Where grassland and pine forest predominate on acid soils, as in Phoukout, productive fallows are difficult to achieve.

The importance of local regulatory systems

In the past 20–30 years many upland communities in Laos have consciously set about managing their resource base and swidden practices in ways that will increase or maintain productivity. Fundamentally, this change has occurred in response to a growing awareness of an imminent Malthusian threat. As population has continued to grow rapidly, the need to use resources more efficiently has become a priority at community level. But without firm leadership and direction the gap between aspiration and implementation would remain large and change would certainly be very slow. The extent to which change has occurred and is occurring reflects then the adoption of stronger social norms and the fact that they have become embedded in the local regulatory systems, governed by the village committees and elders' groups.

At village level local regulatory systems have become the driving force influencing and directing the gradual shift away from the traditional rice-dominant swidden system. The shift is still far from complete, as the next section of this paper will demonstrate, but nonetheless, there is abundant evidence of changes taking place—changes from the simple crop-and-fallow rotational system where rice is dominant, with the risks of yield decline as the fallow length is reduced, towards a more complex 'block-plot' fallow rotational system. Change is being induced through the firm control of village land use, year after year.

The main feature of the 'block-plot' system is that the village authority is given the sole right (by the community) to select and allocate, on a yearly basis, a block fallow site for cultivation by a group of households. For household parcels within the block, it is the village authority which allocates plots. The membership of household groups for each block is fixed and binding on participants, but the allocation of blocks (and plots within blocks) from year to year can be flexible.

The objective of the block-plot fallow allocation system is to achieve fair and equitable distribution of productive cropland among all village members. In practice, since the available land resources vary between individual villages and groups of villages, the actual household allocations are likely to vary markedly between villages, unless cooperative arrangements over land are made. This happens, but considerable differences still exist. In the villages surveyed for this study in 1996 (50 households in each of four districts), mean total land holdings per household varied from approximately 5.4 ha in Viengkham to 4.0 ha in Viengthong, to 3.5 ha in Luang Prabang and 2.0 ha in Phoukout. These data relate to household-controlled land used mainly for crop production and do not include 'public land', such as grassland and unfenced fallows used for livestock grazing, notably in Phoukout.

The overall impact of the local regulatory systems, focused particularly on the issue of food production for expanding village populations, has been to strengthen the trend towards greater diversity of production systems as a risk-reduction strategy, notably in areas where land shortage is more acutely felt. And as production for the market has increased in importance, the combination of local regulatory systems and market opportunities have together encouraged more efficient resource management by households, in such fundamental ways as by improved fallowing.

Nonetheless, the 'block-plot' regulatory system has significant limitations. The preoccupation with production from cropland in the village regulatory system has meant that less attention has been given by village authorities to opportunities for expanding production of large livestock, dependent on open grazing. To achieve the same equity objective as for village cropland, namely an approximation of equality between all owners of large livestock using the village resources of unalienated grazing land, a different set of problems has to be faced. One immediate problem is the substantial capital required for owning and breeding large livestock (buffalo and cattle). It often happens that only a few households can afford to own large livestock. Another problem is the limitation of feed resources; and a third is the considerable risk associated with the incidence of livestock diseases.

It needs to be emphasised that to this point the discussion has been concerned with community-regulated swidden successional systems, now well established in the provinces and districts of northern Laos, very largely as a consequence of local initiative. Their development was only weakly influenced by external political and economic forces. They are different from the newly developed 'state promoted swidden farming systems' in fundamental respects, notably in retaining a corporate type of land ownership and agreed social norms of mutual assistance which pervade the farming practices of the communities and are intended to sustain all villagers at least at subsistence level. In addition, the long-established community-regulated systems act as a restraint on excessive socio-economic stratification, on land-labour imbalances and provide support when particular households experience crop damage, bad harvests, illness and absolute poverty.

Compared with community-regulated swidden successional systems, the state-promoted or state-regulated swidden system initiated by the Forestry Department in 1993 (supported by Decrees 169 and 186) aims to stabilise the practice of shifting cultivation, in order to arrest unsustainable deforestation (Souvanthong 1995: 21–23). With this objective in view, the state-regulated swidden system has set about formalising land tenure through a process of land allocation, or reallocating existing swidden fallow fields. It is assumed that once private ownership is granted over swidden land, farmers will be motivated to manage their land better and so achieve higher output and higher incomes which will lead, in turn, to rapid improvement in standards of living.

Under the state-sponsored swidden system, informal private ownership on swidden land is granted to farmers, on condition that farming activities are directed and controlled by state authorities. All farm work has to follow the basic principles laid down for upland land use. Swidden farmers are not obliged to establish farm work groups since land is already under private ownership. The extent of land brought under the state-sponsored system is so far small, compared with the community regulated swidden systems, but the shift to private ownership has led already to the gradual disintegration of existing community-regulated swidden farming systems in some instances (Pravongviengkham 1997).

Emerging diversity

Farmers in the four districts surveyed are well aware that the traditional rice-dominant swidden system (*hai*) is not sufficiently productive, nor sufficiently reliable from year to year, to ensure their desirable level of livelihood, modest as that is. When measured against the national standard for paddy rice consumption (350 kg/capita/year), three of the four districts commonly record rice production from their upland fields amounting to less than two-thirds domestic requirements. Even when production per capita from upland and lowland ricefields is combined, one of the four districts, Viengkham, commonly experiences rice deficits.

Faced with the inadequacy of upland rice production, upland farmers are now establishing more diversified resource use systems which encompass lowland rice (the *Na* production systems from bunded paddy fields), together with the production of home gardens and maize gardens, livestock and fish production, and the use of forest resources (e.g., fuelwood), as well as income derived from non-farm and off-farm activities.

In terms of rice production, swidden production (*hai*) remains dominant across the whole four-district study area, while the opportunities for *na* are relatively restricted. But in terms of the value of production measured in rice equivalents, swidden rice production is dwarfed by the combined value of products from home gardens (fruit and vegetables) as well as maize, livestock, fish, forest products and the income from non-farm and off-farm activities. Data in Table 4 and Figure 2 show that in the mid-1990s the total contributions to annual household income from sources other than rice were commonly twice as much as the value of rice production itself. These data and the high percentages of households found to be deriving significant income from the sale of

Table 4. Components of mean annual household income: sample households, 1996. (Measured in kg of rice, or rice equivalents)

	Hai	Na	HG	MG	FR	N/O	Buffalo	Cattle	Pigs	Poultry	Goats	Fish	TOTAL
	f = 50 (a) (b)	f = 50 (a) (b)	f = 50 (a) (b)	f = 50 (a) (b)	f = 50 (a) (b)	f = 50 (a) (b)	f = 50 (a) (b)	f = 50 (a) (b)	f = 50 (a) (b)	f = 50 (a) (b)	f = 50 (a) (b)	f = 50 (a) (b)	f = 50
Luang	82	54	54	12	60	19	50	50	70	57	100	33	2520
Prabang	203	201	259	66	183	172	239	929 (x)	149	26	39	55	
Viengkham	100	—	10	—	48	4	62	39	100	80	63	56	1007
	236	—	38	—	102	60	218	193	92	18	47	4	
Viengthong	92	68	30	8	44	14	66	57	79	57	—	88	2248
	349	435	14	30	38	54	354	781	109	17	—	67	
Phoukout	78	56	24	2	46	17	37	25	29	56	—	73	1522
	174	302	25	31	264	71	271	188	78	13	—	105	
							ETHNIC GROUPS						
	f = 67	f = 67	f = 67	f = 67	f = 67	f = 67	f = 67	f = 67	f = 67	f = 67	f = 67	f = 67	f = 67
Lao Loum	72	84	45	—	46	18	50	28	69	66	50	100	1822
	295	378	135	—	121	99	341	304	92	21	21	75	
	f = 76	f = 76	f = 76	f = 76	f = 76	f = 76	f = 76	f = 76	f = 76	f = 76	f = 76	f = 76	f = 76
Lao Theung	93	38	30	8	53	20	61	61	69	54	78	61	1909
	251	320	127	60	104	104	245	621	102	14	49	15	
	f = 57	f = 57	f = 57	f = 57	f = 57	f = 57	f = 57	f = 57	f = 57	f = 57	f = 57	f = 57	f = 57
Lao Soung	100	7	11	9	51	6	44	30	67	72	50	43	1458
	199	147	43	78	158	107	216	161	118	820	38	212	

Notes: *Hai* = upland rice; *Na* = lowland rice; HG = homegarden; MG = maize garden; FR = forest resources (fuelwood etc.); N/O = non-farm and off-farm activities.
(a) Per cent of sample households. for the production of homegardens etc. the value of production consumed and/or sold has been converted to the rice equivalent in value (market prices)
(b) Rice (*Hai* and *Na*) or rice equivalent (kg).
(x) The high number of cattle sold by households in Luang Prabang District in 1996 was a consequence of an official policy of destocking.

buffalo and cattle and small livestock (supplemented by minor income from other enterprises) point to the growing prevalence of a *mixed crop and livestock farming system* already now established in the uplands.

From the survey data shown in Table 4 and Figure 2, it is also strikingly evident that in this four-district study area the income differences between Lao Loum, Lao Theung and Lao Soung communities are minor ones, whether in aggregate per capita income from all sources, or in the 'mix' of farming enterprises pursued. Of the four districts, Luang Prabang and Viengthong are clearly characterised by a larger range of popular farm enterprises and the highest income aggregates per capita, equal to more than six times the national rice consumption standard (350 kg/capita/year). But these data also raise interesting questions for the future. Will the emphasis on livestock production grow in all four districts, or possibly diminish in Luang Prabang if other enterprises are seen to be more rewarding. And given the relatively low value of rice production, might rice cultivation gradually give ground to more profitable enterprises, such as home garden crops, maize and forage production for livestock? An initial answer to the first question was given in Luang Prabang District in 1996 when local authorities ordered de-stocking of cattle. Lao Soung communities were reluctant to obey. Instead, they extended their cut-and-carry practice for feeding cattle with native grass and used backyard forage production to provide supplementary fodder.

Livestock and Fish Production Systems: Perceived Strengths and Weaknesses

In the few years since the New Economic Mechanism (1986) was introduced, and notably since about 1990, livestock production has become a main source of cash income for upland farmers. Even so, livestock management in the four-district study area is often viewed very casually by farmers, as of secondary importance to crop production. There are exceptions, such as the attention now being given to fish culture (an introduction of the past 10 years, mainly for domestic consumption); but otherwise, management practices need considerable up-grading, as the following field observations indicate. There are significant differences in livestock husbandry from district to district, both within the four-district study area and more widely in northern Laos.

Large livestock

- *The free-ranging system with minimum care (or no care)*

In most villages visited in Luang Prabang District, irrespective of the ethnic group(s) involved, livestock are left on their own to browse freely, with little supervision. Commonly, no vaccination is provided, or it is very irregular. The animals rely totally on natural feed resources, without supplementation. Housing is non-existent, or at best it is rudimentary. In most instances, the animals are tethered under the family house at night. When they are left to forage outside the main village area, the animals are visited from time to time (commonly 2–3 days per week).

- *Free-ranging system with individual care*

This system is found in a number of villages in Viengkham, Viengthong and Phoukout Districts where it is associated with regulated swidden succession on fixed sites, but without plots being fixed for the participating village households. Rudimentary fencing is constructed to keep animals in the

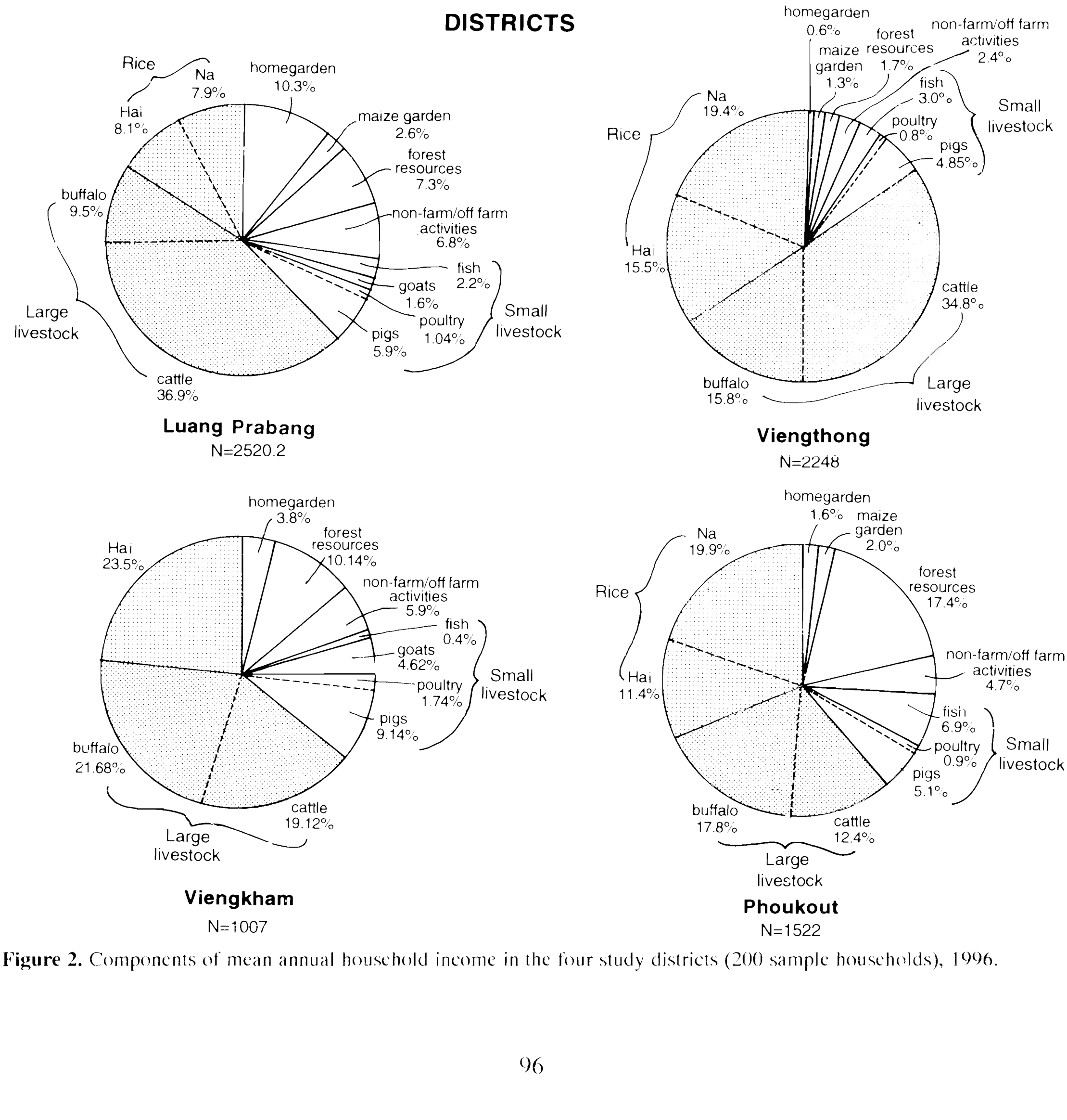

Figure 2. Components of mean annual household income in the four study districts (200 sample households), 1996.

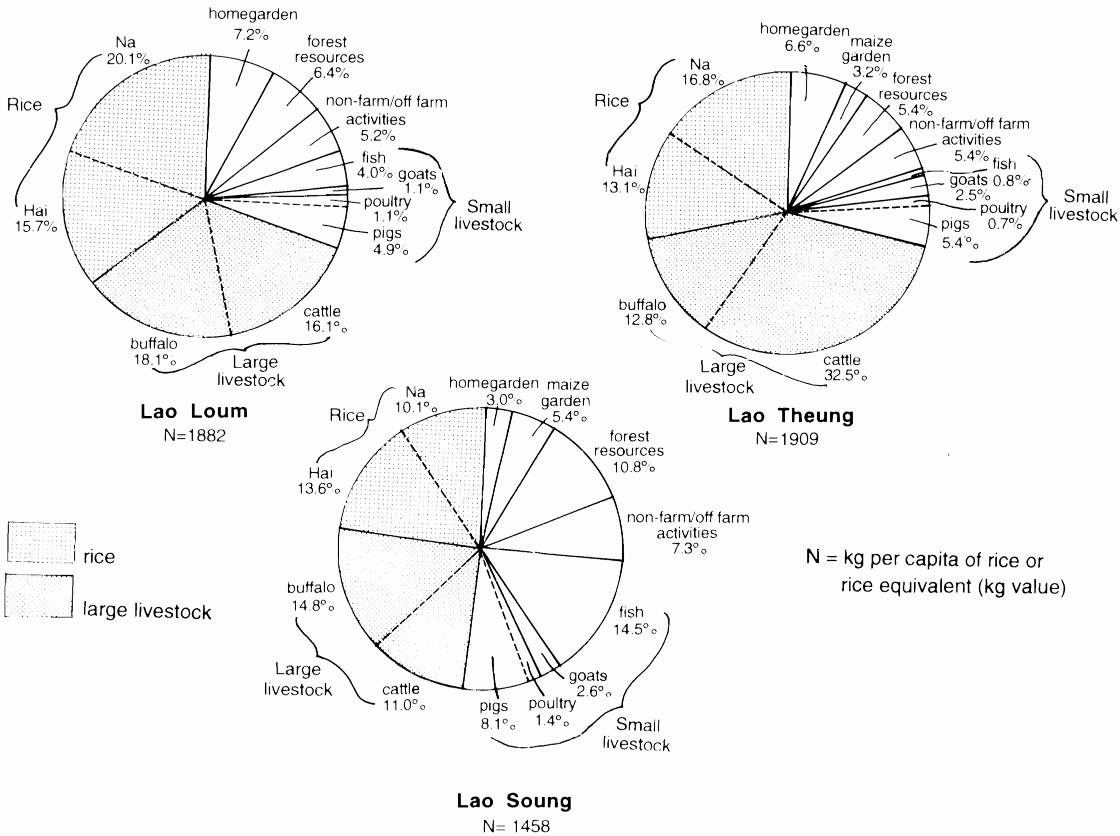

Figure 2 continued. Components of mean annual household income in the four study districts (200 sample households), 1996.

former swidden fields and the animals are checked more or less regularly, mainly to prevent theft. Cut-and-carry supplements are provided from time to time, but vaccination is inconsistent.

- *Free-ranging system with group management, but minimal care*

This practice, common to a number of communities in Viengkham District, is mostly associated with different types of 'community-based, regulated swidden succession' where household groups work together on the same block of fallow land. Commonly, the arrangement made is that representatives of the group are delegated, by collective decision, with the responsibility for regular care of the herd on a rotational basis (about every fortnight). Regular care mainly comprises checking the animals to prevent theft and supplying forage from time to time. A rudimentary enclosure allows penning at night. Vaccination is inconsistent.

- *Free-ranging system with group management, with regular care*

This system, found in Phoukout and in some parts of Viengthong, resembles somewhat the system just described, but the animals are provided with better and more regular care. The animal shelters are stronger and more permanent, as part of a cattle/buffalo yard usually built in the village with or without an additional semi-permanent enclosure in the rangeland or upland rice fallow, in instances where the herd is kept in the field for longer. Vaccination is carried out more regularly, depending on the availability of vaccine. Responsibility for looking after the herd is arranged on rotation, or on a permanent basis. The latter is more common in Phoukout District where full responsibilty for the animals is handed to older people and children who cannot work in the upland swiddens (commonly those over the age of 55 years and under 15). The animals are usually taken daily to the rangelands or fallow fields to graze from 6.00 a.m. to 6.00 p.m. and penned overnight. Regular supplementary feed is given to the animals at night, consisting of rice straw (where available), maize residues, hay and salt. In a few households, backyard forage is produced.

In this system there is clearly better care and management of the village herd. In addition, the available village or group labour appears to be used more effectively, since most of the more active workers are able to concentrate their efforts in the upland fields at times of peak demand, for example, at planting and when weeding is critical.

Small livestock (pigs, poultry and goats)

• *The free scavenging system with minimum care*

In this system, the most widespread in the four-district study area, the animals are left to scavenge freely, with little supervision. No vaccination is provided. The animals rely totally on natural feed resources and crop residues, with minimum supplements from time to time. Housing is non-existent, or very rudimentary. In most instances, the animals are enclosed under the house at night, or in the backyard. In some instances also, animals are left in former rice swiddens to provide isolation from outbreaks of disease.

• *The semi-permanent penning system with regular care*

Also widespread across the study area, but of secondary importance, this system provides semi-permanent and stronger shelter for animals (mostly for night penning), either under the family house or in the backyard. Vaccination is undertaken, depending on the availability of vaccines, and feed is also provided on a more regular basis: for example, twice or three times each day.

• *Permanent penning with regular care*

In this system, focused on pig production and predominant in Viengthong and Phoukout Districts, the animals are kept in permanent enclosures until sale (about 8–12 months), without any scavenging being allowed. Vaccination is undertaken more regularly, depending on the availability of vaccines. The most important feature is that significant inputs are provided for animal nutrition. Twice or three times more feed is provided, compared with what is available from free scavenging. This system is commonly practised by pig fattening enterprises, where pigs of 20–30 kg are purchased and fattened to a live weight of 50–60 kg for sale over 3–4 months. In this system also, poultry is raised semi-permanently (partial penning), but with more inputs provided for nutrition.

Fish culture

- A system of fish production, with several variant forms, is now widespread in all four districts of the study area, even though it began less than 10 years ago. At this stage, it is still mainly a low-input, low-output system, with most of the harvest used for supplementing family subsistence requirements of animal protein. Occasionally, there is surplus production for sale. Three variants in the system can be observed.
- The single pond management system is most common in the study area, in villages of all three ethnic groups. Seed stock (fingerlings) may be found wild, or produced traditionally in household ponds, or obtained commercially, or all three in combination. Initially, ponds are stocked at high density and then thinned out from time-to-time, irrespective of fish size, mainly to satisfy domestic needs.
- The multiple stocking and multiple harvesting system, again found widely in the study area irrespective of ethnic group(s), involves the systematic harvesting of fish from a single pond, usually twice or three times each year, and their replacement by seed stock. The size of the fish harvested is commonly about 0.5–1.0 kg.
- The several ponds system, or multi-stage culture. In this instance, fish are stocked and harvested in a number of water impoundments, with advantage for the management of fish growth and harvesting.

The Present and Future Roles of Livestock in the Swidden Economy: Farmers' Aspirations

Helped by market opportunities for large livestock, small livestock and cash crops in the 1990s, most swidden farmers in northern Laos appear to have turned to different mixes of income-generating activities, to complement the importance of rice as the central element in their household economy. Data in Table 4, for the four-district study area, support this generalisation. Measured in rice and rice equivalents, the aggregate value of farm production per capita in sample households was found to differ markedly between Luang Prabang, on the one hand, and Viengkham on the other (a difference of 150%), but in both districts, half or more households derived major cash income from the sale of buffalo, cattle, pigs and poultry, and lesser income from maize gardens, home gardens (vegetables etc.) and forest products, including fuelwood. Broadly the same range of 'product mix' is evident in the data for Phoukout, despite the expected dominance of large livestock in the swidden economy there.

In summary, despite the higher cash income being derived from particular farm enterprises, such as the production of buffalo, cattle and pigs for market, most households are still reluctant to develop the intensification of one enterprise (e.g., pig raising, or cash cropping) at the risk of other less profitable enterprises (e.g., poultry keeping, or upland rice production). What this emphasizes is that in the risk-prone environment of the uplands, subject to disease outbreaks which can decimate livestock populations, as well as marked fluctuations in upland rice yields in response to rainy season conditions, most upland farmers are primarily concerned with the sustainability of the total farm system from year to year.

Although the existing diversity in household production provides an attractive farm strategy in helping to offset risks, one might look for evidence of a transition to more specialised farming which might offer higher returns on land and labour. So far, such changes are not strongly evident, but in all four districts there are instances where mixed farming systems might be converted to greater specialisation. One example is occurring in Luang Prabang District where the preference is emerging for crop production, including lowland rice, in combination with fish culture and small livestock, and a reduced concern with upland rice and large livestock. A second example is evident in Phoukout, with the dominance of livestock.

In this context — and with special concern for the future role of livestock in the northern uplands of Laos — it is interesting to turn to the responses of the 200 sample farm households surveyed in the four-district study area. Their responses (Table 5) demonstrated a strong preference in the future for mixed crop and livestock farming systems, assuming the continuation of the existing ecological, socio-economic and institutional conditions.

Two aspects of the 'farmer-preferred strategies' listed in Table 5 deserve special comment. Firstly, the totality of preferences show an overwhelming preference for mixed farming with multiple enterprises and additional income-generating activities, not merely upland rice (*hai*) and livestock, or *hai* and cash cropping. Secondly, the need for strong (local) institutional support was identified by many farmer respondents, notably in Viengkham and by Lao Soung communities (Note the Preferred Strategies Nos. 16, 17 and 18). What this preference indicated was a desire for effective local (village-level) management of block-plot fallow successions, in order to achieve more productive land use.

Interestingly, the data for Luang Prabang District (the most 'advanced' of the four districts in terms of aggregate income per capita and diversity of upland farming systems) indicated a strong farmer preference for increasing and intensifying cash cropping, coupled with small livestock and fish production, and the relative reduction of the rice-dominated *hai* farming system. A further interesting point for the future is that in Luang Prabang District none of the preferred farming strategies identified 'large livestock' as a major component. Undoubtedly, a major consideration shaping farmers' responses here in 1996 was the official requirement for the de-stocking of cattle, already noted.

The Future of Livestock Production in the Uplands: An Overview of Main Contraints

Field observations and specific household data discussed in this paper have indicated that livestock production is well established as an integral part of existing swidden-based mixed farming systems, as an important factor in their sustainability and as a leading source of cash income for an increasing number of upland farmers. Even so, for the majority of village households in the uplands of northern Laos, livestock production remains a minimally developed opportunity, far below its potential. A great many livestock projects in the past 20 years have not generated the expected results. Households are still waiting for real progress to be achieved, but now know what their main needs are.

Proximate constraints

The complex of technical constraints restricting livestock production at the current level of management raises issues of disease diagnosis and the provision of effective health services, improved feed resources and 'space'. These are seen by households themselves to vary in their individual importance from one locality to another. The responses of farmers to field enquiries in the four-district study area, discussed in this paper, rated feed availability and diseases, in that order, as the main constraints, followed by 'space' (e.g., competition for land with crop farming) and fourthly, the shortage of labour for farming which is now being experienced in localities where the diversification of farm household activities is already well advanced. Luang Prabang District is an example.

In a livestock management system which is essentially extensive in nature, coupled with low productivity of the existing feed resource base, 'space' has become a serious problem since farmers are increasingly obliged to encroach on other villages' land (normally by agreement) to satisfy the nutritional needs of their animals. A parallel situation exists when swiddens are cleared for cultivation, by agreement, in forest regrowth or on the abandoned fallows of a neighbouring village.

Achieving increased productivity of a village's existing herd (or increasing the population of pigs, goats and poultry) will depend therefore on expansion in one way or another of the existing feed resource base and improvement in nutritional management, together with concurrent improvement in reducing mortalities by means of improved disease control and other animal health measures.

Table 5. Preferred land-use strategies of swidden farmers in the study area, 1996 (per cent of respondents).

	District				Ethnic groups		
	LPB	VKM	VTG	PKT	LL	LT	LS
	f = 50	f = 50	f = 50	f = 50	f = 67	f = 76	f = 57
1	—	—	32	—	—	21	—
2	—	—	38	—	12	14	—
3	—	—	30	—	15	—	9
4	—	—	—	—	—	—	—
5	—	—	—	—	—	—	—
6	—	—	—	—	—	—	—
7	—	—	—	—	—	—	—
8	20	—	—	—	15	—	—
9	10	—	—	80	30	5	37
10	50	—	—	—	19	16	—
11	—	—	—	—	—	—	—
12	10	—	—	—	—	7	—
13	10	—	—	—	2	5	—
14	—	20	—	—	—	13	—
15	—	20	—	20	8	11	11
16	—	10	—	—	—	7	—
17	—	32	—	—	—	—	28
18	—	18	—	—	—	—	6

Sources: Household responses in selected villages, 1996 sample survey. *Hai* = upland rice; *Na* = lowland rice.

1 = improve *Hai* practice & management + increase *Na* + increase livestock & cash crops + start fish + start teak + strong institution support needed.
2 = improve *Hai* practice & management + increase *Na* + increase livestock — fish & cash crops + increase off-farm + strong institution support needed.
3 = improve *Hai* practice & management + increase livestock + sustain *Na* + increase off-farm + increase fish + strong institution support needed.
4 = mixed *Hai* + livestock.
5 = mixed *Hai* + cash crop.
6 = predominately *Na* + complementary *Hai*.
7 = predominately livestock + complementary *Hai*.
8 = predominately cash crop + small livestock + complementary *Hai*.
9 = equally mixed *Hai* + livestock & fish + cash crop + strong institutional support needed.
10 = equally mixed *Hai* + small livestock & fish + cash crop.
11 = convert to all *Na* + complementary small livestock & fish + complementary cash crop.
12 = significant small livestock + increase *Hai* maize + increase cash crops + reduced *Hai* rice.
13 = significant small livestock + increase *Hai* maize + increased cottage + increase cash crop + reduce *Hai* rice.
14 = improve *Hai* practice & management + increase livestock + strong institutional support needed.
15 = improve *Hai* practice & management + increase livestock & fish + increased horticulture.
16 = improve *Hai* practice & management + increase livestock & fish + increased off-farm.
17 = improve *Hai* practice & management + increase livestock & fish & cash crops mainly for sale + strong institutional support needed.
18 = improve *Hai* practice & management + increase livestock & fish & cash crop mainly for sale + increase production of wood products for cottage industry & sale + strong institutional support needed.

Further constraints

Although they are not the most immediate constraints on improved livestock production, there is a set of financial, economic and institutional constraints, which will continue to act as a powerful brake on livestock-based development at village-level, until they can be successfully addressed.

Institutional constraints come in different forms. The most obvious are the inadequacies of existing technical and financial support services. These are in critical need of revision, if they are to contribute more effectively to the improvement of livestock and fish production systems. The establishment of village-level animal health services in the early 1990s, for example, has not contributed significantly and permanently to reducing livestock mortality in villages. The capability of district-level services in providing the necessary supervision and advisory support is still weak, not least because the creation of a number of grassroot technical and credit support programs (all well intentioned) have left district extension services isolated.

A less conspicuous, but no less serious, constraint of an institutional kind exists at village level. The managerial arrangements made in upland villages to support the rice-based swidden system, with its primary focus on sustaining rice production to ensure family food security, often work against efforts to improve livestock production. Village-level regulatory systems are focused on cropland and forest resources, aimed mainly at sustaining and intensifying production from cropland and so protecting forest resources from depletion, but the regulatory systems give scant attention to rangeland resources within the village territory and how these resources should be equitably accessed by households. This is a particularly difficult aspect of resource management. Difficulties are compounded at the outset by existing household-to-household disparities in income, by similar disparities in accumulated capital (often in the form of buffalo and cattle) and by problems of access to credit for buying large livestock and feeding them. Inevitably, however, if village authorities turn a 'blind eye' to within-village inequities in the factors which determine the level of households' participation in livestock production, then existing economic and social disparities within communities will soon be magnified. Another risk is that there will be over-grazing of the available village rangelands.

Finally, and perhaps most easily addressed in the long term, is the marketing constraint limiting livestock production. Upland communities are well aware of the market potentials of their livestock, even though producers are not closely aware of price mark-ups for beef, buffalo-meat, pork and chicken between the village and urban market places. The selling of livestock in the uplands of Laos is no longer a rare event, even though there are no regular marketing channels or a market network. Sales are usually effected through traders who visit villages to purchase animals, often alone and without competitive buyers. In such circumstances, producers may sometimes receive lower than fair market prices, particularly in instances where access to the village is difficult because of isolation and poor roads. On the other hand, in the four-district study area discussed in this paper, although some villages are disadvantaged relative to others, significant urban markets with wide-reaching geographic linkages now exist in both Luang Prabang and Xieng Khouang Provinces. Most of Viengkham District's sales of small livestock are directed to Luang Prabang city and from there meat products are despatched to Vientiane and Xaignabouri. A similar situation exists in Xieng Khouang Province, which also sends meat to Vientiane City (in part by air). Animals from villages in Houaphan are increasingly attracted to Vietnam for sale, as a consequence of the booming economy there in the 1995–97 period.

Conclusion

The sum of constraints outlined above amounts to a massive challenge for the improvement of livestock production in the uplands of Laos. But there are reasons for optimism as the next decade approaches.

This paper has demonstrated from the four-district study spanning three major provinces (Luang Prabang, Xieng Khouang and Houaphan) that many swidden farmers are now practising a *mixed farming strategy* which reduces the food insecurity inherent in a rice monoculture, and also provides families with a sustained level of living in the difficult upland environment.

The diversity of enterprises which has become so important among upland farm households in the 1990s, helped by markets for cash crops and livestock, includes production of small and large livestock and fish as *integral components* in a combined subsistence and commercial economy. In most villages surveyed in these three important provinces, livestock production is now *the leading source of cash income* for farm families, often far out-stripping annual rice production in value (Table 4). This provides a confident base from which livestock production can be developed for the majority of upland farmers, if the complex of constraints can be tackled successfully.

Finally, it might be useful to consider why the 'enterprise mix' is so much more diverse and income-rewarding in the seven upland villages surveyed (50 sample households) in Luang Prabang District, compared with village households in the three more remote districts, namely Viengkham, Viengthong and Phoukout. As household data have shown, differences in the ethnic mix are not the answer. Differences in terrain play a role, with some flatter land giving Luang Prabang more opportunity for *na* and for the construction of fish ponds, but the outstanding differentiating factor is the *easier access to markets and services* that upland farmers in Luang Prabang enjoy.

What follows then, is that a successful strategy for the significant improvement of livestock production needs, at the outset, to be focused on specific locations and nearby areas where local roads are better developed and effective linkages exist between villages and towns. In these situations, a close understanding of local swidden economies, regulatory systems and farming systems becomes a necessary preliminary to implementation of a livestock-centred development strategy. That strategy, a 'package' varying from one village to another, is likely to give priority to ways of simultaneously improving feed production, improving animal health and improving management: ways to be agreed in advance by village participants, village authorities and the agencies providing services. Subsequently, the further constraints on livestock production will need to be addressed over a number of years.

The magnitude of the challenge should not be underestimated. On the other hand, there is the prospect of important financial rewards to smallholders and to the national economy as the farming transition continues ever more strongly and widely in the uplands, towards a secure livestock and crop economy which combines subsistence production with a larger component focused on the generation of cash income.

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References

Fujisaka, S. 1991. A diagnostic survey of shifting cultivation in northern Laos: targeting research to improve sustainability and productivity. Agroforestry Systems, 13, 95–109.

Lao-IRRI 1991 Upland agriculture: Activities by Lao-IRRI Project. Vientiane.

Lao-IRRI 1995. Upland agriculture: Activities by Lao-IRRI Project. Vientiane.

MAF (Ministry of Agriculture and Forestry) 1994. Annual Report. Vientiane.

Pelzer, K.J. 1978. Swidden cultivation in Southeast Asia: Historical, ecological and economic perspectives. In: Kunstadter, P., Chapman, E.C. and Sabhasri, S. eds., Farmers in the Forest. Honolulu, University of Hawaii Press, 271–286.

Pravongviengkham, P.P. 1997. Local regulatory system in support of Lao swidden-based farm economy, presented at an International Seminar on Community Forestry at a Crossroads: Reflections and Future Directions in the Development of Community Forestry, 17–19 July 1997, RECOFTC, Bangkok. 22 p. mimeod.

Raintree, J.B. and Warner, K. 1986. Agroforestry Pathways for the Intensification of Shifting Cultivation. Martinus Nijhoff/Dr W. Junk Publishers, Dordrecht, The Netherlands.

Rambo, A.T. et al. 1990. Agroecosystems in the Midlands of Northern Vietnam. East West Environment and Policy Institute, Paper No. 12, Hawaii.

Souvanthong, P. 1995. Shifting Cultivation in Lao PDR: an Overview of Land Use and Policy Initiatives. Forestry and Land Use Program, International Institute for Environment and Development, London.

Spencer, J.E. 1966. Shifting Cultivation in Southeastern Asia. University of California Press, Los Angeles.

Economic Change in Lao Agriculture: The Impact of Policy Reform

Peter G. Warr[1]

Abstract

Since implementation of economic reforms in the Lao PDR, beginning about 1990, rice output has grown less rapidly than population but cash crop and livestock production has outgrown population. The sources of these events were: (i) The reforms reduced the barriers to domestic trade in agricultural commodities within Lao PDR. Those regions with a comparative advantage in cash crop and livestock production could now more readily sell their output of cash crops and livestock in exchange for rice. It was no longer necessary for a farming household to grow rice in order to be sure of having sufficient rice to consume. (ii) The restoration of good border relations between Lao PDR and Thailand meant that cross-border trade between the two countries was no longer obstructed by political tensions. In addition, the reform process in Lao PDR reduced the administrative barriers to international trade with Thailand, China and Vietnam. (iii) The rapid growth of the Thai, Chinese and Vietnamese economies, with which Lao PDR shares long and permeable borders, produced greatly increased demand for cash crops and livestock, some of which could be produced efficiently in Lao PDR.

DURING 1987, the government of the Lao Peoples' Democratic Republic (Lao PDR) embarked upon an ambitious program of economic reform. In doing so, it took policy steps also taken at around the same time by Vietnam[2], and earlier by China, where a reform process had begun in 1978. The decision to reform the economy reflected the government's assessment that the existing policy framework, based on tight government control of private sector activity and central planning, was not working well. It was evident that comprehensive central planning was in any case virtually unworkable, given the Lao government's very limited resources. Some other way of allocating resources had to be found. The government's policy package for economic reform, known as the New Economic Mechanism (NEM) had, as its central thrust, greater reliance on market mechanisms. The reformers believed that market mechanisms offered a more efficient solution to the resource allocation problem.

Agriculture remains the largest sector of the Lao economy, generating 56% of Gross Domestic Product (GDP) and employing more than 80% of the work force. This paper deals with the impact that the program of economic reform has had on this crucial sector of the Lao economy. Table 1 shows the growth rates of output at current and constant prices, respectively, for the period 1990 to 1995 inclusive. During this period, aggregate agricultural output increased in real terms at the impressive rate of 4.8% per year. This compares with growth of real GDP at market prices of 6.4% and growth of industrial and services output of 10.6 and 6.1%, respectively. The observed rate of growth of aggregate agricultural output is high by international standards. Moreover, in comparing agricultural output growth with that of industry and services it must be recognised that in the case of agriculture this rate of output growth was achieved at the same time as resources were being released from agriculture to the other sectors of the economy, thereby contributing to their growth. From this, it appears that the rate of productivity growth in agriculture exceeded the 4.8% rate of growth of output.

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[2] Vietnam's reforms were officially announced a little later but were already under widespread discussion in 1987.

Table 1. Growth rates of GDP and its components, 1990–1995.

(Per cent per annum)

Sector	Current prices	Constant 1990 prices
Agriculture	14.01	4.75
Crops	10.68	1.43
Livestock and fishery	15.63	6.38
Forestry	30.31	21.06
Industry	19.87	10.62
Mining and quarrying	24.57	15.32
Manufacturing	20.03	10.78
Construction	21.07	11.81
Electricity, gas and water	15.58	6.33
Services	16.37	6.07
Transport, storage & communications	12.95	3.70
Wholesale and retrail trade	19.48	10.23
Banking, insurance and real estate	16.49	7.24
Ownership of dwellings	12.50	3.25
Public wage bill	13.32	4.48
Non-profit institutions	9.92	10.33
Hotels and restaurants	47.45	52.07
Other services	29.56	19.92
GDP at factor cost	15.57	6.06
Import duties	31.02	24.58
GDP at market prices	15.79	6.35
Memorandum item:		
GDP deflator	9.42	0

Source: National Statistical Centre, Vientiane.

When agriculture's major components are viewed, however, a somewhat different picture emerges. The growth rates of these major components have differed significantly. Livestock output grew at an annual average rate of 6.4%, and forestry at the very high annual rate of 21.1%. But the crops sector grew at only 1.4%. The high rate of growth of forestry output must be seen in part as involving a depletion of the natural resource base, the forests, rather than as a reflection of productivity growth. Since population grew at the rate of 2.2% per annum over the same period, it is clear that livestock and forestry output both grew much faster than population but that crops output did not keep pace with population growth. Crops output per head of population declined at an annual rate of 0.6% per annum.

Within the crops sector, the growth rates of output of different crops varied significantly. In general, output of cash crops grew rapidly but staple food output — rice, corn and starchy roots — grew much more slowly. The data suggest that since the reforms agricultural producers have responded to the new market opportunities by moving significant quantities of resources out of staple food production and into production of cash crops. The cash crops where output has grown rapidly include vegetables and beans, soy beans, cotton and coffee. But not all cash crops have responded in this way. Production of mung beans, peanuts, tobacco and sugar cane have actually declined in absolute terms.

The growth of the cash crops and livestock sectors in the post-reform period may be seen as the consequence of three important events.

(i) The reforms reduced the barriers to domestic trade in agricultural commodities within Lao PDR. In particular, those regions with a comparative advantage in cash crop and livestock production could now more readily sell their output of cash crops and livestock in exchange for rice. Since domestic trade was no longer restricted, it was no longer necessary for a farming household to grow rice in order to be sure of having sufficient rice available for its own consumption. Improvements in domestic transportation infrastructure facilities reduced natural barriers to trade and reinforced the effects of this policy change.

(ii) The restoration of good border relations between Lao PDR and Thailand, following serious and sometimes bloody border disputes in the late 1980s, meant that cross-border trade between the two countries was no longer obstructed by political tensions. In addition to the reduction of border tensions, the reform process in Lao PDR reduced the administrative barriers to international trade, in particular trade with Thailand and China, thus facilitating the response of Lao agriculture to the market opportunities created by rapid economic growth in these neighbouring countries.

(iii) The rapid growth of the Thai economy, with which Lao PDR shares a long and permeable border, produced greatly increased demand for cash crops and livestock, some of which could be produced efficiently in Lao PDR. A similar, but somewhat smaller, increase in demand for cash crops also occurred along the Lao PDR border with China. Thailand's growth did not produce a demand for rice from Lao PDR, however, because Thailand is and remains a large net exporter of this commodity.

Rice is by far the most important agricultural commodity produced in Lao PDR and since the reforms aggregate rice output has grown at an average annual rate of about 1%. With annual population growth of 2.2%, these data imply that since the reforms rice output per head of population has *declined* at an average rate of 1.2% per year. In so far as achievement of rice self-sufficiency is a major objective of the Government of Lao PDR, these data indicate continued difficulty in the post-reform environment in moving toward that objective. Comparing the available data on the growth of rice output per head of population before and after the reforms, it is apparent that while rice output grew more rapidly than population before the reforms (the data imply output growth per capita of just under 3% per annum, 1976 to 1990), this momentum was not sustained after the reforms.

Within the rice sector, it is vital to distinguish between the growth of production under irrigated and non-irrigated conditions. An average of around three fourths of total rice production in Lao PDR occurs under irrigation. The scope for substitution out of rice production and into cash crops is much greater under non-irrigated conditions than under irrigation because the irrigation systems in place within Lao PDR are in general specifically designed for paddy rice production. Accordingly, the movement out of rice production and into cash crops described above has been heavily concentrated in upland (non-irrigated) conditions. While rice output under irrigated conditions has grown at 2.8% (more rapidly than population) output under upland conditions has declined at an average rate of 5.4%.

In summary, the decline of rice output relative to population reflects the post-reform economic environment of Lao PDR in three major respects.

(i) The more liberalised trading environment in place after the reforms produced market incentives which favoured movement of resources out of agriculture and into the non-agricultural sectors of the economy

This phenomenon is demonstrated by examining the movement of relative prices. Agricultural commodity prices declined markedly relative to non-agricultural prices, especially those of services and construction. An economic boom followed the more open economic environment created by the reforms, but this boom was concentrated in the services and construction sectors of the economy, which drew resources from elsewhere, especially from agriculture

The inflow of foreign capital which has accompanied the New Economic Mechanism has indirect macro economic effects on agricultural output which are in some cases negative. The increased domestic expenditure made possible by foreign aid and foreign investment produces demand-side effects which imply contraction of agriculture. Increased demand produces increases in the domestic prices of those goods and services which cannot readily be imported. These include most services and construction and the expansion of these sectors attracts resources, including labour, away from agriculture.

This phenomenon has also been observed in other countries experiencing large increases in capital or export revenue inflows from abroad where it has sometimes been called the 'Dutch Disease' or 'booming sector' effect. It causes the prices of agricultural commodities to decline relative to other prices, with negative effects on agricultural production.

To the extent that the New Economic Mechanism increases the exposure of agricultural commodities to international markets, this policy change indirectly increases the impact on agricultural production of these market phenomena.

(ii) Within the agricultural sector, the reforms and related improvements in market access to Thailand generated market incentives which encouraged substitution of cash crops and livestock for rice.

The particular cash crops and livestock enterprises that were suitable varied greatly from region to region. For example, in the Paksong district of the highland plateau region, coffee and green vegetables were the main cash crop alternatives, while in Kaen Thao district of Sayabury Province there were many cash crop alternatives, including cotton and beans. Since the liberalised market environment under the reforms meant that households' rice requirements could be purchased and did not have to be produced, diversification into cash crops became an option that was not readily available before the reforms.

The changes in the composition of output following economic liberalisation suggest that, in terms of economic efficiency alone, comparative advantage in Lao agriculture does not lie in expansion of rice production. Rather it seems to lie in increased high value cash crop and livestock production. The reasons for this conclusion are:

(a) The land endowment of Lao PDR. Laos is mountainous and the scope for lowland irrigation is limited. The 'green revolution' technology, based upon (i) irrigation, (ii) high levels of fertiliser and insecticide use, and (iii) varieties of rice adapted to these conditions, are thus less suited to Lao conditions than to those in some neighbouring countries.

(b) The poorly developed transport system within Lao PDR, which leads to high transport costs for bulky commodities. There is an advantage to producing high unit value commodities which are also storable. In so far as livestock can walk to market, high transport costs favour their production relative to commodities requiring mechanised transport.

(c) Continued rapid economic growth in neighbouring Thailand will produce growing export demand for high value cash crops and livestock products, rather than for staple foods.

(iii) In addition to the above, the Government has introduced policy measures designed to reduce the incidence of slash and burn cultivation and encourage more stable forms of land use in upland areas.

Since a high proportion of upland rice production actually occurs under slash and burn conditions, the movement out of upland rice is in part due to the reduction of slash and burn modes of production. In this respect, the reduction of upland rice production should not be interpreted as an indication of the failure of policy, but rather as an indication of the partial success of policies intended to achieve a reduction of slash and burn modes of cultivation.

Field studies at the village and household level suggest that most rural households have benefited from the new market opportunities made possible by the reforms.[3] Nevertheless, the households best able to adjust quickly to the new economic environment produced by the reforms are those who are already better off. These have been the first farmers to adjust the composition of their output towards more profitable opportunities, the first to adopt modern agricultural inputs and the first to acquire new machinery. The proportionate gains in income achieved by the better off households have considerably exceeded those of the less well off. It is vital to recognise, however, that this fact does not imply that the poor have become worse off in real terms. The reforms will have reduced absolute poverty in rural areas, because almost all households seem to have experienced some improvement in opportunities, but the relative distribution of incomes will have become more unequal.

To a large extent, these outcomes were to have been expected. Better off farmers are generally those best informed about new commercial opportunities and best able to take the risks involved in pursuing them. However, the poorly developed agricultural credit system of Lao PDR is also partly responsible for the difficulty of poorer rural households in participating more fully in the market economy. To adjust the composition of output or to modify existing cultivation practices requires investment, and investment requires credit. But field studies indicate that in general poorer agricultural households can obtain credit only through informal channels that involve very high rates of interest. As of mid-1995, the existing channels of agricultural credit were not reaching the rural poor. This was also true of the government's very limited agricultural extension capacity. As of the time of the study it too was not reaching the rural poor.

The Government's determination to reduce the incidence of slash and burn cultivation is motivated by concern for its environmental consequences. This policy has been applied in a policing manner. Some households, or entire villages, practicing slash and burn methods have been relocated to areas where more sedentary forms of production can be practiced. Elsewhere, the policy has operated by placing maximum limits on the lengths of fallow periods.

The effect of maximum fallow periods is to reduce the amount of land that a household can cultivate and thus reduce the area subjected to slash and burn practices. But within the area cultivated the effect is to hasten the degradation of that land, a fact which is demonstrated by rapidly falling yields on that land. In many cases, the maximum fallow periods are too short to permit productive agriculture to be sustained. Efforts are under way to improve the security of land titling in Lao agriculture and these developments seem to have far greater potential for reducing land degradation than the policing approaches now being pursued. Greater security of tenure reduces land degradation by giving the villagers a greater incentive to maintain the long-term productivity of the land.

[3] Field studies were conducted by the author, together with the colleagues named under the heading Acknowledgments. Two villages were studied in each of the three major agro-ecological zones of Lao PDR — mountainous areas, highland plateau and lowland plains, except for the mountainous areas where a third village was added to extend the study's coverage of shifting cultivation.

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Prospects for Livestock in Upland Lao PDR Farming Systems

Bounthong Bouahom[1]

Abstract

Livestock is an integral part of shifting cultivation systems in the Lao PDR and plays a significant role in the uplands. This paper describes the role of livestock (cattle, buffalo, pigs, poultry) as a component of upland farming systems together with the results of a survey in the northern provinces which identified problems and opportunities for livestock in income generation. Traditional small-scale livestock production systems are now mainly practised by upland farmers, but it is observed that livestock production has improved in some areas of greater potential. Some upland farmers have also changed from shifting cultivation to the raising of cattle, pigs and poultry as a main source of income. Livestock production is being integrated with crop production for feed, particularly for pig and poultry production.

THE GOVERNMENT of the Lao PDR has recognised the negative impact of swidden cultivation and gives high priority to creating permanent jobs for swidden farmers, poverty alleviation, and to increasing the income of households by programs involving crop production, forestry, irrigation and livestock. Resolution VI of the Party Congress (1996) stated that development should focus on increasing productivity with environmental protection and maintenance of soil fertility, and on the promotion of livestock production, particularly in upland areas. The central objective was to contribute to poverty alleviation of the upland people and to develop the economic potential of this sub-sector. Stabilisation and eventual elimination of shifting cultivation is considered the first priority program of the government until the year 2000 and beyond (Forestry Department, 1995).

Livestock and Fisheries as an Integral Part of Shifting Cultivation Systems in Laos

Livestock and fisheries, among other alternatives, can play a crucial and decisive role in upland farming systems since these forms of economic activities can provide a significant amount of cash income and contribute to a more sustainable lifestyle in these regions. Crop-livestock integration is not only common, but is seen to be inseparable.

The potential for livestock development in the uplands lies in improving the productivity of livestock. Demand for livestock products is very strong in the lowland and urban areas and even in the uplands. This demand in the Southeast Asian Region is expected to increase in direct proportion to the projected 6%–8% annual economic growth in those markets over the medium term (World Bank Review, 1996).

The development of upland livestock needs to be addressed through a number of issues. Major issues are:

- the strengthening of support services in these areas (especially for improving animal health and forage production);
- the improvement of farming practices that combine the twin objectives of increasing livestock productivity and protecting the environment; and
- improvement of financial support (e.g., credit) and market structure and facilities (Yadav 1992).

Potential for Development in the Uplands

Numerous studies and development projects in Laos that have dealt with or are still dealing with upland

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rural development in general, or aiming at stabilising shifting cultivation, stress the importance of livestock and fisheries and their potential role in diversifying the swidden systems and contributing to poverty alleviation through increased income-generating opportunities (EU project/Luang Prabang 1994; IRRI project/Luang Prabang 1994, SIDA project/Luang Prabang 1994; IFAD/Xieng Khouang 1994; Lao–American project/Houaphanh 1994; Chazee 1994; Heide 1990; Menzies 1991; Chamberlain 1994; IIED 1995). International aid organisations repeatedly stress their recognition of livestock and fisheries as having a potential role in swidden systems. The reality is that although numerous foreign funded development projects have stressed repeatedly the potential of livestock in the uplands, there has not been significant foreign support primarily for developing the livestock sector in those upland areas, as compared to the other sectors (e.g., forestry).

Most of the observations and findings made on the relative importance of livestock and fish farming are that they are and always have been an integral part of the shifting cultivation systems. Livestock and fisheries represent the most important source of protein (especially fish) and stores of wealth (especially cattle and buffalo). Livestock represents the major source of income for many integral swiddeners, contributing 50% to 70% of total income. Animal production seems to have the greatest potential for providing cash income for swidden cultivators, and these incomes are used to purchase staple food and basic necessities. It is generally understood that farmers are more likely to adopt complementary practices that can be used in conjunction with shifting cultivation, rather than to abandon shifting cultivation in favour of entirely new practices.

The concept of agroecosystem is derived from the theoretical work on community ecology and systems ecology (Rambo 1990). A system is an assemblage of interacting components within a boundary. These components act together so that the system responds to stimuli as a whole, even if the stimulus is applied to only one part of the system. As such, a bounded system produces a distinctive set or configuration of results. Although all the parts of a system may be connected to each other, that does not mean that researchers need to understand every single aspect of the system. Rather, the essential features are determined by a limited number of processes, and the researcher can focus on these key processes and interactions. The agroecosystem analysis approach views agricultural systems in terms of their output of certain critical properties desired by their human managers within a well-defined system hierarchy. Each system hierarchy or level has unique processes and interactions (called 'emergent properties') that lead to synergism. Hence, the yield of a rice crop is not simply a function of the individual rice plant but of the competition between plants in a plot (including weeds). Each level in the hierarchy has to be analysed in its own right.

The Department of Livestock and Fisheries (DLF) currently participates in implementing the program of the Ministry of Agriculture and Forestry in reducing shifting cultivation. Several constraints are faced, notably a limited transport infrastructure, limited staff both in quantity and skills, inadequate credit for smallholders, weak collaboration of different sectors involved, and poorly developed technological packages for the different farming systems. The swidden farmers mostly are living below the poverty line. Their income per household per year is commonly less than 100.000 kips (approximately US $100.00 at May 1997 prices). In this context, the DLF has formulated the following strategies:

- develop infrastructure and institutional strengthening of the livestock sector in large areas to help swidden farmers in poverty alleviation, employment opportunities, and contribute to rural development;
- promote the production of large ruminants together with swine and poultry production, with appropriate farming systems to contribute to reducing and stabilising swidden cultivation;
- promote livestock and fisheries production as the main source of income for poverty alleviation and income generation in areas where there are resources and socioeconomic potential for livestock development.

Methods

To implement its program to encourage swidden farmers to raise livestock, the DLF has taken the following steps:

- formulated a project profile assessing income sources and livestock holding, to help poor farmers strengthen their involvement in livestock raising (cattle, buffalo, pigs, poultry, fisheries) where potential exists;
- carried out socioeconomic and resource surveys in target areas, using RRA and PRA techniques for planning the development process;
- developed a specific program for intervention in upland areas.

Preliminary results (1995–1996 field survey)

In 1995, a team comprising staff members of the DLF with provincial and district officers carried out a rapid rural investigation in five provinces, seven districts and 51 villages in the northern provinces.

One of the major problems was that most farmers did not know how to incorporate a somewhat large number of livestock into their swidden systems in a sustainable manner. Based on the data collected, the DLF proposed to the Agricultural Promotion Bank that credit be provided to 1280 households willing to participate in increased livestock. In 1996, the DLF surveyed seven provinces, 11 districts and 1900 households in target areas, with the objective of involving 2500 households.

Livestock development potential

The Lao PDR is fortunate in being endowed with extensive natural grasslands, estimated at between 8 and 9 million hectares comprising open natural grasslands, dipterocarp forests, mixed deciduous plants and barren lands of which about 6 to 7 million hectares are located in upland areas (Norachack et al. 1993).

In 1996, there were about 1.3 million head of buffalo, 1.2 million cattle, 1.6 million pigs and about 11 million poultry. Buffalo and cattle are concentrated mainly in lowland areas. Approximately 40% of the national herd of buffalo and 29% of the national herd of cattle are located in upland areas (Bouahom 1995). The current stocking rate for ruminants in the uplands is estimated to be more than eight hectares per beast (compared with two or three hectares per beast in the lowlands).

It is important to understand the agroecological zones of the country because the strategic utilisation of foodstuffs and required agroforestry interventions will vary with different agroecological zones.

Important additional feed resources in upland livestock production are rice straw and other crop residues (maize, leguminous crops such as beans and fruits), locally available feed resources (maize, cassava, pumpkin as a feed for pigs and poultry) sourced from the upland cropping systems and significant complementary fodder from home gardens under a 'cut-and-carry' system. The latter is considered to be a principal source of high quality protein fodder to supplement low quality roughages. Shrubs and tree fodders are common in most home gardens and are traditionally used by farmers in feeding livestock.

Fisheries development potential

Fish are recognised as a most important source of animal protein in the diet of local people. Fish account for 40% of total animal protein in the national diet (10 kg per person per year). In rural areas, fish are said to account for more than 50% of animal protein consumption (DLF 1995). Since the Lao PDR is a landlocked country, its fishery resources are confined to the Mekong River, its tributaries, lakes and reservoirs (natural and man-made), innumerable ponds, bunded paddy fields, and swamps. The aquatic food supply in Lao PDR is dominated by capture fisheries and complemented by enhanced fisheries and aquaculture, which are seen to have potential to meet future deficits in fish production caused by the decline in capture fisheries, as well as to increase the present average low level of fish production in the country.

Upland and mountainous regions of Laos have a relatively rich endowment of natural grasslands. There is a tradition that the uplands have always been the major suppliers of livestock to the lowlands and for export. In view of this, the Government of the Lao PDR has recognised livestock production as a viable means for reducing and eventually arresting shifting cultivation practices through increased integration in the rice-based subsistence economy. Major government agencies (e.g., CPC and MAF) perceive that because livestock is already an integral part of the upland economy and an increasingly valuable commodity in the country and in the region, farmers in these areas are more likely to shift from a subsistence economy to a semi-market economy (integrating swidden with livestock) and full market economy dominated by livestock.

Also, since the early 1990s, livestock development programs have formed an integral component of most upland rural development programs in Laos. Because of the relative abundance of water resources in the uplands and the fact that the technical knowledge of aquaculture and especially rice-fish culture are considered as indigenous, the government has considered aquaculture an important possible alternative. It can contribute to improving the nutritional status of the upland population and also eventually contribute to some extent to reducing shifting cultivation practices through better integration of fish culture in the cash income sector of the swidden farming economy. However, past experience in livestock and fisheries development programs in the uplands have pointed to main constraints and problems that affect the acceptability of livestock and fish production.

These are:

- inadequate physical infrastructure, roads and transport;
- a lack of appropriate support, research and extension services in more isolated areas to help sustainable management of livestock in the uplands;
- in the case of fisheries development, a lack of seed production and appropriate distribution mechanisms.

In relation to the first set of constraints, the initial problem is the need to understand upland characteristics, adaptation mechanisms of farmers and major forces that influence the system. Understanding is essential to locating points of entry for integrating livestock and fisheries production within the swidden farming systems.

Results of the 1995–1996 investigation showed that livestock-raising in the upland is traditionally carried out on a small scale. Farmers keep two or three cattle, one or two buffalo, two or three pigs and 10 to 20 chickens or ducks, in conjunction with shifting cultivation. Technical knowledge is primitive or non-existent — only some farmers know how to use local medicines or use supplements for animals. The income is low, commonly less than 100,000 kips per family (about US$100 at May 1997 prices).

The field team observed some progress in livestock husbandry in several upland areas. It occurred in the following ways:

- There was a shift towards a cattle-based farming system, with fencing and the use of supplements such as salt, sown grasses, vaccines and local medicine. In these instances, farmers kept 30 to 40 cattle instead of two or three. They generated sufficient cash income from selling the cattle as the main source of income to allow them to purchase rice and other food. Their living conditions rose above the poverty line and they reduced or stopped shifting cultivation.
- There was a shift to pig-raising integrated with maize. In an area where the farmers planted maize (e.g., Nong Het district), they also commonly grew cassava and pumpkins in permanent plots to feed the pigs. Some farmers kept 20 to 30 pigs and fed them with locally available feed. They generated cash income and were able to stop shifting cultivation practices.
- Poultry production rose from the traditional 10 to 20 per household to more than 100 birds.
- There were some integrated livestock-crop and livestock-fisheries cropping systems.

These sub-farming systems have been helped by many features of the New Economic Mechanism, such as the impact of rural development projects, credit schemes, and technical support adding to farmers' indigenous knowledge.

Previously, most farmers had considered technical recommendations, e.g., management of communal lands, to be irrelevant because the recommendations conflicted with traditional methods of livestock raising. The cattle or buffalo provided to farmers were often more of a burden to swidden farmers rather than a solution or a means of alleviating pressure on the system. Another major problem was that the cattle bank credit program was considered by farmers to be irrelevant.

- In practice now, the technical program of the DLF aims at triangle of cross-section linkages, consisting of three main components:
- credit organisations provide different kinds of credit to farmers;
- a self-guaranteeing farmers' group receives credit and is responsible for it;
- a technical support service, run by DLF which is responsible for rural development agencies and extension agencies.

Results show that the income from livestock in the northern provinces has increased to more than 50% of total household cash income, and there is potential for the development of cattle, pigs, and poultry as main sources of income.

There is a good market for livestock where there are access roads. In the northern provinces, there is a low human population with a relatively high livestock population. Most of the livestock, particularly cattle and buffalo, are slaughtered and sold in the main cities as fresh meat.

Conclusion

The DLF is presently implementing a program for stabilising swidden cultivation, and promoting through provincial officers an in-depth understanding of the role of livestock and fisheries in stabilising and reducing shifting cultivation. Traditional small-scale livestock production is seen to provide opportunities for a range of more market-oriented upland farming systems.

These are:

- cattle-based livestock farming;
- swine-based livestock farming;
- poultry farming;
- fish farming;
- integrated livestock-fisheries farming;
- integrated livestock-crops farming;
- livestock-based agroforestry.

One of the main problems in shifting cultivation is poverty. Farmers practice shifting cultivation because they need rice for consumption to survive in difficult conditions of life where they cannot find alternatives. In all of this, livestock production is expected to be an integral part of the rice-based farming system, but playing a significant role in cash income generation. Income from livestock (cattle, buffalo, pigs and poultry) amounted to more than 50% of total household cash income in the areas surveyed. If the constraints mentioned above could be overcome, the living standard of the upland farmers can be improved to a significant extent.

References

Bouahom, B. 1991. Agroforestry: Possible alternatives to shifting cultivation in the Lao PDR. In: Proceedings of Conference on Recent Research on Sustainable Rural Resource Management in Southeast Asia, Hawaii, 1–14.

— 1994. Cattle Production Systems. Department of Livestock and Fisheries, Vientiane, Lao PDR, 90–99.

— 1995. Research priority for livestock agriculture by agroecological zones in the Lao PDR. In: Proceedings of the Consultation for the Southeast Asia Region. Los Baños, The Philippines, International Institute for Environment and Development, 215–221.

Norachack et al. 1993. Natural grassland in the Lao PDR. In: Proceedings of the Third Regional Working Group, FAO, Bangkok, Thailand.

Pravongviengkham, P. Parisak, 1989. The livestock development program in the Lao PDR. In: Proceedings of SUAN-EAPI Exploratory Workshop on Lao Agroecosystems, Suan Secretariat, Farming Systems Project, Khon Kaen University, Thailand, 20–34.

Souvanthong, P. 1995. Shifting Cultivation in the Lao PDR: An Overview of Land Use Policy Initiatives. International Institute for Environment and Development, Forestry and Land Use Series No. 5, London, 37 p.

SUAN, 1990. Two Upland Agroecosystems in Luang Prabang Province, Lao PDR: A Preliminary Analysis. Suan Secretariat, Farming Systems Research Project, Khon Kaen University, Thailand.

World Bank Review, 1996. Lao PDR Agricultural Sector Memorandum. Report No. 1367-LA, Washington.

Animal Husbandry in Shifting Cultivation Societies of Northern Laos

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Abstract

Shifting cultivation is the dominant type of land use in Northern Laos. Livestock production and shifting cultivation are integrated through fodder production, the use of agricultural by-products for animal feed, the grazing of fallow areas, the use of animals for transport, and the sacrifice of animals for crop production and protection. The economically most important animals are pigs, chickens, cattle, horses, goats and buffalo. Shifting cultivators' livestock production is characterised by slow growth and high morbidity and mortality rates. However, production may remain viable because of the small input of labour and capital. Though higher productivity is technically possible, the adoption of improved feeding and other management techniques is constrained by most shifting cultivators' poverty and labour shortage. The livestock sector offers good opportunities of assisting farmers through veterinary service, extension of improved management and advice on community organisation. Much improvement can be achieved by applying existing technologies and knowledge, but this would require improved delivery of the extension and veterinary service.

STUDIES of the role and management of animals in shifting cultivation communities are sparse compared with the attention given to plant production and the shifting cultivation cycle. Furthermore, comparatively little development aid has been given to improving livestock production in shifting cultivation areas (Carson 1997, these Proceedings). Nevertheless, animal production is economically and culturally important, and is an integral part of most shifting cultivation systems in Laos. Increased and improved livestock production is a component in the Lao authorities' strategy to stabilise or replace shifting cultivation (DoF 1997). It is also expected that livestock production will become the main occupation of some current shifting cultivation households (DLF 1997).

This paper describes some general aspects of livestock production in shifting cultivation areas of Northern Laos.[2] The analysis is partly based on the experiences gained by the Shifting Cultivation Research Project in Luang Prabang Province (Sodarak et al. 1997, these Proceedings).

The Role of Livestock in Shifting Cultivation Communities

Animal raising is important in the upland farming system for food, income, saving, transport, rituals, and for the use of waste products and fallow vegetation. The economically most important animals are pigs, chickens cattle, horses, goats and buffalo. Others commonly kept are dogs, cats, ducks, and various captive animals. Fish-raising has also become increasingly common.

Economic advantages

In many shifting cultivation communities, the sale of animals provides most of the cash income needed to cover rice deficiency and the purchase of market goods. This is particularly the case in more remote communities where off-farm income and cash cropping are limited (Pravongviengkham 1997, these Proceedings).

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[2] The Northern Region usually refers to the seven provinces Phongsali, Luang Namtha, Bokeo, Udomxai, Luang Prabang, Huaphan and Xaignabouri.

As a commercial commodity in remote areas, livestock-raising has several advantages, including its relative independence of road access, since large animals can be herded along trails. Moreover, the price per weight unit is high, compared to most crop products, which lowers the relative transportation costs. Thus, selling a cow worth 150 000 Kip (approximately US$150.00 at May, 1997 prices) from a distant village with no road access is infinitely easier than marketing, e.g., 1000 kg of rice or 500 kg of soybean. Furthermore, unlike perishable cash crops, animals can be sold when money is needed or when the price is satisfactory. Lastly, livestock prices are very stable compared to the often greatly fluctuating prices on crops. Livestock-raising is usually supplementary to shifting cultivation; the relatively few families who specialise in livestock production normally have special access to feed or they obtain a large part of their household income from non-agricultural activities. Such households may include rice millers, schoolteachers and people connected with city-based investors. For most shifting cultivators, specialisation in livestock at the expense of upland rice production is limited by the added risk, the longer return periods, and by the high price and transportation costs of market rice.

Integration with shifting cultivation

Livestock production and shifting cultivation are integrated through:

- the use of agricultural by-products for pig and poultry feed;
- the use of harvested fields and young fallows for ruminant grazing;
- the modification of the vegetation succession, for instance the suppression of potentially difficult weeds, especially grasses;[3]
- the use of horses and, more rarely, bullocks and mules, for transporting crops;
- the production of animal feed, mainly maize and root crops for pig raising;
- the ritual slaughter for crop protection and production;
- the use of manure in plant production.[4]

In Laos, ruminants may have a special role as users of the large areas of land contaminated by American antipersonnel bomblets and other unexploded ordnance from the Indochina War. A recent survey estimates that 26% of villages in Laos still report the presence of unexploded ordnance within the village territories (UXO LAO 1997). Many such areas cannot be brought under cultivation because of the risk of explosions, but may be used reasonably safely for grazing.

There are, however, also some negative interactions between livestock and plant production. Encroachment of farm animals in arable fields is very common and a major cause of community conflict. The encroachment increases the need and the cost of fencing, and limits the opportunities of adopting non-traditional plant production systems, e.g., improved fallows, cover cropping, edible contour barriers, tree plantations and orchards. Some villages have introduced regulations or bans on free-range production. Livestock and crop production may also compete for land, and the burning of natural vegetation for promotion of fresh grass growth can interrupt fallow regeneration. Competition for labour is probably a small problem, as most farmers put little work into animal production. However, more productive livestock production systems will need considerably more labour than are commonly expended, and this may be a major constraint on land-use intensification.

Cultural issues

Culture and tradition usually influence farmers' production goals, the kinds and numbers of animals raised, and the management methods used. Cultural aspects may therefore affect development efforts as much as technical and economic conditions.

However, taking cultural issues of livestock production into account in development work is constrained by:

- the inexperience of technical staff in dealing with cultural issues;
- the condescending attitude of many development workers towards the traditions and religions of minority peoples;

[3] An important example of the effect of grazing in young fallows is the replacement of *Imperata* grass by the unpalatable herb *Eupatorium odoratum* (syn. *Cromolaena odorata*), which often dominates the fallow fields after two or three years of grazing. Farmers generally report higher yields and fewer weed problems than in clearings made in other types of young fallow vegetation. This effect may be related to the high production of easily decomposing leaf material as well as the relative ease of weed control. While the proliferation of *E. odoratum* may improve the beneficial effects of the fallow, it is detrimental to ruminant production on both natural and managed pastures (Falvey 1977; Potter and Lee 1997, these Proceedings).

[4] Manure is rarely collected for use in swiddens, but farmers often claim that post-harvest grazing in the fields is partly meant to deposit manure in the field. When manure is collected, it is more often for use in paddy-fields and gardens, as is common on the infertile soils on the Plains of Jars in Xieng Khouang Province.

- the great cultural diversity between ethnic groups and between locations;
- the scarcity of research and accessible information on the cultural dimensions of livestock production;
- farmers' reluctance to explain seemingly irrational management decisions to outsiders.

The best way for outsiders to cope with these constraints may be by letting farmers lead the development process.

Livestock Technology

Breeds

The animals raised are mostly small local breeds with slow growth rates. Carcasses and meat quality are generally sub-standard for the processing industry, but may be preferred locally. When commercial production expands, many farmers are likely to adopt improved breeds, as has happened around Vientiane and other places. Local breeds do, however, possess properties that may be desirable to farmers, for example:

- the small local cattle are mobile and agile on the often steep slopes and therefore able to use grazing land not accessible to the larger lowland cattle;
- the small body weight is an advantage during the hottest months, when larger cattle breeds spend much of the day in shaded places;
- calving problems are rare for the local cattle breed;
- the relatively small local pig breed is better adapted to high, hot-season temperatures, which cause larger pigs to lose their appetite and general well-being;
- the hairy, black local pigs have less mosquito, sun and scabies problems than, e.g., Landrace and Yorkshire;
- local chickens and pigs are often preferred because of their taste and higher prices;
- the high lard content of local pigs is desirable as it stores well, improves the vegetable rich diet, and is important for the absorption of fat soluble vitamins; thus reducing the common problem of vitamin A deficiency;
- some ethnic groups, such as Akha, require black pigs for ceremonial purposes.

It is often assumed that local breeds are more disease resistant than exotic breeds, but at least for pigs and chickens this seems somewhat incongruous considering their very high mortality rates.

In most communities, few or no attempts are made to improve the livestock through breeding and selection. Some major constraints are:

- little control can be exerted over the free ranging animals;
- farmers often sell their largest animals first to optimise their income, but are thereby likely to lose genetically superior animals;
- excessive numbers of animals are kept relative to the available feed and management resources — the reasons may be for farmers to have a reserve of animals in case of epidemics, and for the sake of the prestige obtained from large stocks;
- lack of tradition for castrating ruminants.

Morbidity and disease control

Very high mortality and morbidity rates are probably the main constraints on livestock production, particularly of pigs and chickens. The main diseases in Luang Prabang Province seem to be *Haemorrhagic septicaemia* in cattle and buffalo, hog cholera in pigs, and Newcastle disease in chickens. Other commonly reported diseases are: foot-and-mouth disease, anthrax, black quarter, fowl cholera, duck plague, pneumonia, and various parasites (Kennard 1996).

Disease problems often occur in epidemics that may wipe out many, sometimes all, pigs and chickens in a village. Cattle and buffalo disease outbreaks are usually less severe, but the economic loss is greater due to these animals' higher value. The high morbidity and mortality rates are probably greatly influenced by inadequate feed; periods of hunger and high morbidity are therefore often concurrent. Parasites are a major problem for animals and humans alike, and are difficult to control because of the free-ranging animals and the general lack of hygienic precautions.

The veterinary and extension service is generally inadequate. Apart from the immediate vicinity of the provincial seats, some districts and certain project areas, vaccine is usually unavailable to upland farmers. Promotion of vaccination is further constrained by difficulties in maintaining the cold chain, by insufficient organisation in the villages, and by the death of animals from other causes, which makes farmers believe vaccination is ineffective or harmful. Treatment of diseases is also difficult because qualified veterinarians are rarely available to assist villagers. More training is needed of field-based staff and village volunteers in diagnosing and treating diseases.

Feeding

Free-range systems are used in most villages. Ruminant production is based usually on free grazing in young secondary vegetation or degraded forest areas. The availability of grazing land therefore partly depends on the continuation of shifting cultivation, since most natural pastures would soon revert into bush or forest with little grazing potential. While improved fodder production systems and suitable crops have been identified, the need for additional land and labour makes such technologies unrealistic or undesirable to many farmers. This is aggravated by the predominantly hilly topography, which hinders even simple mechanisation of soil tillage and transport.

Pigs are normally allowed to scavenge near the village during the day, but will receive supplementary feed such as rice bran, household waste products, wild tubers and banana stems in the mornings and evenings. Pigs and poultry obtain a large part of their food requirement during their free ranging, and attempts to promote penning and caging usually fail because farmers have insufficient feed to offer their animals.

Many Lao Soung farmers have a more intensive pig production based on maize feed, produced in double-cropping with opium poppies, where maize provides shelter for poppy plants in the late rainy season months (August–October). However, without the poppy production, it would be less economical to plant large areas of maize purely for pig production. The suppression of opium cultivation has therefore led many farmers to reduce their pig production as less fodder is available. Because of their tradition for more intensive pig production, Hmong and other Lao Soung farmers have often been the first and best at adopting new technologies, such as vaccines, cross-breeding and increased feed production.

Seasonal shortages of feed for ruminants occur in the dry season between January and April. The most critical period for pigs and poultry is after the supplies of rice and maize have run out. During these periods, large weight losses and increased mortality are common, often accentuated by excessively large stocks of animals. Improved feed production systems for pigs and ruminants are needed, especially with regard to higher protein supply and year-round feed availability.

Productivity

Growth rates are usually very low because of inadequate diet, high morbidity rates and, presumably, low genetic potentials. Under typical conditions cattle take four years to reach 180–225 kg live weight, pigs may take two years to reach 50–70 kg and chickens reach 1 kg only after about one year.

Given the slow growth rates and high mortality rates of farm animals, it may seem surprising that farmers should venture into animal production. However, low production is counter-balanced by the low input of labour and capital, thereby ensuring at least an acceptable productivity.

Environmental Issues

One reason for promoting livestock production as an alternative to shifting cultivation is the supposedly smaller harm to natural resources. Nevertheless, there are several environmental concerns to be considered when promoting livestock in shifting cultivation areas.

Farmers will often burn the grazing areas to favour grass production, thereby damaging forest regeneration and humus accumulation. Large scale cattle production may also cause severe overgrazing, especially near water sources and villages, where animals are likely to congregate. Adoption of balanced stocking rates and management is unlikely to take place as long as grazing land is free and remains a largely unregulated resource.

Under certain conditions, light grazing may facilitate forest regeneration by removing grass vegetation that suppresses tree seedlings through simple competition and through recurrent fires (Hansen 1995). In this regard, domestic ruminants may fill the ecological niche of wild grazers, which have disappeared from most upland areas.

If livestock production were promoted as an alternative to shifting cultivation (i.e., not merely a supplement) each family would need much larger areas than for short-rotation shifting cultivation to get an equivalent income. For instance, to generate a cash income of US$500 (the average income of shifting cultivators in Luang Prabang Province) five cattle would have to be sold annually. To accomplish this, a herd of about 25 animals must be kept, needing a grazing area of approximately 25 ha. In comparison, a typical upland rice producer may cultivate 1.6 ha annually in a 5-year rotation, equivalent to 8 ha. Specialised pig production is also likely to use more land than upland rice-growing because of the smaller labour requirements for maize and cassava production. However, these crops may be cultivated in permanent or semi-permanent plots, which would decrease the land required, but possibly also lead to more erosion and soil fertility problems.

Herding of ruminants in areas important to wildlife imposes several risks. Apart from the degradation of vegetation and land mentioned above, these may be:

1. Increased hunting by herders who spend long, idle days in the forest.
2. Hunting and trapping of livestock predators, such as tigers, leopards and wild dogs, all of whom are severely endangered.

3. Transmission of diseases, e.g., foot-and-mouth disease and *Haemorrhagic septicaemia*, to wild animals.
4. Interbreeding between domestic and wild animals, such as banteng and wild buffalo (Lekagul and McNeely 1988).
5. Competition for feed, water, salt licks and rest areas.

In particularly important wildlife areas, it therefore seems reasonable to prohibit or regulate livestock production.

Trends in the Livestock Sector in Shifting Cultivation Areas of Laos

During the past 15 years, animal production in Northern Laos has expanded substantially (Table 1). Thus, the number of cattle and goats has increased about 150%, compared with a 41% increase in human population. Pigs have increased by the same rate as humans; while the buffalo numbers have only grown slightly, possibly because the paddy area has remained unchanged over the years.

In later years, market opportunities have improved because of:

- the liberalisation of the economy has meant that more traders are operating even in so-called remote areas;
- increasing domestic and regional demand for meat products;
- improvements of the infrastructure, which has reduced the cost of marketing;
- fewer restrictions on inter-provincial trade;
- expansion of the export opportunities in Thailand.

The trends are likely to continue, and the general prospects for the livestock sector therefore seem good (see Warr, these Proceedings, for further discussion).

There is a risk, however, that the positive development opportunities may be off-set by increasing population pressure, restrictive regulations on land acquisition, and by general environmental degradation. Furthermore, the competitiveness of small-hold producers may be threatened by unequal resource and market access, and by the emergence of large-scale, specialised producers.

As land pressure and commercialisation increases, farmers are likely to adopt more labour and capital intensive technologies. This will probably lead to further integration of livestock and crop production, for instance through:

- increased application of manure, which is currently used rarely in shifting cultivation;
- increased feed production, particularly for pigs and cattle;
- more common use of animals for land tillage as permanent cultivation or long cropping periods increases;
- utilisation of forages produced in crop rotations, contour barriers, living fences, ley system, plantations and other innovative cropping systems. Such systems are much more likely to be adopted if coupled with profitable undertakings such as livestock-raising.

With the likely intensification of land use, the livestock research and extension sectors should be prepared to assist farmers in improving the quality of animal production. There will also be demands for working in larger and more diverse areas as road access improves.

Conclusion

Compared to other economic ventures, livestock-raising in shifting cultivation areas of Laos has several advantages, including a reasonable income potential, relatively stable prices, less dependence on infrastructure, optimised use of natural pasture and open forest, manure produced for crop production, and possibilities of using waste products. Furthermore, the demand for livestock products is likely to increase, and market access is improving in many

Table 1. Livestock and human population numbers in Northern Laos, 1980 to 1995.

	Year				Increase 1980 to 1995
	1980	1985	1990	1995	%
Pigs	575 600	454 300	665 500	798 800	39
Buffalo	251 200	243 400	295 200	297 400	18
Cattle	81 600	94 500	154 800	213 800	162
Goats and sheep	37 100	49 500	65 700	85 800	131
Human population	1 064 000	1 203 000	1 349 000	1 502 600	41

Source: NSC 1995

areas of Northern Laos. However, current management is characterised by low area productivity, little interest or scope for intensification, encroachment in arable fields and high mortality rates. Although livestock-raising is considered environmentally less damaging than shifting cultivation, several environmental risks need to be addressed, especially if the number of animals increases.

The livestock sector offers good opportunities to help farmers through veterinary service, improved management, increased feed production, and credit schemes. Such activities are already tested and substantial improvements can be made by applying existing technologies and knowledge. With increasing land pressure, development efforts should aim at improving the productivity, quality and health of farm animals, rather than aiming for simple expansion of livestock holdings. Further research is needed on a number of issues, but such research should preferably be conducted in co-operation with farmers, and will benefit from being linked to practical development and extension efforts.

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References

DLF (Department of Livestock and Fisheries) 1997. Role of Livestock and Fisheries in Stabilising Swidden Cultivation. Paper presented at the Stakeholder Workshop on Shifting Cultivation Stabilisation, Vientiane, Laos, 6–7 February 1997. Ministry of Agriculture and Forestry and Asian Development Bank.

DoF (Department of Forestry) 1997. Plan to the year 2000 for stabilising shifting cultivation by providing permanent occupation. Paper presented at the Stakeholder Workshop on Shifting Cultivation Stabilisation, Vientiane, Laos, 6–7 February 1997. Ministry of Agriculture and Forestry and Asian Development Bank.

Falvey, L. 1977. Ruminants in the Highlands of Northern Thailand: An Agrosociological Study. Thai Australian Highland Agronomy Project, Chiang Mai University. 124 p.

Hansen, P.K. 1995. Shifting Cultivation Adaptation and Environment in a Watershed Area of Northern Thailand. Communities in Northern Thailand. Ph.D. Dissertation, Department of Crop Husbandry, Royal Veterinary and Agricultural University, Copenhagen, Denmark, 280 + 140 p.

Kennard, R.O. 1996. Livestock production and diseases study. Consultant Report. Luang Namtha Integrated Rural Development Project, 45 p.

Lekagul, B. and McNeely, J.A. 1988. Mammals of Thailand (second edition). Saha Karn Bhaet Co., Bangkok, 758 p.

NSC (National Statistical Centre) 1995. Basic Statistics about the Socio-economic Development in the Lao PDR 1975–1995. Committee for Planning and Cooperation, Vientiane, 172 p.

UXO LAO (Lao National UXO Program) 1997. National Survey of the Socio-economic Impact of Unexploded Ordnance in Lao PDR: Preliminary Report, Ministry of Labour and Social Welfare, Vientiane, 32 p.

Livestock Development by the Shifting Cultivation Research Project in Luang Prabang Province, Lao PDR

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Abstract

The Shifting Cultivation Research Sub-program has, among other activities, carried out livestock related development and research work since 1991. This includes revolving fund credit schemes, vaccination, veterinary service, pig cross-breeding, extension of improved management methods, trials on fodder production systems and research on farmers' livestock technology. Good results were obtained in introducing vaccination of large ruminants, expansion of stocks, adoption of fish ponds, and familiarising farmers with more intensive management systems. Because farmers have different resources and interests, most activities were relevant only to a minority of households. Extension of new management practices should therefore offer several options for farmers to choose from. A common constraint on technology adoption was the extra labour requirements, which few farmers were prepared to apply. Another problem was the limited staff capability in extension and community development.

ANIMAL husbandry is economically important to shifting cultivators in Laos. As an economic venture, livestock production benefits from relatively stable prices, from independence of infrastructure, and from being a productive means of saving. Surplus capital is therefore very often invested in farm animals, and farmers generally see increased livestock production as a plausible way of improving their livelihood. Furthermore, animal husbandry can make use of natural pastures, open forest, household waste products and crop residues that are of little other use. Support to the livestock sector was therefore prioritised by the Shifting Cultivation Research Sub-program, as described in this paper. Project activities included credit schemes, vaccination, veterinary service, pig cross-breeding, extension, trials on fodder production and improved fallows, and research on farmers' livestock technology.

The Shifting Cultivation Research Sub-program

The Shifting Cultivation Stabilisation Sub-program in Luang Prabang Province was established in 1991. Until 1995, the main objective was to test technologies and extension methods that may improve land-use in shifting cultivation areas of Laos. This was attempted through a combination of research, training and practical development activities in forestry, crop production, horticulture and animal husbandry.

Method development was the main scope of the project, but practical development work was initially carried out in 14 villages, and, in 1992, was expanded to an additional 20 villages. The Sub-program also assisted other target areas of the Lao Swedish Forestry Program, both in the north and the south of Laos.

During 1996–2000 the sub-program will concentrate on applied research, so a new name was accordingly adopted: the Shifting Cultivation Research Sub-program (SCRS). The purpose is to create an adaptive research system that will produce results for improving land-use in shifting cultivation areas of Laos. Research includes both experimental field trials and descriptive research.

The sub-program is part of the Lao Swedish Forestry Program (LSFP), which is carried out by the Department of Forestry, with support from the Swedish International Development Co-operation

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Agency (SIDA). The SCRS works closely with the five other sub-programs of the LSFP, namely: institutional strengthening, extension, land-use planning, forest management, and conservation.

The Target Area

The original target areas of the SCRS consisted of Thong Khang Sub-district of Luang Prabang Province. The area covers 16 000 ha and 14 villages located in Nane District, 38 km south-southwest of Luang Prabang City (66 km by road). As conditions in the target area are fairly typical for Luang Prabang Province and for much of Northern Laos, some general aspects are described (based on Hansen and Sodarak 1996).

The land is mountainous, consisting mostly of steep and very steep slopes. Flat and gently sloping land represents less than 15% of the area and occurs at foot hills, at the bottom of river valleys and on limestone plateaux. Elevations vary from 480 to 1380 metres above sea level, but areas higher than 1000 metres account for only about 12% of the total area. The altitude range induces different climatic conditions, which in turn cause variations in soil properties, vegetation, crop suitability, etc. The average rainfall is about 1600 mm per year, which is relatively low for mountainous areas in Laos.

The most common rock types are siltstone, sandstone, limestone, schist and phyllite with quartz inclusions occurring sporadically. Alluvial deposits cover less than 1% of the area. Soil properties vary greatly, particularly in response to varying slope conditions and soil parent material. The most widespread soil groups are Haplic Alisols, and Dystric and Farallic Cambisols. Such soils are mainly found on the hill slopes, which make up most of the area. The upland soils are moderately fertile, usually having medium levels of exchange capacity and nutrient availability. The main soil fertility constraints are probably phosphorus deficiency and low pH.

The climax vegetation is deciduous and evergreen forest, but shifting cultivation and, to a lesser extent, logging have all but eradicated the mature forest. Today, older forest stands account for only about 10% of the total area, and are almost exclusively found on the steepest and most inaccessible hill sides, especially limestone escarpments. Most of the vegetation is in some stage of secondary regeneration. Younger stages are often dominated by *Eupatorium odoratum* (syn. *Cromolaena odorata*), other herbs and bushes, although grasslands of *Imperata cylindrica* are formed where longer or repeated cultivation periods are practised. Bamboo thickets are common, particularly where the land has been under repeated and short-term cultivation. Regeneration of forest is usually good, and dense, low tree stands may establish in 6–10 years. However, the succession is often interrupted by cultivation as only short fallow periods are used now.

Ban Thong Khang Sub-district contains 14 villages, ranging in size from 30 to 127 households, but with an average of 49 households per village. The population consists of about 4000 people in 690 families, of which 42% are Lao, 41% Khamu, 12% Hmong, and 5% Yao Mien. Of the 14 villages, four are at the Luang Prabang-Sayaburi road, while three other villages are situated on all-weather secondary roads. The other seven villages are located 30 minutes to 3 hours walk from a road.

Agriculture in Thong Khang Sub-district is mainly aimed at subsistence production, but commercial production is gradually increasing. Shifting cultivation is the predominant occupation, with 82% of the households engaged mainly in shifting cultivation and an additional 12% combining shifting cultivation with other activities, such as paddy farming. Because of land scarcity and government regulations the fallow periods are now only 3–6 years, alternating with cultivation periods of one or two years.

Upland rice is planted on at least 70% of the cultivated area; the remaining production being paddy rice, 13%; maize, 8%; and other crops, 9%. The group of other crops include sesame, Job's tear, cowpea, peanut, mungbean, soybean, castor, cotton, tobacco, vegetables, etc. Upland rice yields are on average around 1300 kg/ha, paddy rice 2200 kg/ha, maize about 1800 kg/ha and most pulses around 600 kg/ha.

Domestic animals include chickens, turkeys, ducks, pigs, buffalo, cattle, horses, goats, dogs and cats. Sale of animals and animal products provides about 50% of the average farm's cash or barter income (not including subsistence crop production). The average farm income from livestock production is about US$80, compared to a mean household income of US$50–500.

Only about 5% of the area is under cultivation in any one year, but at least half the area is part of the shifting cultivation cycle, or has been cultivated within the past 20–30 years. The uncultivated land, including the remaining forest, is used for a variety of purposes: grazing, hunting, and as sources of building materials, food, fodder and sales products. Fishing in streams and rice fields probably gives an important supplement to the diet. Commercial logging took place until 1986, but commercially accessible timber is no longer available.

Land-use has changed in recent years, partly because of project initiatives and the general economic liberalisation. Thus, crop production has become more diversified, more land has been put under paddy cultivation, fruit tree areas have increased, tree plantations have expanded, and animal husbandry has improved.

Major development problems in the Ban Thong Khang area include:

- Decreasing sustainability and productivity of agriculture and forestry.
- A rapidly increasing population.
- Poor human health and nutrition.
- Poor education opportunities.
- Few job opportunities outside agriculture.

The sub-program has carried out various activities related to livestock production, including:

- Revolving fund credit schemes.
- Vaccination and veterinary service.
- Pig cross-breeding program.
- Extension of improved management methods.
- Expand the livestock production.
- Trials on fodder production and improved fallows.
- Research on farmers' livestock technology.

Some results and experiences are summarised below.

Revolving Fund Credit Schemes

Limited and costly access to credit is believed to be a major constraint on farmers' adoption of land-use alternatives to shifting cultivation. In 1991, the Shifting Cultivation Stabilisation Sub-program therefore started trials on revolving funds in three villages and later expanded to 29 other villages.

The credit was distributed to and administrated by the Village Development Committee, who obtained technical and administrative advice from the project. To rationalise the dispersal of funds and to have farmers support each other, loans were usually released to groups of at least five households. However, members of loan groups did not share liability for the loans. Villagers were free to suggest activities for funding, although the contracts would often stipulate that farmers should follow certain practices recommended by the project, e.g., vaccinating animals and ensuring that enough fodder was produced. Twenty-five per cent of the budget was allocated as support to women's groups, as an attempt to benefit women.

Potentials and benefits

- Credit schemes were much appreciated by villagers and could have a major development impact.
- Revolving funds helped introduce new technology and management systems to farmers.
- Farmers perceived animal husbandry as the main possibility of agricultural development. Thus, credit for livestock raising constituted 80% of the released funds.

Constraints

- The repayment rate was too low to justify the revolving fund scheme.
- Households depending solely on shifting cultivation were mostly unable to repay the loans.
- The mortality rates of pigs and chickens were very high. However, the reported mortality rates were inflated because the project had promised to replace dead animals if farmers followed the management recommendations.
- The credit enabled some families to become involved in pig production although they did not have the necessary experience, management skills and feed resources.
- Administrative support and monitoring proved extremely time consuming to the project, partly because of inappropriate routines.
- The commitment to repay loans vanished as a growing number of farmers were unable to pay.
- The project probably pushed too hard for farmers to borrow money, which led some families with inadequate capability into debt.

Recommendations

- The use of revolving funds should be accompanied by technical support to farmers.
- Specialist credit organisations, for instance, the Agricultural Promotion Bank, are probably better than development projects at administering revolving funds and other credit schemes. However, implementation by projects may be suitable when working with shifting cultivators in remote areas who would have difficulties in obtaining credit through commercial channels.
- Proven administrative and monitoring routines are essential. Gradual implementation may therefore be best to test the applied methods.
- Activities promoted through revolving funds must be economically viable and profitable, not experimental or merely aiming at improved sustainability. Careful monitoring and evaluation of pilot activities should be carried out before large-scale promotion.
- In retrospect, many farmers suggested that larger sums of money should be allocated to a few households rather than small sums to most households. Thus, small sums would not enable farmers to change their production system sufficiently.

Livestock Vaccination

Vaccination has been made available in all villages since 1992. Vaccination was given against hog cholera (pigs), *Haemorrhagic septicemia* (buffalo and cattle) and Newcastle disease (chicken). A village volunteer was elected in all villages, and received livestock training from the project. The volunteer was responsible for co-ordinating livestock activities, for vaccination, for training of farmers and for communication with the project.

Potentials and benefits

- Vaccination is an efficient and cheap way of helping farmers.
- Vaccination can be self-financing.
- Most cattle and buffalo were vaccinated, and farmers have accepted vaccination as a regular management practice.

Constraints

- Farmers requested vaccination after animals had become ill or epidemics had started.
- Farmers' interest in pig and poultry vaccination remained low (around 20% of households).
- Animals died of other causes, which diminished the credibility of vaccination to farmers.
- Village livestock volunteers were not sufficiently motivated and trained.
- There were difficulties in maintaining the cold chain because of inadequate cooling facilities, long transportation time to remote villages and inadequate co-ordination in the villages.
- There were communication problems with farmers, e.g., in collecting all animals in time for vaccination, or under-reporting of the number of vaccination doses needed.
- There was an erratic supply of vaccine from the Department of Livestock and Fisheries.

Recommendations

- The delivery service must be improved through better information and communication with farmers, timely delivery of vaccine, and through monitoring and analysis of the work.
- Community rules and regulations should be promoted to ensure a sufficiently high vaccination coverage.
- The low interest in poultry and pig vaccination may be related partly to the fact that these animals are the responsibility mainly of women, to whom the project was less efficient in addressing. Thus, more efforts must be put into establishing effective working relationships with women.
- The Village Veterinary Workers should be better motivated, for instance through more training and better remuneration.

Pig Cross-Breeding Program

In 1992, 10 pigs of the exotic breeds Duroc, Yorkshire and Landrace were obtained from the Nong Taeng Pig Station in Vientiane for cross-breeding with local pigs. The breeding was mainly done at the project's demonstration and training ground, but some farmers obtained pure-bred animals for further cross-breeding in the villages. Farmers obtained pure or cross-bred pigs either for fattening or further breeding. Many pigs were distributed to farmers through the revolving fund scheme.

Potentials and benefits

- Cross-bred pigs were generally superior to local pigs in litter size, weight gain and carcass quality.
- Farmers with sufficient pig feed and management skills benefitted economically from raising cross-bred pigs.

Constraints

- For most farmers, cross-bred pigs probably have few advantages as their pig production is constrained by high morbidity and mortality rates, by lack of feed and by low management skills.
- The evaluation criteria and breeding principles were not sufficiently substantiated from the start.
- It was difficult to obtain new supplies in Laos of superior pure bred animals to renew the breeding stock.
- Testing, selecting and maintaining a large number of breeding animals is very expensive unless the off-spring can be sold at a premium rate.

Recommendations

- A pig cross-breeding program is mainly suitable to farmers with good management skills and feed resources.
- Private companies may be more suited to serve the relatively few farmers who may benefit from cross-breeding.
- Improvement of local pigs through simple selection seems plausible and more realistic than a cross-breeding program. Such selection may also be a necessary first step to gaining full advantage of cross-breeding programs.

Extension of Improved Management Methods

The project sought to improve farmers' management practices through technical advice and by providing them with access to vaccine, medicine, fingerlings, etc. A general management recommendation for all types of animals was the improvement of feed quality and quantity. This included promotion of higher yielding maize varieties, leaf fodder from fast growing tree legumes, cut and carry feeding from improved pastures, and dry season cover cropping. Another recommendation was balancing the number of animals with the availability of feed, since most farmers raise more animals than their feed resources can sustain. Furthermore, the project promoted better criteria for selection of breeding animals, and, in particular, dissuading farmers from selling their best animals. Lastly, penning of pigs and poultry was promoted as a means of diminishing disease and parasite transmission.

Potentials and benefits

- About 30% of the households improved or expanded their livestock production significantly.
- Farmers became familiar with new technologies, and may increase the adoption as further land-use intensification becomes necessary.
- Vaccination, medicine, fingerlings, barbed wire and other production inputs were well received, even though farmers had to pay for them
- Staff capability improved considerably. This included a more realistic picture of suitable and unsuitable technologies for the given production conditions.

Constraints

- Lack of a formal extension system that can provide farmers with comprehensive access to information, production means and other services.
- The project was uncritical in accepting farmers' expressed wishes, but did not assess farmers' capability and production objectives.
- Lack of economic analyses of livestock production, including the profitability of fodder production systems.
- Implementation was biased towards men, the richer farmers, and the more capable farmers.
- Many technologies, e.g., improved pastures and the penning of pigs, were inappropriate to the current farming systems and production goals employed in the area.
- The conditions and production problems were not sufficiently analysed when project activities started. Also, experience gained from extension was not sufficiently employed to change the extension recommendations.

Recommendations

- Careful evaluation of technologies and extension methods before large scale implementation starts. This would involve close co-operation with farmers in all stages of the work.
- Demonstration activities can be improved by providing more data and practical recommendations. Also, different systems should be demonstrated, not just a single recommended technology.

Expand the Livestock Production

Many activities mentioned above aimed at expanding farmers' livestock production and lowering their dependency on shifting cultivation. Livestock promotion was also inspired by the government's recommendation to establish model farmers who have abandoned shifting cultivation and adopted so-called permanent occupation.

Potentials and benefits

- Many farmers consider increased livestock production the most realistic way of increasing the income.
- About 30% of households expanded their animal production considerably.
- A few farmers specialised in livestock production and virtually stopped upland rice production.

Constraints

- Only richer households can specialise in livestock production because of the investments, longer return periods, and risks involved.
- Livestock production requires more land than plant production to generate an equivalent income.
- Some farmers increased their herd sizes without increasing their management inputs.
- Many farmers already have more animals than they can raise in a rational and productive manner.

Recommendations

- Most farmers should continue integrated livestock and crop production.
- The number of animals should be balanced with the amount of feed available.

Trials on Fodder Production and Improved Fallows

Trials were carried out to screen exotic pasture legumes and grasses, to investigate the possibilities of improving the natural fallow vegetation, and to improve the pasture production systems.

Potentials and benefits

- Out of 20 pasture legumes 10 species performed well under the local conditions: *Crotolaria juncea* (sun hemp), *Cajanus cajan* (pigeon pea), *Vigna unguiculata* (Cowpea), *Dolichos lablab* (Lablab), *Desmodium intortum* (Greenleaf desmodium), *Arachis pintoi* (Perennial peanut), *Stylosanthes hamata* (Verano stylo), *S. guianensis* (Cook stylo), *Pueraria phaseoloides* (Kudzu) and *Centroscema pubescense* (Centro).
- *Crotolaria juncea* (sun hemp), *Arachis pintoi* (Perennial peanut), *Stylosanthes hamata* (Verano stylo), *S. guianensis* (Cook stylo), *Pueraria phaseoloides* (Kudzu) and *Centroscema pubescense* (Centro) were able to persist for four years in a profuse natural fallow, indicating that they may have a role in improved fallow systems.
- Pasture lugumes that did not perform well include: *Neonotonia wightii* (Cooper glycine), *Calopogonium mucunoides* (Calopo), *Macrotyloma axillaris* (Archer), *Macroptilium atropurpureum* (Siratro), *D. uncinatum* (Silverleaf desmodium), and *Medicago sativa* (Hunter River lucerne). Low soil pH is presumed to be a main constraint on many of these species.
- Low soil pH may also explain the low performance of potential leaf fodder trees, particularly *Leucaena leucocephela*.
- Rice yields were significantly higher after three years of legume fallows than after three years of natural fallow.
- Introduced maize varieties gave much higher yields than local varieties, and were readily adopted by farmers as a cash crop.
- Biologically improved fallows were of less interest to farmers than economically enriched fallows, such as fallows of paper mulberry (*Broussonetia papyfera*) and *Styrax tonkinensis*.

Constraints

- Many on-station trials were bio-physically very interesting, but impractical to adopt on a whole-farm scale because of the extra labour requirements for weeding and establishment.
- Farmers showed little interest in participating in on-farm trials of pasture species, as they saw little benefit from intensified production systems.
- On-station trials were over-prioritised, which meant that critical issues to farmers, their experience, and their opinions on new technologies were disregarded.

Recommendations

- Prior screening of exotic species and varieties is recommended when they are being introduced in a new area.
- Dry season feed production should be a major objective of pasture trials.
- Experimental cropping systems should be tried in farmers' fields early in the testing program.
- Farmers should participate in all stages of the research.

Research on Farmers' Technologies and Production

Accompanying the livestock extension and vaccination work, various surveys were conducted to analyse the situation and to monitor the project achievements. Latterly, more analytical research was conducted to assess the constraints and potentials of livestock production.

Potentials and benefits

- Research results were used in both extension and strategy recommendations.
- Surveys of the livestock numbers, ownership and economic indicators gave a better grasp of the importance of the livestock sector to different groups of farmers.
- The combination of research and extension improved the quality and relevance of both.

Constraints

- Too little attention was given to assessing farmers' livestock production. For instance, there is not enough known about the causes of the high mortality rates and the relationship between disease, feeding and other management.
- Much of the collected information was not used sufficiently or was generated after development activities had already started.
- The staff capability and training were insufficient to take full advantage of the work.
- More knowledge could be generated from comparative studies in areas representing different environmental conditions and production strategies.
- Surveys were too large and too concerned with quantitative information.

Recommendations

- Early efforts should be put into additional participatory diagnostic research carried out as co-operation between farmers, extension workers, veterinarians and researchers.
- Small, but repeated surveys of key indicators should be preferred to large surveys that are difficult to repeat and analyse.
- Further attempts should be made to describe and analyse farmers' technologies and the development potentials and constraints in different areas.

Conclusion

The conditions for animal husbandry varied greatly between villages and between individual households. Each of the different livestock development activities promoted by the project was only suitable, or of interest, to a minority of farmers. However, by offering farmers a choice of several activities, many farmers were able to benefit. Projects will normally not be able to consider the great variety in individual households' resources and inclinations. It is therefore important to enable farmers to take advantage of project support through their own initiatives. Regrettably, the potentials and constraints of many project activities were not sufficiently analysed from the start. Farmers' reluctance to adopt certain activities was therefore unjustly considered a sign of ignorance, rather than sound scepticism.

The most relevant technical options for livestock extension and development in areas similar to the project's core area seem to be:

- Vaccination programs, including vaccine supplies, training and community awareness.
- Improved pig-feeding systems.
- Better selection of local breeding animals through, culling, castration and improved selection criteria.
- Credit for buying cattle, if suitable grazing areas are available.
- Fish-raising, if suitable areas for ponds, as well as fingerlings are available.
- Assist communities in developing regulations and co-operation in the livestock sector.

Community regulations may include agreements on, for instance, the organisation and coverage of vaccination, penning or other confinements, management of communal grazing areas, control of crop damage by animals, and the role of and incentives for village volunteers.

From carrying out the various livestock development activities, a particular need has been found for further research into:

- Pasture and pig-feed production systems suitable for shifting cultivators in the uplands, especially in regards to higher protein supply and year-round feed availability.
- Studies of farmers' production technologies under different conditions.
- The direct and associated causes of the high mortality and morbidity rates in livestock.

It should be noted that much of such research has recently started in Laos, including research projects presented in this volume.

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References

Hansen, P.K. and Sodarak, H. 1996. Environment, socio-economic conditions and land-use in Ban Thong Khang Sub-district, Northern Laos. Technical Report No. 2. Shifting Cultivation Research Sub-program. Department of Forestry, Lao PDR, 19 p.

'Lower Slope' Villages Going Downhill: Lao Soung (Akha) and Lao Loum (Lue) Relations in Muang Sing

Paul T. Cohen[1]

Abstract

This paper examines Akha and Lue economic relations in Muang Sing (Luang Namtha Province) in the context of the Lao PDR policy on shifting cultivation. The resettlement of highland Akha communities to lower slope areas as a means of ending shifting cultivation and preserving forests has had unintended but deleterious consequences for relocated Akha: increased human and livestock epidemics, more severe rice shortages, and demoralisation. Combined with high rates of opium addiction, the deterioration of 'lower slope' Akha villages has led to economic dependence on lowland Lue villages in a way that advantages the Lue more than the Akha. For the Akha, livestock epidemics have not only been an obstacle to the development of wet rice cultivation but have also precluded a potential source of cash income. It is suggested that improved veterinary services in Muang Sing could help halt the downward economic spiral in which 'lower slope' Akha have been caught.

MUANG SING is a district of the northern province of Luang Namtha located about 60 km northwest of the provincial capital and only 12 km from the border with Yunnan Province, PRC. The Muang Sing Valley is now inhabited mainly by Lue, a Tai-speaking ethnic group whose homeland is the neighbouring Xishuangpanna region of China. The Akha, who have traditionally occupied the surrounding highlands, far outnumber the Lue (11 073 to 6309)[2], but the Lue have always been politically and economically dominant. This paper argues that the Lao PDR government policy on shifting cultivation has, in Muang, led to the economic and social deterioration of relocated 'lower slope' Akha villages and extensive economic dependence on the Lue, including the supply of cheap wage labour to the advantage of the local Lue economy.

Lue Surplus Rice Economy

Three main rivers with potential for providing water for irrigation flow through the Muang Sing Valley: the Nam Sing, the Nam Dai, and the Nam Yuan. In 1990, it was estimated that the Valley had more than 9000 hectares of flat land. By then, 1000 hectares had been developed for irrigation, but the total irrigation capacity is 1788 hectares (LGCP 1995:30).

A low population, due largely to the exodus of Lue during the war conditions of the 1960s, has minimised pressure on available land resources in the valley. Consequently, the present land situation for the Lue of Muang Sing is quite favourable: minimal landlessness and inequalities of landholdings, limited tenancy, and an on-going process of expansion of wet rice fields.

A high percentage of Lue villagers of the Muang Sing Valley produce above subsistence requirements and many produce substantial rice surpluses for sale. This is confirmed impressionistically by the large number of Lue and Chinese traders from Xishuangpanna in China who can be seen buying cartloads of rice during the harvest season in November and December. More concrete evidence comes from a survey conducted by the author of the Lue village of Baan Tin Thaat, about 4 km from Muang Sing town.

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[2] In 1995, the ethnic composition of settlement in Muang Sing District was: Akha, 68 villages; Tai Lue, 26 villages; Tai Neua, 5 villages; Tai Dam, 1 village; Yao, 6 villages; and Hmong, 3 villages.

Here 19 (or 76%) out the 25 households surveyed sold rice from the 1995 harvest with an average of 1.77 tonnes per household. Of the 25 households, only two did not produce enough rice for consumption. According to the headman, in the whole village there are 10 mostly young, newly established households, whose people produce below-subsistence requirements. They are all landless or near landless, and have to rent land.[3]

'Traditional' and 'Lower Slope' Akha Villages

A socio-economic baseline survey for the Muang Sing Integrated Food Security Program of the Lao German Cooperation Project distinguishes two types of Akha villages: traditional Akha villages situated in the highlands and those which have moved down from the highlands to the lower slopes.[4] The 'traditional' villages are up to two days walk from the lowlands and have only occasional contact with the market centre of Muang Sing. These villages are dependent on swidden cultivation of dry rice and opium, with only limited use of cash and virtually no hiring out of labour (LGCP 1995:6). The 'lower slope' villages have a much greater reliance on wet rice cultivation, have much more contact with the Muang Sing market centre and lowland Lue villages, and are more closely enmeshed in a cash economy (including wage labour).

The report on the baseline survey of the Lao German Cooperation Project attributes the establishment of the 'lower slope' Akha villages to requests by government authorities who promised the Akha assistance if they were prepared to cultivate flat land and abandon shifting cultivation (LGCP 1995:11).

Lao PDR government policy is committed to ending shifting cultivation by the year 2000 on the premise that shifting cultivation is a major cause of deforestation. This policy is being pursued in the context of a number of programs that aim to:

a. develop technical packages which will improve the productivity of crops and livestock;
b. improve land use planning at the local level;
c. formalise land tenure through a process of land allocation; and
d. develop alternatives to agricultural income for shifting cultivators (Fisher 1996).

[3] The average landholding (wet rice) per household for the 25 households was 1.5 ha, which is very close to the headman's figure for the village as a whole (75 households) of 1.6 ha.

[4] The survey included 11 'traditional' Akha villages and 22 'lower slope' villages in Muang Sing district.

However, while many Akha villages in Muang Sing district have been encouraged to move down to the lower slopes, little government assistance has been received, due presumably to the shortage of government funds and skilled personnel. *'The villagers expectations have been raised, but to not much avail so far'* (LGCP 1995:7). This was confirmed in an author interview with the headman of the Akha 'lower slope' village of Ban Sopi Mai (not included in the LGCP survey). The headman claimed that government officials had prohibited them from growing opium with the promise of assistance if they ceased; but no assistance had yet been provided. Sopi Mai villagers stopped cultivating opium for three years, but, due to lack of government assistance, resumed growing opium in 1996 on a small scale to test official response.

According to the LGCP report, the movement of Akha down to the lower slopes is correlated with a number of significant health and economic changes: a higher incidence of human epidemics and higher mortality rates[5] (causing individual and community demoralisation); livestock epidemics have been much more frequent; more severe shortages of rice; and a much greater dependence on wage labour. The comparative statistics are listed in the following table:

Table 1. 'Traditional' and 'lower slope' Akha villages compared.

	Traditional	Lower slope
Human deaths from epidemic diseases	199	749
Livestock deaths from epidemic diseases	19	39
Child mortality	133	326
Per cent villages in which 50%+ households reported rice shortages of 4–6 months	36.3	55
Per cent villages in which 50%+ households hire out labour	0	52.3

N.B.: These figures are taken from various parts of the report (LGCP 1995, Table 5, p.15; Table 7, p.29; Table 8, p.32). The livestock and human epidemics reported are those since arrival or during the past 10 years.

[5] The high human mortality is due mainly to poor sanitation and water supply and increased risk of malaria at lower altitudes (LGCP 1995:35). No doubt these factors contribute significantly to the high level of child mortality (children under 5 years, deaths per 1000 live births). Livestock diseases are attributed to the absence of veterinary services and a vaccination program in Muang Sing (LGCP 1995:29).

The LGCP report argues that livestock epidemics resulting in the loss of plough animals have severely impeded the development of wet rice land (LGCP 1995:28). This factor has combined with lower opium production and high rates of opium addiction[6] to force addicts into hiring out their labour to nearby Lue, to the neglect of their own wet rice fields. This results in low rice production and increased rice shortages and even greater dependence on wage labour — a vicious cycle from which it is difficult for the people to extricate themselves.

Another important factor in the dependence of 'lower slope' Akha villages on wage labour, not mentioned in the LGCP report, is recent opium price rises. The Norwegian Church Aid report (see Footnote 5) attributes this rise to several possible factors: high demand from opium importing countries such as Thailand, law enforcement and increased risks of trafficking, and poor opium harvests due to severe drought in the northern provinces of Laos. The report notes that in 1990 highland labour was paid four *saleung* of opium (11 g) for a day's work, but only one *saleung* in 1994 (NCA 1994:19), forcing them into more frequent wage labour to support their habit. In Muang Sing, payments in opium for Akha rice harvest labour varied from 1 to 1.5 *saleung* per day in 1995 and 1.5 to 2 *saleung* in 1996. Despite these recent wage increases many addicts still have to work all day to supply their daily opium need, the average consumption per day being 4.9 g or 1.8 *saleung* (according to the NCA estimate for Luang Nam Tha and Bokeo provinces, p.15)

How do these studies fit with the author's research in Muang Sing? In the following, the author provides some basic socio-economic data from two Akha villages, Ban Sopi Mai and Ban Yang Luang. They are two of the three Akha villages that are economically dependent on Baan Tin Thaat on which the author's research on the Lue village economy of Muang Sing was focussed. Both meet the criteria of 'lower slope' Akha villages but neither were included in the LGCP survey.

Akha Villages of Ban Sopi Mai and Ban Yang Luang

Ban Sopi Mai is located about 6 km from Muang Sing town near the main road to Luang Nam Tha and on the banks of the Nam Sing River. There are 38 households and a total population of 179 (Nov. 1996). The heads of six households are widows. The village was established only two years go. The original village was Sopi 1. Some villagers split off from the parent village to establish Sopi 2, but then moved to Sopi Mai following an epidemic.

Although Ban Sopi Mai has only been recently settled, Sopi villagers have been cultivating wet rice here for some 20 years. Now the area of wet rice is quite extensive by local standards, i.e., 72 ha (all irrigated except for 3 ha of rainfed fields). The maximum area per household is 3.5 ha and minimum 1 ha. In 1996, there were seven households that had rice shortages for 3–4 months of the year. Five of the householders were widows, and two households were new. In 1995, an epidemic killed 50 water buffalo, sparing only 12. Other households were forced to borrow animals for the ploughing of their wet rice fields and reciprocated with planting labour or the payment of 1500 Kip per day. Only three households could be considered well-off in that they had sufficient rice to eat, enough livestock and did not have to hire out their labour. Other non-addict households were still compelled to undertake occasional wage labour for nearby Lue villagers.

There are 17 opium addicts (14 male and 3 female) from 17 households. As noted previously, opium has not been grown for the past three years. This has made it imperative for addicts to hire out their labour regularly to the Lue.

Ban Yang Luang is 3 km from Baan Tin Thaat and 7 km from the town of Muang Sing. The village was established in 1990 after 49 families split off from the parent village of Huai Nam Kaeo on the mountain side about 30 minutes walk away. The parent village began to cultivate wet rice in the valley about 30 years ago. Two other groups of households split off to form new villages at the same time. The decision to segment from the original village was principally influenced by encouragement of district officials to reduce swidden cultivation.

Ban Yang Luang now comprises 61 households with a population of 328 persons. There are nine households in which the head is a widow. The headman claimed he did not know the total area of wet rice owned by villagers but said the areas ranged from 3 ha to 0.8 ha per household. All households, he said, owned some wet rice fields; in the case of seven households the land is unproductive due to lack of water. All heads of these households are young and

[6] The LGCP report indicates that the rates of addiction are not higher than for the 'traditional' Akha villages: an addiction rate of 9.3% (of adult population) for all Akha villages surveyed, 14.2% for 'traditional' villages and 14.4% for 'lower slope' villages (Table 13, p.46). According to a Norwegian Church Aid report, Opium Addiction in Luang Namta and Bokeo provinces, the high rate of opium addiction among Akha, Yao, Hmong and Lanten ethnic groups was due to its abundance and cheapness in the 1970s and 1980s (1994:16).

work their parents' wet rice land. Only three households cultivate dry rice fields. Again, the headman was uncertain as to the total number of water buffalo in the village, but he did know that only eight households lacked buffalo. These borrowed from fellow villagers in return for planting labour or payment in rice (600 kg of unmilled rice per ha).

All households grow opium (except the headman!) but production is generally low with a maximum of one *joi* (1.6 kg) and minimum of 0.5 kg per household. Only a few households produce opium in excess of the consumption needs of a single household.

According to the headman, some 30 households (almost 50%) do not have enough rice for the year. He emphasised that this is not because they do not grow enough rice, but because they are forced to sell some of their rice for cash. The author suspects that these are predominantly addicts who, at the time of rice harvest in November, have run out of opium (prior to the opium harvest in February) and need cash to buy opium.

The author's research[7] indicates that there are 41 opium addicts (12.5% of the total population) from 36 households. Of the addicts, 28 are male and 13 female. The age of the addicts ranges from 14 to 62 years.

The headman reported that those who hire out their labour to local Lue (especially the Lue villagers of Baan Tin Thaat) are mainly widows, widowers and opium addicts. Given that almost 60% of households have at least one addict, the dependence on seasonal wage labour would be substantial.

Akha Labour Dependence on the Lue

Although more intensive research in both these villages is required, some provisional generalisations can be made.

Wet rice cultivation appears to be quite productive, more than likely because paddy fields have been long established (20 and 30 years)[8]. Even the livestock epidemic in Sopi Mai does not seem to have severely impeded production due to the possibility of borrowing plough animals from fellow villagers. Yet both Sopi Mai and Yang Luang have become heavily dependent on wage labour for local Lue. A critical factor in this dependence is probably the shortage of alternative sources of cash income, exacerbated by the decline in opium production (the cessation of opium cultivation in Sopi Mai forcing even non-addicts to occasionally hire out their labour).

The author's research in Baan Tin Thaat shows that the predicament of Yang Luang addicts not only forces them into wage labour dependence on the Lue, but also into a number of economic exchanges in which they are significantly disadvantaged. It was noted previously that a high percentage of Akha from Yang Luang, mainly addicts, suffer rice deficits because they sell some of their rice for cash. According to Lue informants, some Akha addicts also exchange rice for opium in the rice harvest period of November/December (when opium is in short supply) at the rate of 10 kg of unmilled rice for 1 *saleung* (2.7 g) of opium. Furthermore, after the opium tapping in February (when rice is in short supply and depleted by earlier sales) Akha addicts exchange opium for milled rice at 1 *saleung* per 1.7 kg of milled rice. The Akha lose out in these transactions by being compelled to sell when prices of opium and rice are lowest and buy when highest.

The Lue also acquire opium from the Akha in exchange for woven cloth, fish, cigarettes and cakes (in the opium fields during the tapping). By these means and those above, some Lue households accumulate between 60 and 120 *saleung* a year. Little of this is traded out of the village; almost all is used to hire Akha labour. Payment in opium is usually for physically more onerous work such as digging ditches (*khut hong*) around wet rice fields (to prevent intrusion and damage by livestock) and invariably for preparation of new wet rice fields (*buk boek*). In the latter respect, the author argues that opium has come to have a crucial role in the Lue surplus rice economy through the use of cheap Akha labour to expand wet rice cultivation.

Cash is more commonly used for planting and harvesting of wet rice (in 1995, 1000 Kip per day plus a mid-day meal). This represents better pay due to greater competition for labour. During the 1996 harvest at Baan Tin Thaat, competition between Lue forced the price of Akha labour up to 1500 Kip per day.

Lue villages closer to China, where Akha can get higher wages, and Lue villages near Akha villages receiving assistance (rice and rice stores) from the Lao German Cooperation Project, were paying 2000 Kip per day. One Lue village reported being unable to hire any Akha labour at all from villages receiving such assistance. This highlights the critical role of economic assistance in minimising Akha labour dependence on the Lue.

Conclusion

This paper has examined the Lao PDR government policy of eradicating shifting cultivation by resettlement of highlanders in or at the edge of lowlands and

[7] A survey carried out in November 1996.

[8] Compared with the 22 'lower slope' Akha villages of the LGCP survey which found that 17 (77%) of villages had been established within less than 10 years previously (LGCP 1995:67–89).

the promotion of wet rice cultivation. On the basis of research on Akha and Tai Lue communities in Muang Sing, it has been argued that, in the absence of significant assistance from government, this policy has had serious repercussions for relocated 'lower slope' Akha villages: deterioration in health conditions, increased human and livestock mortality, increased rice deficits, social anomie, and economic dependence (in particular, of opium addicts) on Lue lowlanders. The latter, in many transactions with the Akha, have an exploitive advantage which enables them, among other things, to extend wet rice cultivation in response to an expanding rice market.

In Thailand, where government policy on shifting cultivation has been similar, some experts have criticised resettlement programs and advocated the introduction of novel land-use systems in the highlands such as agri-silviculture (McKinnon 1977). If the government of Lao PDR rejects such highland-oriented development policies, then it is imperative that more income-generating activities be found for relocated villages. Here, animal husbandry deserves special attention. The LGCP report has focussed on livestock epidemics as a major impediment to Akha wet rice productivity. Equally disadvantageous is the loss of potential income from the sale of livestock. There is a sizeable market for water buffalo and cattle in Thailand which could be exploited for the benefit of 'lower slope' Akha villages with improved animal husbandry and veterinary services (including vaccination) in Muang Sing and which could help arrest their economic and social decline.

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References

Fisher, R. 1996. Some Observations on Shifting Cultivation in Laos, Report to Australian Research Council funded Trans-Mekong Project.

McKinnon, J.M. 1977. Shifting Cultivation: Who's Afraid of the Big Bad Wolf. Agriculture in Northern Thailand Seminar, Chiang Mai: Faculty of Agriculture, Chiang Mai University.

LGCP (Lao German Cooperation Project: Muang Sing Integrated Food Security Program) 1995. Report of the Muang Sing Socio-Economic Baseline Survey, April–May, by Rita Gebert et al., Vientiane, Ministry of Public Health, Lao PDR & Technical Cooperation, FRG.

NAC 1994. Opium Addiction in Luang Namta and Bokeo Provinces, Report submitted by C. Escoffier-Fauveau to Norwegian Church Aid, Vientiane.

Case Study: The Role of Livestock in Upland Farming Systems in Luang Namtha

A.D. McLaren[1]

Abstract

Luang Namtha Province is one of the northernmost provinces of Lao PDR. Most of the province's rice is grown under shifting cultivation or slash and burn systems, and livestock are an integral part of these systems. Figures are presented to illustrate the numbers of livestock owned, consumed and sold by families in 11 villages targeted by the EC-funded Integrated Rural Development Project. Values are attributed to sales, providing some measure of the contribution made to family incomes from livestock production. Constraints to increasing production are described, and opportunities suggested for overcoming these constraints and increasing income from livestock production.

LUANG Namtha Province is one of the northern provinces of Lao PDR, bordering on China's southern Yunnan Province and with Burma/ Myanmar, and sharing internal boundaries with the provinces of Bokeo and Oudomxai.

It has average annual rainfall in the order of 1250 mm, mostly distributed in the months from June to September. The months from November to April are generally very dry, with occasional periods of absolute drought lasting from 6 to 10 weeks. Average monthly temperatures range from 18.3 °C in December, to 27.5 °C in May. The driest periods coincide with the coldest months of the year, with minimum temperatures in December and January often falling below 10 °C, occasionally to 5 °C, and maximum temperatures often failing to reach 20 °C.

Most of the province is mountainous, but there are two relatively major rice plains, around the provincial capital of Luang Namtha, and the district centre of Muang Sing.

The Lao-IRRI Project (Lao-IRRI 1996) characterises rice production in the province as being 20–40% from lowland rainfed rice, and 60–80% from upland rice, almost all of which is grown under 'slash and burn' or shifting cultivation systems.

Rice is the dominant component of the overall farming system, around which other activities revolve. A recent survey of local production systems in the province (McLaren 1996) identified the other components as non-rice upland crops, dry season vegetable crops, livestock, and the collection of forest products. The same survey tried to ascertain the importance of livestock in the overall production system.

Survey Results

The survey covered the first eleven villages targeted by the EC-funded Integrated Rural Development Project[2]. These comprised three predominantly lowland villages, and eight predominantly upland villages. It should be noted however, that all upland villages had small areas of rainfed lowland rice in addition to their upland areas, and two of the three lowland villages also had some families dependent on upland rice. Villages comprised people of six ethnic groups, representing the three major classifications of Lao Loum, Lao Theung and Lao Soung, broadly categorised as people of the lowlands, uplands and mountain areas, respectively.

Livestock numbers

All villages had significant numbers of livestock, as indicated in Table 1, following:

[1] Agriculturalist, EC Integrated Rural Development Project, PO Box 124, Luang Namtha, Lao PDR

[2] Project details and objectives are summarised in the Appendix. In 1997 (May), there were 27 target villages.

Table 1. Numbers of livestock of each category in project target villages: 1996 survey.

Village/Ethnic group (No. of families)	Buffalo	Cattle	Goats	Pigs	Horses	Turkey	Geese	Ducks	Hens
Namthung Thai Lue (175)	213	143	0	173	0	105	0	241	718
Ban Phoung Thai Dam (166)	158	150	0	300	2	100	20	300	800
Namngen Mainly Thai Dam (383)	487	110	26	2633	0	150	4	810	2167
Houaidam Khamu Ou (60)	52	150	0	250	3	0	0	150	500
Nateuil Khamu Ou (83)	10	200	0	165	0	24	0	50	455
Tintok Khamu/ Hmong (37)	25	70	0	100	0	0	0	20	300
Hat-ngao Hmong (87)	104	450	7	500	2	25	0	0	150
Lakkhammai Ikaw (37)	25	0	0	80	0	0	0	12	370
Namkhon Lanten (28)	8	3	11	100	0	0	0	8	100
Namke Lanten (21)	25	0	80	73	0	0	0	30	400
Xuanya Lanten (14)	19	14	20	78	0	0	0	6	630
Totals (1091 families)	1126	1290	144	4452	7	404	24	1627	6590

These figures give an indication of the order of magnitude of livestock numbers in each village. It can be seen at a glance, for example, that there are many more buffalo in the three lowland villages (Namthung, Ban Phoung and Namngen) than in the upland villages, where there is little need for them, due to the limited areas to be cultivated for lowland rice. It is clear that the Hmong village of Hat-ngao owns more cattle than any other village, and it can be seen that goat ownership is more common in the uplands, and particularly in the Lanten villages. Pigs are the most commonly kept larger animals, and 59% of these are owned by Namngen village, which probably has the best food security of the whole area, and is also the oldest-established village in the area covered by the survey. Turkeys, geese and ducks tend to be concentrated in the villages of the lowland plain, where rice bran is most plentiful, permitting the feeding of larger types of poultry.

Off-take in terms of consumption and sales

Livestock numbers alone, however, do little to indicate their level of importance in the shifting cultivation system. What is more important is their contribution to the economics of the system. Tables 2 and 3 indicate the levels of annual off-take in terms of recorded sales and consumption, for larger animals, and for different categories of poultry, respectively.

Value of sales

In the course of the survey, information was obtained about prices received when selling livestock. Prices varied considerably from one place to another, and probably from one season to another: they also varied according to the size of the livestock being offered for sale. For purposes of calculating the order of magnitude of sales value, the following prices

Table 2. Levels of off-take of larger animals in terms of sales and consumption: 1996 survey.

Village/ethnic group/(families)	Buffalo (Total No.)			Cattle (Total No.)			Goats (Total No.)			Pigs (Total No.)		
	(Total No.)	Consumed	Sold	(Total No.)	Consumed	Sold	(Total No.)	Consumed	Sold	(Total No.)	Consumed	Sold
Namthung Thai Lue (175)	(213)	3	12	(143)	7	20	(0)	0	0	(173)	15	60
Ban Phoung Thai Dam (166)	(158)	0	5	(150)	0	5	(0)	0	0	(300)	0(?)	0(?)
Namngen Mainly Thai Dam (383)	(487)	8	20	(110)	5	5	(26)	2–3	?	(2633)	200	442
Houaidam Khamu Ou (60)	(52)	?	3	(150)	2	40	(0)	0	0	(250)	20	15
Nateuil Khamu Ou (83)	(10)	0	0	(200)	0	15	(0)	0	0	(165)	18	15
Tintok Khamu Ou/Hmong (37)	(25)	0	1	(70)	0	4	(0)	0	0	(100)	0	40
Hat-ngao Hmong (87)	(104)	1	8	(450)	9	15	(7)	0	0	(500)	100	144
Lakkhammai Ikaw (37)	(25)	1	2	(0)	0	0	(0)	0	0	(80)	74	0
Namkhon Lanten (28)	(8)	0	1 in 3 yrs	(3)	0	0	(11)	2	3	(100)	20	48
Namke Lanten (21)	(25)	0	0	(0)	0	0	(80)	12	8	(73)	42	8
Xuanya Lanten (14)	(19)	0	3	(14)	0	5	(20)	1–2	0	(78)	28	10
Totals (1091 families)		13	54		23	109		17	11		517	782

Table 3. Levels of off-take of different categories of poultry in terms of sales and consumption: 1996 survey.

Village/ethnic group/(families)	Village/ethnic group	Turkeys (Total No.)			Geese (Total No.)			Ducks (Total No.)			Hens (Total No.)		
		(Total No.)	Consumed	Sold	(Total No.)	Consumed	Sold	(Total No.)	Consumed	Sold	(Total No.)	Consumed	Sold
Namthung Thai Lue (175)	Namthung Thai Lue	(105)	40	20	(0)	0	0	(241)	60	124	(173)	300	500
Ban Phoung Thai Dam (166)	Ban Phoung Thai Dam	(100)	10	15	(20)	2	2	(300)	50	60–70	(800)	400	200
Namngen Mainly Thai Dam (383)	Namngen Mainly Thai Dam	(150)	0	18	(4)	2	4	(810)	130	270	(2167)	500	1000
Houaidam Khamu Ou (60)	Houaidam Khamu Ou	(0)	0	0	(0)	0	0	(150)	180	120	(500)	150	360
Nateuil Khamu Ou (83)	Nateuil Khamu Ou	(24)	?	0	(0)	0	0	(50)	10	20	(455)	?	?
Tintok Khamu Ou/Hmong (37)	Tintok Khamu Ou/Hmong	(0)	0	0	(0)	0	0	(20)	0	0	(300)	100	100
Hat-ngao Hmong (87)	Hat-ngao Hmong	(25)	10	0	(0)	0	0	(0)	0	0	(150)	50	0
Lakkhammai Ikaw (37)	Lakkhammai Ikaw	(0)	0	0	(0)	0	0	(12)	0	0	(370)	200	370
Namkhon Lanten (28)	Namkhon Lanten	(0)	0	0	(0)	0	0	(8)	0	0	(100)	60	180
Namke Lanten (21)	Namke Lanten	(0)	0	0	(0)	0	0	(30)	0	15	(400)	100	50
Xuanya Lanten (14)	Xuanya Lanten	(0)	0	0	(0)	0	0	(6)	0	3	(630)	200	100–150
Totals (1091 families)			60	5		4	6		430	617		2060	2885

have been used as standards for all villages (these reflect typical prices at the time of the survey, combined with knowledge of prevailing 1997 prices):

Buffalo	250 000 kip	(approx $250)
Cattle	120 000	$120
Goats	18 000	$18
Pigs	40 000	$40

(relatively low price reflects the fact that many upland villages tend to sell young pigs, rather than the fully grown pigs more commonly sold from lowland villages)

Turkeys	8000	$8
Geese	8000	$8
Ducks	3000	$3

(value of duck egg sales has been ignored, though in a few villages, especially Namngen and Houaidam, about 2000 eggs per year were reported to be sold, at 100 kip each, giving income of approximately 200 000 kip/village.)

Hens	2000	$2

(any sales of hen eggs were negligible)

Table 4 combines the figures of livestock sales numbers with the values of livestock given above, to present a total income per village and per family, from livestock sales.

Table 4. Value of income from livestock sales, for each village, and average sales per family, 1996–97.

Village	Value of livestock sales (million kip)	No. of families	Value of livestock sales per family
Namthung	9.332	175	53 325 kip
Ban Phoung	2.581	166	15 548 kip
Namngen	26.266	383	68 580 kip
Houaidam	7.230	60	120 500 kip
Nateuil	2.460	83	29 638 kip
Tintok	2.530	37	68 378 kip
Hat-ngao	9.560	87	109 885 kip
Lakkhammai	1.240	37	33 514 kip
Namkhon	2.416	28	86 304 kip
Namke	0.609	21	29 000 kip
Xuanya	2.009	14	143 500 kip
Total	66.233	1091	60 709 kip

Source: 1996 survey data with prices adjusted to May 1997. (US$1.00 = 1000 kip approx.).

It can be seen that for most villages, livestock production is of considerable importance in terms of its contribution to family income. This is most noticeable in the upland villages, where income from livestock tends to be higher than for the three lowland villages of Namthung, Ban Phoung and Namngen. In terms of total income, this figure would be proportionately even higher for the upland villages, since they have very few other sources of income, with no disposable rice surpluses and few other upland crops to sell. For many upland families, the only other sources of cash income are from sales of forest products.

There are some anomalies in the Table. Ban Phoung's figure seems unexpectedly lower than that of the other basically lowland villages, but in the survey it was revealed that the village had lost 50 pigs due to suspected pasteurellosis during the period covered, so it may well be that they were retaining all potential breeding stock in order to build up numbers to pre-disease outbreak levels. The high value of livestock sales, and cattle sales in particular, from Houaidam and Xuanya, while perhaps accurate for the year in question, are not sustainable; Houaidam claimed to have sold 40 cattle, but claimed to have only 30 breeding females, while Xuanya claimed to have sold five cattle from just six breeding females; while this may be possible in one year, it certainly cannot continue year after year. Furthermore, the high livestock income figure for Hat-ngao masks the fact that almost 80% of families owned no cattle, a further 80% owned no buffalo, although all households owned some pigs. This implies that even higher income levels prevail for the best-off families. Despite the various anomalies however, it is felt that these levels of income are of the correct order of magnitude, and reflect the big contribution that livestock makes to the economy of the typical upland family or upland village.

Constraints to Increased Livestock Production

The 1996 survey sought to ascertain what farmers perceived to be the main limitations to increased livestock production. The question was made as an open one, followed by a request for listings of diseases affecting livestock in the previous year. This may have influenced respondents to concentrate on disease problems rather than on other constraints, but it did appear that all villages felt prevalence of diseases to be a major factor limiting increased livestock production. This point was further emphasised in a short-term consultant's report (Kennard 1996).

Kennard stated that 'there is no incentive for smallholders to invest resources in better husbandry methods until the survival of livestock is improved, and livestock ownership is perceived as less risky'. In order to address this situation, he emphasised that 'vaccination is the programme of choice for project implementation *and presages all others.*'

For pigs and poultry, lack of feed is a seasonal problem, especially in upland villages, due to shortages of rice, and therefore shortage of rice bran for livestock. Rice shortages frequently last 3–6 months for a majority of families, with only a few families having surpluses. In this case, pigs receive whatever bran is available, and poultry are basically left to find whatever they can around the village. For ruminants, the dry season presents some problems, with livestock grazing farther and farther from the villages, occasionally damaging forest areas, or upland crop fields and fences, in their search for adequate forage.

Indiscriminate breeding of livestock is another constraint to improved production. There is little if any selection of improved breeding stock, except perhaps in the Hmong village of Hat-ngao, where, for pigs and cattle, there may be some selection of better boars and bulls. But in general, this is not the case, resulting in an element of in-breeding. Kennard (1996) observed that in the case of cattle, there was very probably an unintentional reverse selection process, whereby the largest bulls, commanding the highest prices, would be sold off first, leaving smaller bulls in the herd for breeding. He suggested that local cattle were probably 50–100 kg lighter than those of similar breed in southern China.

Lack of technical skills on the part of farmers is a further constraint to increased production. The vast majority of farmers have received no training at all in improved animal husbandry, and indeed there are few extension agents in the province capable of providing such training. The provincial Department of Agriculture has only four or five livestock specialist staff, at least two of whom are involved in quarantine checking at the Chinese border, and on full-time fisheries work, respectively. There are a number of village veterinary workers, but again, most of these have received little training in recent years, and have only very limited access to vaccines or extension materials.

Opportunities for Improved Livestock Production

The main opportunity for increased livestock production comes from merely increasing the off-take of existing herds. For all categories of livestock, there are surplus, unproductive animals, especially males not required for breeding, but which could be sold to raise income, and to permit available feed resources to be better used by the reduced total number of stock remaining. Figures for different categories of livestock showed that for buffalo there was a male to female ratio of 1:1.4, for cattle the ratio was 1:3.6, for goats 1:6.66. In each case, this is a far higher ratio than is required for effective breeding. For pigs, there was some confusion in survey responses, although it would appear that there was generally more efficient production, with pigs being the only animals where young males are routinely castrated.

For ruminants at least, off-take could be increased very dramatically by merely selling these surplus males, retaining the best stock for future breeding. However, the reasons for keeping so many unproductive males are not clear, and require further investigation. Possible reasons include the fact that livestock ownership confers prestige, while the livestock themselves represent a source of capital that can be cashed in as required. It may also be that in some ethnic groups there is a reluctance to use female animals for certain ritual ceremonies, resulting in a reserve of surplus males being kept.

Better training of farmers could lead to improved disease control, to selection of better breeding stock, better use of available and perhaps novel sources of animal feed, and to greater awareness of the opportunities for making livestock production into a more organised, income-generating enterprise. The point should also be made that women should be targeted for much of the training, since they are involved in much of the livestock work, especially that which involves poultry and pigs.

Conclusions/Recommendations

Livestock production, for both sale and local consumption, is of very considerable importance to most families, in most upland villages of Luang Namtha Province. In order to improve productivity, it is necessary to remove or at least ameliorate the constraints to increased production. First priority would appear to be the need for large-scale and sustained vaccination programs, to ensure survival of larger numbers of livestock. Much more attention also needs to be given to training farmers, both male and female, in techniques such as improved nutrition, improved animal husbandry techniques, and improved breeding through sire selection. In particular, training is needed to change the attitudes of farmers, and to emphasise to them that efficient livestock production can be a realistic income-generating enterprise — in fact, a serious alternative to shifting agriculture.

References

Kennard, R.O. 1996. Livestock Production and Diseases Study. Final Report. Internal Technical Report to the EC Luang Namtha Integrated Rural Development Project.

Lao-IRRI, 1996. National Rice Research Program and Lao-IRRI Project, 1995 Annual Technical Report.

McLaren, A.D. 1996. Report on a Production Systems Study, Luang Namtha Province. Internal Technical Report for the EC Luang Namtha Integrated Rural Development Project.

Appendix
EC–Luang Namtha Integrated Rural Development Project
PO Box 124, Luang Namtha, Lao PDR (Laos)

Project information summary (May 1997)

Title: EC–Luang Namtha Integrated Rural Development Project, No. ALA/93/34

Duration: 1995–2000 (6 years)

Funding: 8.0 million ECU (approx. US$9.25 million) from European Union

Location: Luang Namtha Province, Districts of Namtha and Viengphuka.

Participants in the project:

Lao staff seconded by Government Units: 18 (heads of units, etc.)

Lao staff privately hired: 42

Village volunteers: 2 per village = 54

Foreign Technical Assistants: 5 (Finance & Admin./ Village Devmt.; Agriculturalist; Rural Engineer; Business & Credit Specialist; Technical Training Specialist)

Villages: currently 27 target villages with total 2242 families. (approx. × 6 for total pop'n.)

Classification by ethnic group

Lao Loum: Thai Dam (3), Thai Lue (3), Yang, Nyuane

Lao Theung: Khamu Ou (3), Khamu Khuene (5) Khamu Rock (2)

Lao Soung: Hmong (2), Lanten (3), Ikaw (3) Kouy Luang

Population growth probably in line with national average. Most villages in stable location, but Lao Soung villages likely to move, usually within relatively short distances, according to land needs. (two villages known to have moved within past five years). Some inward migration from returning refugees, relatively small numbers.

Occasional government resettlement in project area, though not with project target villages.

Project emphasis:

Integrated, participative approach, based on village development and village initiatives.

Overall objectives:

- establishment of sustainable mechanisms for integrated rural development in northern Lao (on a pilot basis);
- improvement of living conditions of deprived populations and of economically weak groups;
- harmonious integration of target populations towards a market economy;
- reduction of progress of degradation of the environment.

Specific objectives:

- improvement of living conditions with food security as priority, but also in areas of health, education, water supply etc.;
- help beneficiaries to adapt to economic changes, by promotion of alternative income-generating activities, and commercial exchange;
- reduce environmental degradation by introduction of viable, sustainable farming systems capable of protecting the environment;
- assure a development process capable of self-help in promotion of competence and implementation capacity at provincial government and village levels.

Problems: poverty; poor health, lack of access, market limitations. Family labour in a few villages limited by opium dependency.

Successes: construction of rural infrastructure; construction of agricultural resource centres (two completely operational, three nearing completion of buildings and already largely operational. Their purpose: demonstrations of alternatives to shifting cultivation (crops, fruit trees, contour strips, integrated with livestock) establishment of nurseries which will become self-financing, and farmer training); savings and credit schemes; training of youngsters on maintenance and repair of engines for hand tractors, rice mills, generators, etc.

Constraints, etc.: difficulty in attracting staff to area, initially; slow pace of implementation at village level; difficulty of communication (poor access, and in some villages only a few people understand Lao language). For Production Systems/Environment Unit, big current problem is that of obtaining good planting materials, in terms of tree seeds, and fruit tree budwood for grafting on to nursery rootstocks.

Prospects: prospects for progress seem encouraging in all aspects of the project. In the Production Systems/Environment Unit, contour demonstrations are now looking good, mostly planted with pasture species. Integration with livestock has begun, with small goat, pig and poultry units established recently. One-year-old mother fruit trees are beginning to recover from the dry season, and in future will make the project independent of outside sources of budwood. Farmer training has been launched, now that demonstrations are to be seen, and in April alone over 500 person training days were achieved. It is hoped to continue to develop farmer training much more in future. A major step ahead will be the completion of the privately-funded Namtha-Viengphuka road in the next two years. At present, the 67 km. takes three hours to drive, and is often impassable — for five months in the rainy season. This will be part of the new and long-awaited Thailand to China road, which in itself is bound to bring new market opportunities to many villages.

The Village Veterinary Worker (VVW) — Promoter for Livestock Development? Experiences from Tonpheung District, Bokeo Province

Silke Stöber[1]

Abstract

The Rural Development Project–Bokeo Province supports activities aimed at increasing food security and cash income from agriculture and livestock. More than 115 600 people, equally divided between upland and lowland areas, engage in mixed swidden/paddy farming, with livestock production playing only a minor role because of low input husbandry methods and high mortality rates. During 1996, the livestock development campaign focussed on vaccination. According to village veterinary workers (VVWs), the major constraints to a successful vaccination campaign were the availability of vaccines at district level, cold chain in the village, and the reluctance of farmers to vaccinate their animals. The village veterinary workers, however, seem to be competent partners with the government in promoting livestock development. They are motivated to run campaigns because of the remuneration involved. In addition, they are accepted by the villagers as consultants, not simply as vaccinators, and therefore need more training in livestock management, animal nutrition and disease prevention.

THE RURAL Development Project — Bokeo Province began in January 1995 and supports local authorities to implement rural development programs in agriculture, livestock, health, education, community development and rural infrastructure. In agriculture and livestock, the project supports activities to increase food security and cash income.

The main objective of livestock development is to increase the productivity and marketability of livestock raised by smallholders. To reach this objective, three major activities are carried out, namely, vaccinations, livestock extension, and marketing. Inputs to the project are grouped as civil works (offices, livestock sale yards), equipment (cold chain, basic diagnostic instruments, medical kits), vaccines and drugs, vehicles and training.

General Situation in Bokeo Province

Bokeo is one of the more remote provinces and, in spite of its position between Thailand, Myanmar and China, has remained largely isolated from the rest of Laos. The terrain is mountainous and difficult to access. The Mekong River is the dominant feature and forms the border with Thailand and Myanmar to the west and the Province of Oudomxai to the south. Luang Namtha Province adjoins Bokeo in the northeast.

The three main ethnic groups of the five districts are Lao Loum representing about 40% of the population, Lao Theung about 30%, and Lao Soung about 20%.

A wide range of farming system types are represented in Bokeo Province, and in some cases the differences between them are extreme. At one end of the spectrum (swidden farming), Black Lahu can be found living in small settlements and almost totally reliant on shifting swidden farming, hunting and gathering of non-wood-forest-products. At the other end, Lao Loum villagers on the banks of the Mekong River engage in paddy farming, raise a variety of large and small domestic animals, and regularly sell significant quantities of cash crops to traders either from within Laos or from Thailand.

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Table 1. Bokeo Province: Population by district, 1996.

District	Villages	Population	Households	H-holds in uplands	H-holds in lowlands	Ethnic majority
Houayxai	141	45 366	6016	38%	62%	50–60% Lao Loum
Tonpheung	60	20 427	3641	25%	75%	50–60% Lao Loum
Meung	22	7 282	1270	27%	73%	Mainly Lao Soung
Paktha	47	15 415	2735	79%	21%	75% Lao Loum
Phaoudom	123	27 192	4126	85%	15%	40% Lao Soung, 40% Lao Theung
TOTAL	393	115 682	17 788	52%	48%	

Source: Provincial Agriculture and Forestry Office

Table 2. Livestock numbers per district, 1996.

	Houayxai	Tonpheung	Meung	Paktha	Phaoudom	All districts
Buffalo	6 861	6 121	1 973	2 984	7 577	25 516
Cattle	6 993	3 693	3 094	4 551	1 437	19 768
Pigs	12 829	4 112	6 838	16 640	9 937	50 356
Chicken	65 619	85 478	27 149	72 400	35 567	286 213

Source: Provincial Agriculture and Forestry Office

Role of Livestock in Bokeo Province

In the subsistence swidden farming system, animal husbandry is limited to chickens, pigs, and some cattle. All livestock roam freely and this affects the viability of gardening and dry-season cropping. Swiddens are fenced to protect crops from cattle and pigs.

In the subsistence paddy farming system, animal husbandry includes pigs, chickens, ducks, cattle and buffalo, which in some cases are reared for regular sale. Dry season farming zones and paddy-fields are all protected by fences against livestock. In addition to being a source of income, large animals are reared for draught power.

In the market-oriented paddy system, all kind of domestic animals are reared, for sale and for home consumption. Draught power plays a minor role, because buffalo are being replaced by hand tractors.

In all farming systems, animal mortality and low production levels are a major limitation. Vaccination is carried out to a small extent (in 1993, 9% for buffalo, 8% for cattle, 0.6% for pigs and 6% for chickens). Poor feed quality compounds the effects of disease in all farming systems by weakening animals' resistance to infection.

Overall, livestock numbers in 1996 were approximately 1.5 large animais, 2.8 pigs and 16 chickens per household.

Institutional constraints with regard to livestock development are numerous. The District Livestock Offices are poorly equipped (three refrigerators for five districts) and quite understaffed (five district livestock officers). Diagnostic instruments are not available in the province, the cold chain is inadequate, and there are only 244 trained VVWs in the whole Province, i.e., one VVW for: 41 households in Houayxai, 70 households in Tonpheung, 160 in Paktha, 188 in Phaoudom and 212 in Meung.

Predominant Farming Systems in the Target Area of Tonpheung District

The project works in 21 target villages of Tonpheung District, with most of the villages close to the Mekong River bank. In three villages, the market-oriented paddy farming system is predominant, 13 villages are subsistence paddy farming system-based and in five villages, the mixed swidden/paddy farming system is predominant.

In the mixed swidden/paddy farming systems, the livestock number per household is lower than in the paddy based farming systems.

The number of village visits by the District Livestock Office in 1995 were on average one visit to villages less than 10 km from the district capital. If villages were more than 10 km distant, only 50% were visited once in 1995 by district livestock officials.

Table 3. Livestock population in different farming systems.

	Mixed swidden/ paddy	Subsistence paddy	Market-oriented paddy
Households	345	555	483
Buffalo per household	0.8	3.0	2.2
Cattle per household	0.6	1.6	2.5
Pigs per household	1.1	1.5	2.3
Chickens per household	7.9	12.1	11.1

Losses of buffalo are less than 2%. Losses of cattle are on average 13 %. *Haemorraghic saepticaemia*, foot and mouth disease and theft are stated as major problems for large animals. An important pig disease is swine fever, causing losses of up to 70%. Losses could be due to other diseases as well, but the diagnosis of diseases is still inadequate. Poultry die epidemically in some months, and losses of up to 100% are common. Newcastle and fowl cholera cause the epidemics, but other diseases like fowl pox and poisoning cause losses as well.

Low input animal husbandry methods are predominant in all villages. Pigs and chickens range during the day and are penned at night. Keeping pigs in pens the whole day is now promoted in many villages. Rice bran, leaves, and kitchen waste for pigs, and broken rice or rice bran for chickens are the most common forms of feed. Some villagers add cooked maize to the diet of chicken and pigs. A very few villages feed pigs on taro leaves, cooked papaya or chopped banana stalks and used rice mash after distilling rice liquor. For large animals, nutrition is derived from the natural grazing ground and the harvested paddy-fields.

As for marketing, all villagers keep chickens for home consumption. In the mixed swidden/paddy and the subsistence paddy farming system, large animals are very rarely sold. A typical family sells perhaps one animal per year. A buffalo can be sold on the Thai market for up to 8000 Baht. Pigs are marketed from time to time, but as herd sizes are low and mortalities high, sales are few.

In the market-oriented paddy farming system, farmers sell cattle, buffalo and pigs in the village or at local markets more frequently.

Set-up of a Veterinary Network

As the vaccination rate was very low and losses due to diseases seemed to be high, the project concentrated in 1996 on the set-up of veterinary services, with 45 VVWs trained. The results of the campaigns differ considerably:

- Campaigns were carried out in 14 villages. Seven villages did not vaccinate animals.
- Vaccination rates differ in villages with campaigns, varying from 12% to 100% for buffalo, and from 0% to 100% for cattle, chicken and pigs. The average vaccination rates were: buffalo 38%, cattle 7%, pigs 25%, chickens 6%.
- Successful vaccination campaigns (with high vaccination rate: >50% for large animals and/or >50% for small animals) were conducted in 10 villages.
- The predominant farming system type does not determine the vaccination rate.
- The location of the village (distance to the District Livestock Office) determines the success of the vaccination campaign. The closer the village to the District Office, the more the VVW vaccinate the animals. This has two causes: first, the transport cost for the VVW is low to zero; second, the organisation of the cold chain is much easier.

Statements on the constraints to livestock development were made by the VVWs during the last three campaigns.

- Availability of vaccines on District level not assured

"I went four times to the District Livestock Office because the village had serious disease problems with chickens. Twice I went by boat on the Mekong, and twice by bicycle, but the District was still waiting for the delivery of the vaccines from the province. Only on the fifth time was I successful."

- Cold chain equipment not sufficient

"As the villagers did not bring all their animals in time, I had to travel back to the District to buy more ice. Therefore I needed a second ice-box, because I could not store the vaccines properly in the meantime."

- Some farmers do not believe in vaccination

"Even if the poultry are vaccinated, the chickens die for other reasons. Poisoning of poultry is quite a big problem. I need to explain to the farmers that wrong husbandry methods also can cause diseases."

- Pigs have low weight gain

"The pigs in this village do not grow satisfactorily. A one-year-old pig might weigh 50 kg maximum. How can we improve the weight gain?"

- Number of VVWs in the village not sufficient

"Our village is quite big. It is not possible to vaccinate all animals at once, because some farmers forget to bring the animals into the village in time. More farmers should be trained in vaccination of small animals."

After one year of work with the project, many VVWs are very interested in livestock development and veterinary services. Rather than feeling like the 'vaccinator' of the village, they are motivated to take responsibility for livestock development. They could not always give appropriate answers to the farmers on diseases and animal nutrition, but they have the position to do so. Many of them wish to have other people trained in vaccination, because as soon as the vaccine is in the village, they need more helpful hands to vaccinate the animals.

As the campaign is a remunerative business, there is a strong incentive to work at it intensively. The financial analysis for two villages shows that a VVW in PonHom village can earn 25 600 Kip[1]. He has no transport costs, because the village is close to the District Livestock Office. In Nakham village, the VVW has to walk for about an hour, and by boat about half an hour before he reaches the District Office. He could earn 11 200 Kip.

Table 4. Financial analysis of two village vaccination campaigns (in Kip).

Pon Hom village			
Revenue	Vaccinated animals	Price/animal	Revenue
Buffalo	91	300	27 300
Pigs	22	200	4 400
Total revenue	113		31 700
Costs	Unit/Qty	Price/ Unit	Costs
HS vaccine	3 bottles	1000	3 000
Swine fever vaccine	3 bottles	900	2 700
Ice	2 kg	200	400
Total costs			6 100
Gross Margin			25 600

Village data: 75 households, Lao Khamu, subsistence paddy farming, 1 km from Tonpheung District capital, 30 minutes travel by foot, 110 buffalo, no cattle, 195 pigs and 1100 poultry

Nakham village			
Revenue	Vaccinated animals	Price/animal	Revenue
Buffalo	27	300	8.100
Cattle	22	300	6.600
Pigs	63	200	12 600
Total revenue	112	200	27 300
Costs	Unit/Qty	Price/ Unit	
HS vaccine	3 bottles	1000	
Swine fever vaccine	9 bottles	900	
Ice	5 kg	200	
Transport	2 boats	2000	
Total costs			16 100
Gross Margin			11 200

Village data: 42 households, Lao Lue, subsistence paddy farming system, 30 km from Ton-pheung District capital, 1.5 hours travel, 196 buffalo, 300 cattle, 253 pigs and 491 poultry.

[1] In 1996, US$1.00 = 980 kip approximately.

Conclusions

Because VVWs are highly motivated and have a personal interest in livestock promotion, the vaccination rate increased considerably. VVWs are able to determine the technical, institutional and socio-cultural constraints of livestock development.

Technical constraints are mainly the destruction of fields through free-ranging animals, deficiency in cattle nutrition due to the low digestibility of feed, low weight gain of pigs because of lack of protein and digestible carbohydrate in the diet, and epidemics among chickens. Institutional constraints are the difficult cold chain and the understaffed livestock offices.

Institutional constraints are more severe in the upland area than close to the Mekong. Socio-cultural constraints affect cattle and chicken production: Stock owners are not interested in improving managerial and economic inputs for cattle, and chickens are kept as a low-input source of food and cash. Due to the regular and severe mortalities, farmers are discouraged from investing in chickens.

Recommendations

- Assist district authorities in setting up a revolving fund for vaccines to ensure vaccine supply.
- Promote livestock in the upland area, as livestock still have a minor role and irrigation potential is limited.
- Provide refresher courses for trained VVWs concentrating on problems during implementation, revolving fund improvement and disease prevention.
- Design, print and distribute formsheets for accounting/reporting for VVWs.
- Design and distribute leaflets and posters to villages addressing the importance of vaccination and disease prevention.
- Let each village determine selection of the village veterinary worker and give them adequate time to do so.
- Train farmers in improved animal nutrition and quantity and quality of food for pigs, poultry and cattle. Diet components must be locally available or be produced locally.
- Enforce vaccination of chickens and pigs.
- Promote women's participation and selection as VVWs.

Reference

International Fund for Agricultural Development (IFAD) 1994. Lao PDR Bokeo Food Security Project, Appraisal Report, Volumes I-III.

Opportunities for Increased Livestock Production in Laos

LAO SOUNG (Hmong) farmer returning with his buffalo and cut grass from grazing land 8 km from his home in Ta village, Xieng Khouang Province. (Photo: Peter Horne)

BULL selection for mating using indigenous knowledge, Nong Het District, Xieng Khouang Province. (Photo: Bounthong Bouahom)

GOAT-RAISING (with fencing) may become more important in the uplands of Laos, as fallow management intensifies. In this instance, goats in Timor were browsing a *Leuceana leucocephala* hedge during a long drought attributed to El Niño. (Photo: Malcolm Cairns)

FORAGES in a farmer's fallow field, Xieng Khouang Province. (Photo: John Holmes)

FREE range system of pig production, Xieng Khouang Province. (Photo: Bounthong Bouahom)

PIG-raising integrated with fish production. Nong Het District, Xieng Khouang Province. (Photo: Bounthong Bouahom)

Rice straw preservation and grass cultivation (near barn), Xieng Khouang Province. (Photo: Peter Horne)

Cattle grazing coppicing alders (*Alnus nepalensis*) and crop residues in a swidden field, Nagaland, Northeast India. (Photo: Malcolm Cairns)

The Role of Livestock in Upland Farming Systems in Huaphan and Phongsali Provinces: Social Implications

Tony Bott[1]

Abstract

The Lao Australia Health and Local Development Project is supported by the Australian Government and will be implemented gradually in Huaphan and Phongsali Provinces of Lao PDR during the next five years (1997–2001). Its purpose is to improve the quality of life of rural communities in targeted districts. Global objectives include improvement in the quality and delivery of primary health care services, with emphasis on Mother and Child Health (MCH), food security, and socioeconomic wellbeing. The project is being implemented through various agencies at provincial and district levels: health (involving MCH, and the Clean Water Institute), Lao Women's Union, agriculture (including irrigation, crops and livestock). While the project is just beginning, it will expand during the next five years to cover a total of about 150 villages in six districts of the two provinces.

HUAPHAN and Phongsali are two of the most remote provinces in the Lao PDR, and the most rugged and mountainous. In general, 90% of the land is classified as highland or mountainous, with only 10% classified as flat. This flat land is found in small pockets and valleys between sharp, rugged hills, mountains and ravines.

Due to the nature of the terrain, the flat and lower areas of these provinces are subject to severe flash flooding in the wet season. In general, there is an opportunity only for micro-scale irrigation, although there is potential for a few small-scale schemes.

The provinces have a high percentage of forest cover, probably due in large part to the remoteness and inaccessibility of the forest and its precious logs. The provinces are extremely fragile environmentally, with slopes so steep (between 45° and 65°) that naturally-occurring landslides are common.

Most farmers in these areas practise slash and burn (95% of this project's targeted communities). The provinces also have a high percentage of minority groups who traditionally grow hill rice, maize and opium, and raise cattle, goats, pigs and poultry on a small scale. People in the lower areas also raise buffalo.

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Current government policy in both provinces involves voluntary, but heavily encouraged, relocation of highlanders to lower upland areas. In very few cases can communities be resettled in valley floor areas because land is simply not available, having been settled by others much earlier.

While the focus of these Proceedings is the role and potential of livestock in upland farming systems, some liberty has been taken here to focus on the people who practise the upland systems and who raise the livestock. It is important to add that these people are in transition, not only changing their physical location but also what they do and how they do it.

What is the role or potential for livestock? Certainly, the potential for markets appears favourable, given the province's proximity to China and Vietnam. Although road infrastructure is poor, these provinces are sufficiently close to borders to make cross-border trade feasible. Constraints relate to the environment itself and the current levels of technology and expertise among the people.

Farming is presently based on traditional methods and systems, with livestock only as a small-scale component, free-ranging according to local conditions. Further developments in the role of livestock must take these constraints into account.

Livestock development will have to be intensive, due to the fragility of the environment and the lack of sufficient flat or rolling land to grow fodder or to graze animals. Intensive farming means intensive management, with detailed planning and education as a pre-requisite. This process would also have a social impact, with people in new situations having to use new technologies and practices, requiring massive behavioural and attitudinal changes.

Some communities are now taking on new ways of farming. Many will need draught animal power for ploughing, and there will be an increase in the number of buffalo being raised for this purpose as more people move away from the highlands, but it is not envisaged that this activity will develop beyond satisfying community needs for ploughing. Poultry and pig raising can be expanded easily as not so much land is needed as for grazing animals. However, it will still require adaptation by farmers to new conditions and new methods. Moving into lower, more populated areas will undoubtedly result in increased exposure to diseases.

Raising larger livestock such as cattle and goats presents a more difficult scenario. If it is to increase, it must be on an intensive basis, and this is where problems occur. At present, local farming communities are not familiar with intensive agriculture, or the intensive management that must accompany it to be successful. For government agencies, there is more to the challenge than simply introducing new technology to farmers. It extends to having to ensure that farmers are sufficiently trained and disciplined to undertake intensive agriculture.

Detailed planning is a pre-requisite to which communities have had little exposure. Communities are not sufficiently aware of the effect on the environment that particular farming practices can have. Cause and effect can be hidden by other systems of thought, such as animism. The people are not so sophisticated, scientific or diversified in their thinking as to understand, for example, how to embark on watershed management and protection or why.

State agencies must assist in the further education of these communities, in the development of land capability surveys and participatory land use plans. This type of planning will determine the areas physically suitable for raising particular types of livestock and to what scale, and any other agricultural activities that can be carried out on a sustainable basis. These plans must be able to demonstrate sustainability and set limits to the amount of livestock in a particular area.

The elements of intensive farming must be demonstrated to the communities and they must be trained to be responsible for all those elements. All concerned need to have a commitment to persevering with new management techniques, as the environment simply cannot handle an expanded role for large livestock without it. The communities must also accept that the traditional ways of allowing livestock to forage freely are no longer viable in a changing environment, and that their traditional slash and burn farming systems are obsolete.

It is this re-education process that requires attention. The links between research, extension and the farmers need examination and redefining to ensure that proven technology can be made available in order for farmers to conduct their own adaptive research. Extension agents must be thoroughly competent in their respective subject areas in order to provide a service of value to farmers. It is this 'end user' adaptive research that becomes important, with farmers seeing that they themselves, or others just like them, are capable of adopting new technology successfully.

The question is, how can this be done properly and effectively to ensure that farmers are adequately trained, monitored and supported, and as cost efficient as possible — a principal consideration when developing any delivery strategy, especially in developing countries. Perhaps one answer lies in the use of community development techniques to be applied to the research-extension-adoption process.

One such technique can be borrowed from the community organising strategy. Through the use of this strategy, communities are encouraged to form groups of their own choice comprised of farmers undertaking the same or very similar activities. These groups become the point of interface between research, extension and community. The grower group or the livestock group can then be trained to plan and to manage its own activities. The focus of the training becomes the group and its members must be encouraged to undertake trials and to set up demonstrations on their own land. The groups must eventually be seen to be stakeholders. Group strengthening strategies are needed to establish and to maintain group cohesion. There must be meaning to being a member of a group and there must be some tangible benefit. The benefit may be the opportunity to trial some new technology, or to receive instruction or advice. It may be that one must be a registered member of a group in order to undertake a particular activity.

Once a group is established strongly, it is able to maintain discipline among its members and, in the case of intensive farming, use its significant peer pressure to enforce compliance to rules or technical guidelines by its members. Agency staff should work through group structures, using them as conduits for the delivery of services, and in the process, strengthen the group by supporting its role and function.

It is basic that research to identify and to prove new technologies must be pursued. The point at issue is that farmers must be trained sufficiently so that they can successfully adopt any new technology, method or system. While research is able to develop many new technologies, and the training of technical staff to implement them is ongoing, it is the transfer of skills to farmers that lags behind. The linkage is weak. Extension agents often express frustration at the reluctance of farmers to adopt new technology or practices. Many agents seem not to understand the risk factors that are weighed by farmers contemplating experimentation.

Not much can be expected if results cannot be guaranteed. However, extension and training techniques can be modified. By the use of group strategy, farmers can be made to feel they are sharing the risks of new technologies. By encouraging farmers to test new technologies on their own land and under their own conditions, opportunities are provided to give farmers a much better understanding of the technology being tested and the methods and systems that need to be employed to be successful. By supporting and monitoring local adaptation and adoption, technologies and the extension process itself can be improved, with the aim of building up the confidence of farmers. The role of extension agents is to support farmers and to advise them on recommendations and guidelines. Actual testing is carried out by the farmers themselves, with the knowledge shared by all members of the group.

It is this philosophy that has and will shape the delivery strategies used in the Lao Australia Health and Social Development Project.

Livestock in Upland Rice Systems in Northern Laos

Keith Fahrney,[1] Soulasith Maniphone[2] and Onechanh Boonnaphol[3]

Abstract

Upland rice is the predominant crop in northern Laos, grown on 60%–80% of the cultivated land area and accounting for the majority of grain production in several mountainous provinces. Most upland rice is grown in shifting cultivation systems. Government policy aims to end shifting cultivation and decrease areas cropped to upland rice by allocation of land to households and diversification of permanent production systems. Population growth and restrictions on land available for cultivation have led to shortened fallows, increasing weed problems, and declining soil fertility. Supplemental planting of fast-growing species can help increase biomass production for weed suppression and accelerated nutrient cycling and accumulation. Improved fallow plantings must be protected from free-ranging livestock for growth of sufficient biomass. Prior to cropping, farmers currently burn fallow vegetation to clear land and release nutrients as ash. Burning destroys most of the nitrogen and organic matter contained in fallow vegetation. Nutrients in ash are subject to leaching and runoff losses. Most species used for fallow improvement are legumes with high feed value and palatability to livestock. Controlled grazing of livestock on improved fallow vegetation can increase livestock production and cash income to households, while helping to conserve nutrients to maintain productivity of upland agroecosystems.

Upland Rice Production in Northern Laos: Changing Traditional Systems

The predominant crop in northern Laos is upland rice, which is nearly always grown in traditional rainfed, short-term bush fallow rotation systems, commonly referred to as shifting cultivation or 'slash-and-burn' systems. Forests, secondary fallow vegetation, and crop residues are burned to provide nutrients for annual cropping and for land preparation prior to dibbling seeds into untilled soil. Fertilisers and other modern agricultural inputs are generally not available to upland farmers and slope gradients are too steep for tillage. Fallowing and fire are the primary means of fertility regeneration and weed control; however, increasing population pressure and restrictions on cultivation of new lands have resulted in shorter fallow rotations with declining soil fertility and increasing weed problems (Roder et al. 1995a). In extreme cases, fallow periods have decreased to as little as three years, followed by two or more years of rice cropping. Productivity of the resource base is declining. The vast majority of rural households depends on the cultivation of a single upland rice crop each year to try to meet their basic food needs. Surplus production is rare and rice deficits are common.

Nationwide, upland rice is a major crop, planted on 28% of rice lands and accounting for 19% of grain production in 1996 (Table 1). In several mountainous northern provinces, upland rice is grown on 60%–80% of cropped land areas. In Luang Prabang, nearly two-thirds of the province's total annual rice harvest currently comes from upland fields.

Government policy aims to end shifting cultivation and decrease the area planted to upland rice (Table 1). Decreases in upland rice production will need to coincide with corresponding increases in lowland rice production in order to meet the policy goal for national self-sufficiency in rice production (Table 2). While land areas cropped to upland rice decrease, productivity on permanent upland fields

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Table 1. Targeted decrease in upland rice area and production.

	1995				2000			
	Area		Production		Area		Production	
Upland Rice	Ha	%	Tonnes	%	Ha	%	Tonnes	%
Lao PDR	178 500	28	266 000	19	52 500		81 000	4
Luang Prabang	35 900	77	59 500	65	18 900	59	34 020	41

Sources: Ministry of Agriculture and Forestry (1995). National Rice Research Program and Lao-IRRI Project (1997). Crops Section, Luang Prabang Agriculture and Forestry Service (1996).

Table 2. Policy targets for changes in land areas of rice environments in the Lao PDR and Luang Prabang Province.

		1994		2000		Change
Land areas of rice environments		Ha	%	Ha	%	%
	Rainfed upland	219 100	36	52 500		– 76
	Rainfed lowland	380 800	62	438 000	77	+ 115
	Irrigated lowland	11 000	2	75 000	13	+ 682
Lao PDR	Total rice land	610 910	100	565 500	100	– 7
	Rainfed upland	55 900	86	18 900	58	– 66
	Rainfed lowland	8 800	13	11 510	35	+ 131
	Irrigated lowland	400	0.6	2 150	7	+ 537
Luang Prabang	Total rice land	65 100	100	32 560	100	– 50

Sources: Ministry of Agriculture and Forestry (1995); MAF pers. comm. National Rice Research Program and Lao-IRRI Project (1995). Crops Section, Luang Prabang Agriculture and Forestry Service (1996).

must increase to feed the growing population. Increased productivity must be maintained to prevent abandonment of fields and shifting to new lands. National policy for improving productivity and stability of upland systems involves: land allocation to individual households, diversification of cropping systems, and increasing yields of upland rice by utilising higher yielding varieties, fertiliser inputs, and improved weed and pest management (Schiller et al. 1996).

Identifying superior varieties can help to increase yields of upland rice, but maintaining long-term productivity requires integrating and diversifying the upland 'rice-based' cropping system to include non-rice annual crops, soil improvement crops, fruit and timber trees, forages, and livestock. Key strategies for improving productivity of upland rice-based systems include: crop and fallow rotations with rice, fallow improvement, improved management of fallow vegetation, and soil conservation measures which encourage integrated landscape management. Livestock have an important 'value-added' role to play in providing incentives for implementation of these strategies, generating cash income to largely subsistence-based household economies, and raising productivity of the upland agroecosystem.

Current Situation: Under-utilised Fallows and Free-range Grazing

Natural fallow vegetation in most areas of northern Laos consists of annual weeds and aggressive shrubby perennials such as *Chromolaena odorata* in early years, followed by increasing predominance of bamboo and coppice regrowth of secondary forest trees in later years. Most fallow species are unpalatable to livestock or of poor nutritive quality.

Ruminant livestock[4] belonging to both lowland and upland farmers are commonly turned loose to

[4]This paper focusses on ruminant livestock in upland rice cropping systems. Small livestock (swine, poultry, fish) also depend on primary productivity from upland rice systems in the form of gleanings and grain milling by-products.

graze in fallows and forests during the upland rice cropping season. They are often a serious pest to the rice crop and necessitate construction and maintenance of sturdy fences. In surveys of upland farmers in Oudomxai and Luang Prabang provinces, 15% of (129) farmers interviewed indicated that damage from domestic livestock was a serious constraint to rice production (NRRP and LIP, 1992).

Fence construction requires up to 10 days of labour per hectare; but is generally less, averaging 2 days per hectare (Roder et al. 1997), because farmers group their fields together in blocks and share labour for fencing perimeters of the cropped area. Lowland farmers derive benefits from open grazing of livestock in the uplands, but they increase risks of livestock damage to upland rice fields without contributing labour or material resources for upland field protection. Among the upland farmers, it has generally been observed that Lao Soung (summit dwelling) ethnic groups are more advanced in livestock containment and grazing management practices than Lao Theung (midland dwelling) or Lao Loum (lowland dwelling) ethnic groups, but reasons for these differences (if they do, in fact, exist) are not clear.

Barbed wire, in quantities required for adequate protection of fields, is not affordable for most upland farmers. Most fences are constructed from bamboo and fence failures are common. *Jatropha curcas*, known locally as *houng kaew* is also commonly planted vegetatively as living fences, usually reinforced with bamboo or barbed wire. Participatory research on establishment and management of multipurpose tree species for use as living fences is needed.

As livestock populations increase in the uplands, communities will need to decide whether it is more efficient to continue fencing livestock *out* of fields or to begin fencing livestock *in* to pastures or stalls for controlled grazing and cut-and-carry systems. Fencing around upland fields is usually not maintained during fallow periods. Intensifying upland cropping systems (by fallow improvement and perennial plantings) and livestock systems (by planting forages) will depend on restricting free-range grazing practices.

Crop-Livestock Interactions: Prospects for Improvement

Though ruminant livestock are currently pests in upland rice fields in northern Laos, with proper management to control timing and intensity of grazing, livestock could utilise improved fallows and forage crop rotations to the mutual benefit of both livestock and crop components of integrated upland production systems.

Fallow improvement

Managing natural fallow regrowth is no longer an effective means of maintaining crop productivity. Supplementing natural fallows by cultivation of fast-growing species which produce large quantities of biomass can help to maintain or improve soil fertility and to control weeds. Accelerating biomass production increases cycling of nutrients by preventing losses from the system through leaching and erosion. Deep-rooting plants extract nutrients from a larger volume of soil and deposit them as leaf litter on the soil surface. Conserved and mobilised nutrients are thus available for crop production. Nitrogen-fixing species can add significantly to the pool of the nutrient which most often limits crop production.

Fast-growing tree species may be most promising for fallow improvement because they produce a canopy above most annual weeds and may help to suppress their growth by shading. Natural and improved fallows can be enriched by planting perennial crops with market value such as paper mulberry *(Broussonetia papyrifera)* (Fahrney et al. 1997). Paper mulberry bark is harvested and sold to provide cash income during the fallow phase of the rotation. Leaves are also a favoured fodder for ruminant livestock, pigs and fish.

Legumes are generally favoured for fallow improvement because of their rapid growth and potential nitrogen contributions to systems. Most legume species used in fallow improvement are attractive forages or fodders for ruminant livestock and have potential for increasing livestock production if sufficient biomass is allowed to grow (by protection from livestock) during the fallow regeneration phase of the rotation.

Improved management of fallow vegetation

Benefits to crop production of increased nutrient inputs and cycling from improved fallows may depend largely on how the biomass is managed in the conversion from the fallow to the cropping phase of the rotation cycle.

The amount of biomass produced by short-term improved fallows is similar to amounts produced by several years of natural fallowing. Fallow vegetation must be cleared prior to planting rice or other crops. Burning destroys most of the nitrogen and organic matter contained in fallow vegetation. Soluble nutrients contained in ashes may be lost by runoff or leaching.

Systems that involve burning may be necessary for clearing woody vegetation and for weed control, but 'biodigesters' — livestock — can help to clear leafy green vegetation from improved fallows or forage crop rotations, conserving, concentrating, and delivering nutrients in a relatively stable, but plant-available form, i.e., manure. More research is required to understand better the prospects for improving nutrient management in hybrid grazing/burning systems.

Livestock feed is usually in shortest supply at the end of the dry season. Utilising improved fallows as a forage or fodder resource should benefit livestock production. Cut-and-carry systems are a major departure from current livestock production practices and are likely to have less chance of adoption, at least in the near-term, compared to modifications to existing grazing practices. Controlled grazing practices (timing, numbers of livestock, etc.) which are optimal for both fallow management and livestock production have not yet been determined. On-farm studies are needed to develop grazing systems utilising improved fallows. Livestock and crop scientists will need to work together with farmers and village leaders to find systems that work.

Soil conservation and integrated landscape management

Soil conservation is essential for permanent cultivation systems, particularly on steep slopes that are cropped in northern Laos. Contour plantings of vegetative erosion barriers, forage strips, and fruit and timber trees can be the basis for transforming swidden rice fields into integrated and stable mixed farming systems.

Contour hedgerows (of vetiver grass, forage grasses, and *leucaena*, for example) are effective in reducing soil losses and increasing infiltration of water. Hedgerows break the slope into smaller lengths, reducing erosion, but they also break the field into management units which are useful for practicing rotations of rice with cash crops, forages, improved fallows, perennial plantings of fruit and timber trees, and livestock feeding pens. The dual-purpose nature of forages as hedgerows (feed resource, as well as erosion control) may serve as an enabling incentive for farmers to establish and maintain hedgerows.

Timber trees, such as teak (which after 4–6 years can serve as fence posts for barbed wire), or more closely spaced multi-purpose trees planted as living fences along contour hedgerows, can serve to contain livestock for cut-and-carry feeding of forages and improved fallow vegetation. Rotating locations of feeding pens can concentrate nutrients and organic matter in manure, rapidly building up soil fertility and water holding capacity, maintaining or improving productivity and increasing opportunities for crop diversification.

Rice-Based Cropping Systems Research Relating to Livestock Production

The uplands research component of the Lao National Rice Research Program and the Lao-IRRI Project conducts 'rice-based' cropping systems research at Houay Khot Station in Luang Prabang province and on farms at near-by villages in Xiengnguen District. In 1996, on-farm systems research extended into Luang Namtha, Oudomxai, and Xaignabouri provinces. Most cropping systems studies involve research on fallow improvement and rotations with legumes.

Establishment methods for potential improved fallow/forage species were evaluated on-station in 1992 and 1993 (Roder and Maniphone 1995b). Since 1993, an observation nursery of forage/fallow/cover crop species has been maintained and expanded on-station. Currently there are 48 species or varieties of mostly viney legumes, but also including some shrubby legumes and grasses. Table 3 shows suitability for various uses of some legumes considered to be promising for fallow improvement. Several of the legumes are 'three star' forages.

Two long-term on-station experiments, the Leucaena Rotation Study and the Continuous Rice Cropping Study (Maniphone and Fahrney 1996; NRRP and LIP, 1994–1997) aim to determine weed suppression and rice yield improvement potential of shrubby legumes (*Leucaena leucocephala*, *Gliricidia sepium*, and *Crotalaria anagyroides*, a non-forage legume) in various interplanting and rotational patterns as dry season or annual fallows. Similar studies could include grazing management treatments.

An observational nursery of different species and varieties of multipurpose nitrogen-fixing trees was established on-station in 1996, with seed material and technical support from the Forages for Smallholders Project (FSP), to test adaptability of various species to local micro-climates. The nursery will also serve as a seed source for further on-station and on-farm studies with promising varieties.

On-farm cropping systems experiments, established at four sites in three northern provinces in 1996, will test weed suppression and crop yield improvement potential of dry season fallows (*Stylosanthes guianensis, Crotalaria anagyroides,* and a mixture of the two species) oversown in rice fields after the third weeding of the current rice crop. Depending on quantities of biomass produced, researcher and farmer collaborators will decide on residue management prior to the 1997 rice crop. Treatments may include burning, mulching, grazing, or combinations. Another type of on-farm fallow improvement experiment, established at two sites in 1996, will determine weed suppression, cash income

Table 3. Multi-purpose uses for species showing promise for fallow improvement.

	Promising species for fallow improvement						
Species	Food	Fodder (quality)	Fuel	Cover	Weed suppression	Biomass	Seed
Arachis pintoi	◆	◆◆◆		◆◆	◆◆	◆	◆◆
Calopogonium caeruleum				◆◆◆	◆◆◆	◆◆	
Centrosema pubescens		◆◆◆		◆◆	◆	◆	◆
Crotalaria anagyroides					◆◆◆◆	◆◆◆◆	◆◆◆
Gliricidia sepium		◆	◆	◆	◆◆◆◆	◆◆◆◆	
Leucaena leucocephala		◆◆◆	◆◆	◆	◆◆	◆◆◆	◆◆◆
Stylosanthes guianensis		◆◆◆		◆◆◆	◆◆	◆◆	◆◆
Pueraria phaseoloides		◆◆		◆◆◆	◆◆	◆◆	◆
Mucuna cochinchinesis	◆◆	◆		◆◆◆	◆◆	◆◆◆	◆◆◆

Source: Modified from NRRP and LIP (1994).

benefits, and rice yield potential of interplantings of *Leucaena leucocephala* and *Broussonetia papyrifera* (paper mulberry) with rice, and subsequent fallows of varying durations. Both of these fallow species are high quality forages.

Livestock have been un-invited, but eager participants in many of the field experiments, particularly on-farm. Often, interactions with the livestock component have confounded interpretation of planned treatment effects. In the future, the authors look forward to working with livestock scientists to establish controlled studies (with livestock as treatments) which can demonstrate a synergistic relationship between cropping and livestock systems in the uplands.

Conclusions

Natural fallow rotations have shortened to the point of declining productivity of the natural resource base, with increasing weed problems and decreasing soil fertility. Fast-growing improved fallow species can supplement natural fallow vegetation, accelerating nutrient cycling and accumulation; but improved fallows must be adequately protected from free-ranging livestock to allow for production of sufficient biomass to effectively suppress weeds and restore fertility. Most species used for fallow improvement are legumes with high nutritive value and palatability to livestock. Controlled grazing of livestock on improved fallow vegetation can increase livestock production and cash income to households, while helping to conserve nutrients and maintain or increase productivity of the upland agroecosystem.

Sustainable upland production systems require adoption of effective soil conservation practices. Forages can be planted as contour hedgerows, encouraging rotations and perennial plantings in integrated landscape management systems.

Realising potential synergistic relationships between upland crop and livestock production systems will require a better understanding of nutrient dynamics within upland systems and the development of management practices that are acceptable within the social context of local communities. On-farm participatory research can aid in understanding of conditions that determine adoptability of improved crop/livestock systems.

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References

Crops Section, Luang Prabang Provincial Agriculture and Forestry Service. 1996. Strategy Plan: 1996-2000. Luang Prabang, Lao PDR. 38 p (in Lao).

Fahrney, K., Boonnaphol, O., Keoboulapha, B. and Maniphone, S. 1997. Indigenous management of paper mulberry *(Broussonetia papyrifera)* in swidden rice fields and fallows in northern Laos. Paper prepared for the regional workshop on Indigenous Strategies for Intensification of Shifting Cultivation in Southeast Asia, Bogor, Indonesia, 23–27 June 1997.

Maniphone, S. and Fahrney, K. 1996. Research on forages in upland cropping systems in northern Laos. SEAFRAD Newsletter. Issue 3. Nov 1996. Southeast Asia Feed Resources Research and Development Network.

Ministry of Agriculture and Forestry. 1995. Proceedings of the National Meeting on Agriculture and Forestry. 18–22 October. Vientiane, Lao PDR, 43 p (in Lao).

NRRP and LIP (National Rice Research Program and Lao-IRRI Project). 1992–1997. Annual Technical Reports (1991–1996). Lao-IRRI Project, Vientiane, Lao PDR.

Roder, W., Phengchanh, S. and Keoboulapha, B. 1997. Weeds in slash-and-burn rice fields in northern Laos. Weed Research, 37, 311–319.

Roder, W., Phengchanh, S. and Keoboulapha, B. 1995a. Relationships between soil, fallow period, weeds, and rice yield in slash-and-burn systems in Laos. Plant and Soil, 176, 27–36.

Roder, W. and Maniphone, S. 1995b. Forage legume establishment in rice slash-and-burn systems. Tropical Grasslands, 29, 81–87.

Schiller, J.M., Khamhung, A., Boonnaphol, O., Manivong, V. and Fahrney, K. 1996. Production constraints and research direction for sustainable upland rice-based agriculture in northern Laos. Paper presented at the Eighth Annual Meeting of the IBSRAM Asialand Network on The Management of Sloping Lands for Sustainable Agriculture in Asia, 23–27 September 1996. Vientiane, Lao PDR.

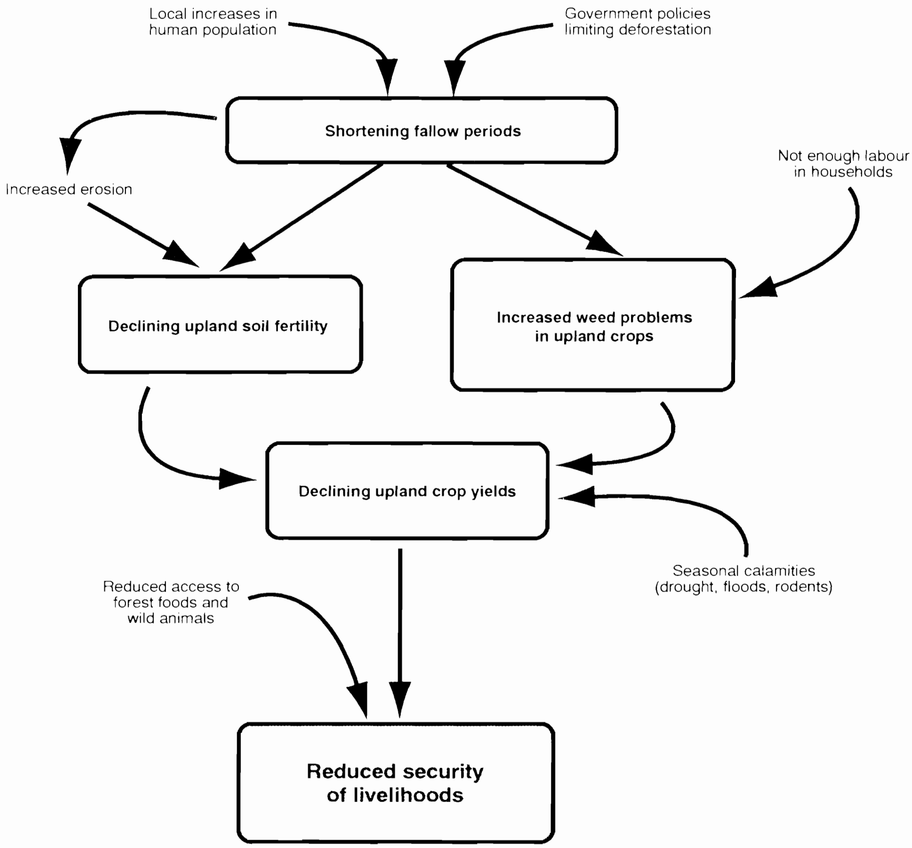

Figure 1. The changing dynamics of shifting cultivation in Lao PDR.

These shorter fallow periods have resulted in lower yields of crops in the *hai* mainly because of declining soil fertility and increasing weed problems.

Declining soil fertility

Although it has yet to be documented, fallow periods of 3–4 years probably return substantially less organic matter to the soil per year of fallow than longer fallow periods (8–10 years). Furthermore, with shorter fallow periods, the sloping *hai* are exposed more frequently to the heavy, erosive rains of the early wet season. The consequence of these two effects is rapid decline in soil fertility. In some areas of northern Laos, upland rice yields have fallen to 700–900 kg/ha after 4-year fallows compared with 1500 kg/ha after 9-year fallows in the same area (Figure 2).

Increasing weed problems in the *hai*

Shorter fallow periods result in shrubby fallow vegetation, predominantly *Chromolaena odorata* and *Ageratum conyzoides*, which seed prolifically and can become the main weeds in subsequent crops. Longer fallow periods (>7–8 years) result in arboreal fallow vegetation which has a lower weed potential. With the shrubby fallow vegetation of shorter fallows, at least two rounds of weeding are necessary to grow upland rice, which can take from 140–190 person-days/ha, amounting to 40%–50% of the total labour input in the *hai* (Roder et al. 1995). As a result, the area of *hai* that a family can cultivate is very often limited not by their consumption requirements, but by the availability of household labour simply to weed the *hai*.

These effects highlight the extent of the problem of declining productivity of the *hai*. However,

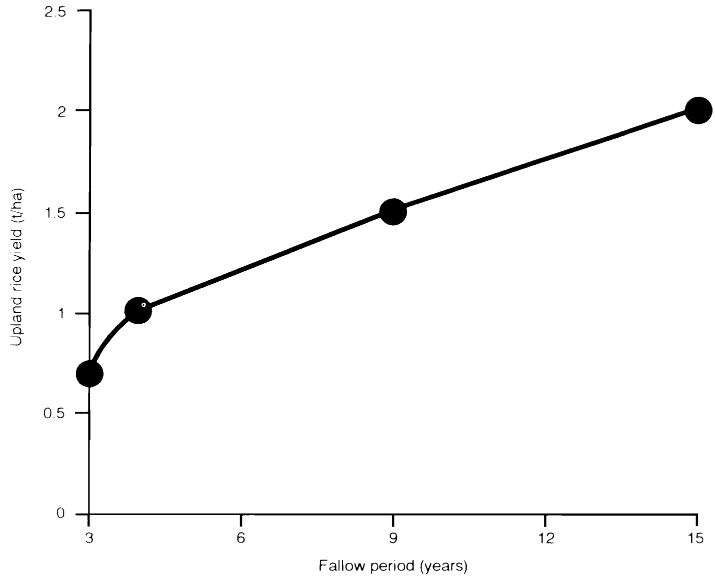

Figure 2. The relationship between shortening fallow periods and upland rice yields in northern Laos (after Chazee 1994).

shifting cultivation has always been a risky and time-consuming agricultural practice, which has resulted in farmers opting for diversifying rather than intensifying their livelihood systems to be able to deal with adversity. In the past, when crops in the *hai* failed because of natural calamities or when seasonal food shortages occurred, shifting cultivation communities were able to rely on traditional coping strategies to provide their food requirements until the next cropping season. The main strategies were:

(1) hunting wild animals and gathering forest foods for local consumption;
(2) gathering non-timber forest products for sale;
(3) selling labour;
(4) selling opium; and
(5) selling livestock (cattle, buffalo, pigs and chickens).

However, the first four of these strategies are becoming less reliable.

Primary forests in northern Laos have become both diminished in area and more heavily exploited for non-timber forest products. In the mountainous province of Luang Namtha, farmers report that wild animals that were common even 10 years ago are now rarely seen. Opportunities for selling labour are limited largely to communities near roads or towns. Opium production is being strongly discouraged by the Lao government. This has left farmers with an increasing reliance on livestock as a source of cash income and livelihood security.

The Role of Livestock in Securing Farm Livelihoods

As a resource for securing livelihoods in shifting cultivation areas, there are few better alternatives than livestock as an integral part of the cropping system. The benefits are numerous, with the most common ones mentioned by farmers being:

(1) Livestock can be sold at any time on a market which has a constant demand and relatively stable prices

By comparison, most fruit and vegetable crops must be picked when ripe and often sold on a market where prices are depressed by oversupply. A recent example is oranges, which are well suited to the northern regions, but which had a market value of only US$0.02 per fruit in provincial capitals at the height of the 1997 season.

(2) Larger livestock (cattle, buffalo and goats) can be walked long distances to market

In one recent example (cited by Horne 1997), Hmong farmers walked 20 bulls from Nong Het in Xieng Khouang province 350 km to market in the capital, Vientiane. The marketing flexibility this provides is especially important in a country where many communities are remote. SWECO (1990) found that only 57% of the district centres in Lao PDR (excluding provincial capitals) had year-round access by road and 17% had no access even in the dry season. For many farmers, the nearest road may be one day's walk or more from their village. This will limit their cash crop options, as most crop products are bulky and would have to be carried long distances to market for meagre returns per unit weight. In a study of shifting cultivation in four districts of three northern provinces, Pravongviengkham (these Proceedings) found that livestock (including both large and small livestock) had the highest share in household income generation across all districts.

(3) Livestock provide manure

In most areas of northern Lao PDR, farmers have either no cash to buy fertilisers or no access to fertiliser suppliers. Where soil fertility is poor (e.g., large parts of Xieng Khouang and Luang Prabang), farmers recognise manure as an essential input for maintaining the productivity of small areas of rice fields and home gardens. By grazing in surrounding forests and grasslands and returning to the villages each night, larger livestock effectively concentrate nutrients around the villages. Horne (1997) cites an example from Xieng Khouang where villagers are changing their livestock management practices specifically to bring cattle back to the village from the grazing land more often, so they can collect larger amounts of manure, thereby obtaining more sustained yields from their rice paddies and reducing reliance on the production from the *hai*. In some villages, livestock owners sell manure for significant cash or food returns.

(4) Livestock provide a relatively high profit for very low labour input

The two most common livestock rearing systems in northern Lao PDR are free-range systems: either (1) day grazing and penned at night; or (2) continuous grazing, returning to villages only occasionally. Both require little labour input compared to shifting cultivation.

(5) Larger livestock (cattle, buffalo and goats) use feed resources that cannot be utilised for any other purpose

These livestock are commonly grazed in forests, high grasslands or in fallow fields where they survive by foraging on grasses, shrubs, tree leaves and crop residues. The communally-owned feed resources provide farmers with substantial returns and livelihood security for little or no management input.

The importance of these numerous benefits to farmers is best demonstrated by the fact that, although large livestock frequently damage crops and are susceptible to disease epidemics, farmers continue to keep them as an asset to be sold in times of calamity.

Opportunities for Improvement—What Can Forage Technologies Do?

When asked what aspects of their farming systems they would like to strengthen, farmers in shifting cultivation areas of Lao PDR commonly give high priority to the following (see, for example, Connell and Ravong 1994):

- improved production from paddy fields and home-gardens (where they exist). The main issue is declining yields resulting from depletion of soil fertility.
- improved production from the *hai*. The main issues are declining soil fertility and severe competition from weeds.
- improved production from livestock. The main issues identified by farmers (commonly in this order) are animal disease, insufficient feed and crop damage caused by livestock. Introduction of 'improved' breeds (for example, cross-bred cattle) is sometimes requested by farmers but would be inappropriate until the existing management problems (disease, feeding and uncontrolled breeding) are resolved.

Forage plants have a potential role to play in all three objectives. By providing more feed of higher quality near villages, farmers may be able to better manage the manure resource which is so essential to fertility of rice paddies and home gardens. Forage legumes sown in fallow fields or oversown into the *hai*, can benefit both soil fertility (through cycling of nitrogen and organic matter and through erosion control) and weed control (*Stylosanthes guianensis*, for example, has potential to smother weeds in upland rice crops without adversely affecting the crop). Forage grasses and legumes can be planted in plots near barns to supplement grazing animals at night or at times of greatest need (such as at rice planting or harvesting, when animals are kept in the barn because there is not enough labour to look after them). Forage tree species can be used as both a source of high quality feed and fence lines to protect fields from wandering stock.

Although these potential uses of forage species have been well understood for a long time — for example, Shelton and Humphreys (1975a,b) demonstrated the effectiveness of *Stylosanthes guianensis* as a cover crop in upland rice in Lao PDR more than 20 years ago — very little adoption has occurred. One reason for this is that frequently the forage technologies offered to farmers were inappropriate for reasons unknown to the researchers. Another is that, until recently, traditional feed resources in shifting cultivation areas have been adequate. However, farmers now complain that these feed resources are becoming scarce or degraded because of:

- increased livestock numbers, resulting in over-utilisation of the feed resources;
- expansion of upland agriculture into traditional grazing lands;
- reforestation of grazing land;
- prohibition of cattle grazing on forested land;
- utilisation of paddy-fields for longer periods of cropping, excluding animals from grazing stubble.

In response to feed resource degradation, farmers have begun to develop their own strategies. Examples of farmers innovating in this way are:

- thousands of Hmong cattle farmers in Xieng Khouang and Luang Prabang provinces cultivating small plots of napier grass (*Pennisetum purpureum*) near their grazing lands to supplement their cattle in the dry season;
- Iko farmers in Luang Namtha province planting creeping legumes as cover crops in their upland fields to control weeds;
- lowland farmers in Champassak province managing and collecting green forage from islands in the Mekong river for feed during the rice-growing season (at other times the cattle graze on the paddies);
- farmers in one village of Xieng Khouang who collected *Brachiaria ruziziensis* seed from an old demonstration trial 40 km away and planted it near their barns so they could keep animals closer to the rice fields to provide manure.

In each case, the technologies were probably not the best (for example, *Brachiaria ruzizensis* is not well adapted to the long dry seasons and poor soils of Xieng Khouang), but the farmers demonstrated their capacity to try to solve their own problems by using and adapting whatever technologies were available.

These farmers are natural experimenters; frequently all they lack is promising species and information on how these species can be managed. However, species alone will not provide a solution to the three objectives described earlier. What is needed are 'forage technologies', which are the combination of adapted species with the way these species can be integrated within a farming system. Researchers can identify adapted, potentially promising species and suggest ways of using them, but only the farmers can develop these into working technologies. The AusAID-funded Forages for Smallholders Project (FSP) is working with innovative farmers (like those described above) in upland areas of Lao PDR to develop their own forage technologies that may contribute to solving the three common objectives described earlier. Promising forage technologies described in more detail by Horne and Stür (1997) are:

1. grass/legume mixtures for grazing;
2. legumes as cover crops and green manures in upland cropping systems;
3. grasses for hedgerows in upland cropping systems;
4. legumes and grasses for cut and carry feeding systems (in hedgerows or intensively-managed plots);
5. multipurpose tree and shrub legumes in fence lines, contour hedgerows and intensively-managed plots;
6. legumes for leaf meal production.

In the first two years (1995–1997) of the 5-year project, regional nurseries were planted at five sites throughout Lao PDR. The most promising, broadly adapted species that have emerged so far are *Brachiaria decumbens* cv Basilisk, *Brachiaria brizantha* (cv Marandu, CIAT16835, CIAT16827), *Brachiaria humidicola* CIAT6133, *Andropogon gayanus* cv Kent, *Panicum maximum* TD58 and *Stylosanthes guianensis* CIAT184. In the wet season of 1997, the work began with shifting cultivation farmers in Luang Prabang and Xieng Khouang provinces to develop these species into forage technologies. The approach being used, known as Farmer Participatory Research (FPR), has been described in detail by Okali et al. (1994), van Veldhuizen et al. (1997a, b) and Horne et al. (1997). In short, FPR methods are based on empowering farmers like these to develop their own solutions by providing the information and promising technologies they lack. The main difference from previous R&D approaches is that FPR is based on active involvement of farmers, who make decisions at all stages of forage technology development. In partnership with development workers, farmers identify and prioritise the problems they experience, decide which forage technologies to test, run their own experiments (often informal), evaluate the outcomes and modify the forage technologies to meet their specific needs.

What Forage Technologies Cannot Do

Forage technologies are new to farmers in Lao PDR. Farmers and researchers often have unrealistic expectations of these technologies. Common misconceptions are:

1. Communal grazing land can be improved with forages. Without control over wandering livestock or control of land by individual farmers, there is little that can be done to improve the feed resources of communal grazing land.

2. Forages can solve all feed resource problems. Forages will only ever be part of the solution, supplementing existing feed resources, such as native grasses, crop residues and tree leaves.
3. Forages require no management. Like crops, forages need careful management during establishment, especially to minimise the impact of weeds and wandering animals.
4. Forage grasses require no inputs. One forage technology that many farmers are testing is grasses planted in intensively-managed plots to provide cut feed to animals when they return from grazing or when the farmers are too busy to look after the animals (such as at rice harvest). If cut regularly, grasses can remove large quantities of nutrients from the soil. With napier grass yielding 18 tonnes dry matter/ha, for example, a nutrient off-take in a cut-and-carry system of 300 kg N/ha/year, 20 kg P/ha/year and 150 kg K/ha/year is possible. Unless nutrients are returned to the soil, yield decline of highly productive planted grasses (such as *Panicum maximum* and *Brachiaria decumbens*) is inevitable, to a point where they may be no better than naturally occurring grasses (as shown in Figure 3). Nutrients can be easily returned with manure, if the grasses are planted close to the barns.
5. Forage species exist that can give high yields during long dry seasons. There are no miracle species. During short, dry seasons, some species (e.g., *Brachiaria decumbens* cv Basilisk) can maintain reasonably high yields. However, if dry seasons are long (>5 months) and severe, yields of all forage species will fall substantially. Some species survive long, dry seasons better than others, but yields may be little better than the naturally-occurring grasses. Forage tree legumes can be useful in these situations as their deep rooting systems allow them to access soil moisture beyond the reach of grasses and legumes, maintaining production of green leaf long into the dry season.

Conclusions

Livestock are central to the livelihood security of resource-poor farmers in upland agricultural systems of Lao PDR. Traditional feed resources for these livestock are becoming scarce or degraded. Forage technologies exist that have the potential to overcome the livestock feeding problems as well as providing other benefits within shifting cultivation systems. However, the key is to provide farmers with access to these technologies, allowing them to evaluate and to develop them to suit their needs.

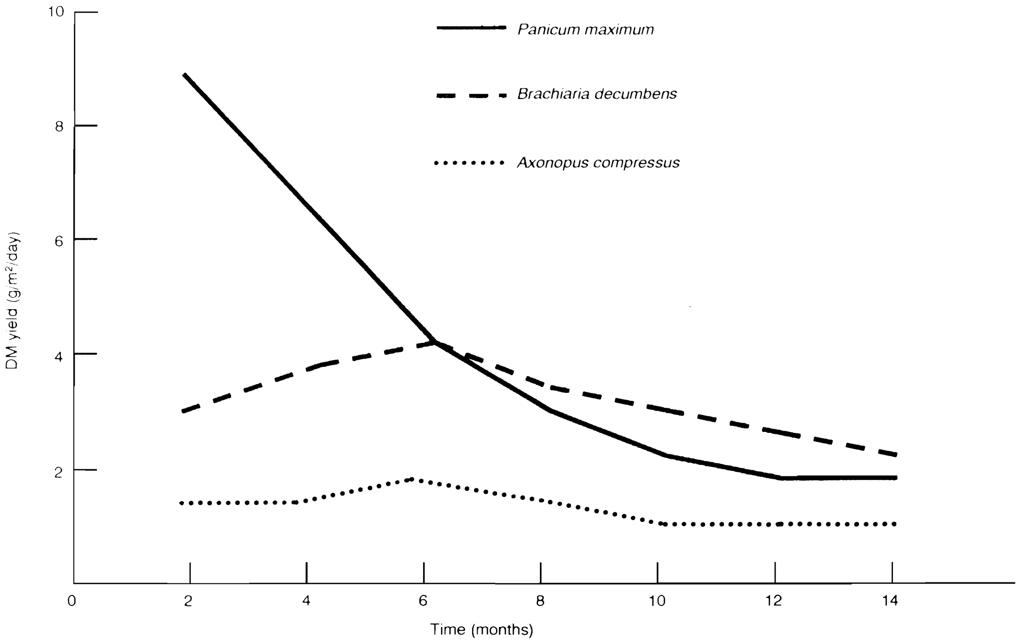

Figure 3. Yield of grass species cut every two months in an unfertilised cut-and-carry feeding system in Bali (I.K. Rika, unpublished data)

References

Chazee, L. 1994. Shifting cultivation systems in Laos: present systems and their future. In: van Gansberghe, D. and Pals, R. ed., Shifting cultivation systems in rural development in the Lao PDR. Proceedings of a workshop held at Nabong Agricultural College, July 14–16, 1993. UNDP, Vientiane, Lao PDR, 66–97.

Connell, J. and Ravong, P. 1994. Issues and opportunities for extension of sustainable agricultural strategies. Proceedings of the national workshop on Sustainable Agriculture in the Uplands, February 9–11 1994, Vientiane Lao PDR (Sustainable Agricultural Forum, Vientiane), 48–53.

Horne, P. 1997. Farmer-developed forage management strategies for stabilisation of shifting cultivation systems. Paper presented to the ICRAF workshop, Indigenous strategies for intensification of shifting cultivation in southeast Asia, Bogor, Indonesia, June 23–27 1997 (in press).

Horne, P.M., Stür, W.W., Gabunada, F. and Phengsavanh, P. 1997. Prospects for introducing forages in smallholder farming systems in southeast Asia. In: Stür, W.W. ed., Feed resources for smallholder livestock production in Southeast Asia. Proceedings of a meeting in Vientiane, Lao PDR, 16–20 January 1996. CIAT Working Document No. 156. Los Baños, 122 p.

Horne, P.M. and Stür, W.W. 1997. Current and future opportunities for improved forages in Southeast Asia. Tropical Grasslands (in press).

Okali, C., Sumberg, J. and Farrington, J. 1994. Farmer participatory research. Rhetoric and reality. Intermediate Technology Publications, London, 159 p.

Roder, W., Phengchanh, S., Maniphone, S., Songnhikongsuathor, K. and Keoboulapha, B. 1995. Weed management strategies aimed at reducing labour for upland rice production. Proceedings of the International Rice Research Conference, 13–17 February 1995, IRRI, Los Baños, Philippines.

Shelton, H.M. and Humphreys, L.R. 1975a. Undersowing rice (Oryza sativa) with *Stylosanthes guianensis*. II. Delayed sowing time and crop variety. Exp. Ag. 11, 97–101.

Shelton, H.M. and Humphreys, L.R. 1975b. Undersowing rice (Oryza sativa) with *Stylosanthes guianensis*. III. Nitrogen supply. Exp. Ag. 11, 103–111.

SWECO 1990. National transport study. Final Report. Ministry of Communications, Transport, Post and Construction, Vientiane, Lao PDR.

van Gansberghe, D. and Pals, R. ed., 1993. Shifting cultivation systems in rural development in the Lao PDR. Proceedings of a workshop held at Nabong Agricultural College, July 14–16, 1993. UNDP, Vientiane, Lao PDR.

van Veldhuizen, L., Waters-Bayer, A. and de Zeeuw, H. 1997a. Developing technology with farmers: a trainer's guide for participatory learning. ETC, Netherlands, 224 p.

van Veldhuizen, L., Waters–Bayer, A., Ramirez, R., Johnson, D. and Thompson, J. 1997b. Farmers' research in practice: lessons from the field. Intermediate Technology Publications, London, 320 p.

Management of Trees for Animal and Wood Production in Upland Farming Systems

J. Brian Lowry[1]

Abstract

Existing information suggests that for considerable areas of the wet-dry tropics it would be possible to create an agroforestry system in which production of quality timber was combined with increased animal production. The essential feature of this system is the use of particular tree species at wide spacings in open grassland. These trees provide feed by (1) the dry-season fall of edible leaf, flower, or pod, and (2) by the tree canopy causing an increase in grass production and quality. Further animal production benefits would come from the moderation of seasonal extremes and the option of lopping part of the green canopy for drought feeding. Managing open-grown trees to obtain clear wood would require more management than for forage alone, but need not reduce forage production. Returns from wood production would depend on on-farm processing, the technology for which is increasingly available. Possible species for the Lao DPR include siris *(Albizia lebbeck)*, white siris *(Albizia procera)*, yemane *(Gmelina arborea)*, and raintree *(Samanea saman)*. A number of other species are also of interest and may well be found in the local flora.

THERE HAS been much consideration of the role of multi-purpose trees in the tropics. Usually this means trees for fodder with a number of other benefits such as fuel wood, fertiliser, or soil conservation. The practical application is best seen in the mixed garden system of West Java. However, there is a system that appears biologically feasible for *Imperata* dominated or degraded grasslands, yet is relatively untried. This involves tree species that have the potential to be grown at wide spacings for wood production while at the same time promoting animal production and restoring soil fertility.

Animal Production from Dual-Purpose Trees

This depends on considerably widening the concept of fodder trees, overcoming the assumption that trees can contribute feed only when animals browse green leaf, or it is cut and carried.

Deciduous leaf fall

The species of interest are obligately deciduous in the dry season, or else facultatively deciduous under prolonged dry conditions. In either case, the entire standing leaf crop becomes accessible to the grazing animal.

The suggestion that fallen tree leaf could make a useful contribution to grazing-animal nutrition is novel, as it has been assumed to have low feed value. However, in the tropics one must take account of the dry-season loss of feed quality in the grasses. When the rumen digestibility of fallen leaf from 27 native deciduous trees was compared with dry-season grasses in North Queensland (Lowry 1995) it was found in general to be more digestible than the grasses. However the fallen leaf has quite different nutritional characteristics (Kennedy and Lowry 1996). There is thus the contradiction of low digestibility and high intake, as was found for fallen leaf of *Albizia lebbeck* (Lowry 1989). Overall, it seems likely that utilisation of fallen leaf by grazing ruminants occurs to a considerable extent in tropical rangelands. The paucity of published accounts and research is simply because it is not a conspicuous behaviour and no one has paid much attention to it.

Flowers and fruit

Depending on the species, annual production of flower or fruit biomass may be negligible or up to

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20 kg/tree. It may have high feed value or none at all. It may be shed at a time of year for it to be of little use, or at a time when it has high strategic nutritional value.

Promotion of pasture in the wet-dry tropics by tree canopy

It is generally assumed that because trees compete for water with grasses, they will have an adverse effect on pasture. However, in northern Australia, it is very easy to observe that large isolated trees of *Albizia lebbeck* sometimes have a zone of enhanced pasture growth below the tree canopy. This is not an optical illusion. In North Queensland early wet season yields of grass dry matter were 82% higher under the canopy in grazed areas and 127% higher in an ungrazed area (Lowry et al. 1988). Apart from the question of relative overall dry-matter production, it was noted that grass below the canopy remained green and continued growing for up to two months after that in the open had died off, and that, at the end of the dry season, there was a more rapid response to rain from grass below the canopy. In addition, it has been found that grass associated with the canopy in North Queensland had digestibility 5–10 units higher than that in the open, and maintained quality for 6–8 weeks longer at the onset of the dry season (Liano 1990).

A fuller discussion of this aspect, and the mechanism by which it happens, can be found in the report by Lowry and Seebeck (1996). However, key references on the ecophysiology of grass enhancement by tree canopies in the African savanna are Belsky (1992 1994), and in Australia, on the effect of shade alone, showing that some grasses can be more productive under 50% shade, is Wilson (1996).

Overall, these results suggest that it is possible to devise agroforestry regimes for the seasonal tropics in which the trees will not only increase total pasture production but also prolong the period of higher pasture quality. It is also possible to indicate the conditions under which positive effects can be obtained: strongly seasonal climate, medium dense tree canopy (40%–60% transmission), medium to low fertility soils, and preferably but not necessarily a nitrogen-fixing tree species. Naturally, a major long-term effect will be improvement of soil condition in the sub-canopy area, so this system is also a strategy for rehabilitating degraded grasslands.

Wood Production from Dual-Purpose Trees

There are a number of tree species well recognised as fodder trees, that are, sometimes in a quite different context, also known as a source of quality timber. Normally, these uses would be somewhat exclusive. Fodder would be browsed or collected from wayside trees that would be of little use for timber. Quality timber would come from trees in forests or forest plantations that would provide little feed for livestock. It has been suggested that large isolated trees in grassland can promote animal production in the ways outlined above. The question is, can these trees be managed for quality timber? Trees growing in the open will tend to adopt a multi-branched spreading habit, and this is the aspect that requires active management. Pruning open-grown trees to obtain a good stem form is now a well-established practice in Australia and New Zealand, the number of species to which it has been applied is growing, and there seems no reason why any species of interest in the Lao DPR should not be managed similarly. The technology is simple, with labour costs less of a constraint. Developments in mobile milling technology mean that timber of precise dimensions can be cut from the log in situ (Lowry and Seebeck 1996). This avoids the use of heavy transport and allows the economic utilisation of small volumes of wood.

Notes on Particular Tree Species

The siris tree–*Albizia lebbeck*

Siris is a medium to large tree, found throughout much of Asia. It is of multi-stemmed widely spreading habit (to 30 m diameter, 20 m high) when grown in the open, but capable of good log form in plantation. The tree is fully deciduous in the dry season.

Large trees can boost animal production in all three ways noted here: as a feed, as a supplement, and by improving grass quality. Results of analyses and actual feeding experiments are reviewed in Lowry et al. (1994). The fallen leaf is of surprising value because of the high voluntary intakes shown by sheep. Fallen flower is an excellent feed. The value of siris as a supplement in extensive grazing systems would be that leaf, flower and pod drop sequentially during the dry season and can be utilised directly by grazing animals. In mature trees, leaf, flower and pod fall in comparable amounts (Lowry 1989) and can total 100 kg. The wood is of recognised value, and is exported to Europe as East Indian Walnut. A recent summary of timber properties is that of Keating and Bolza (1982).

White siris–*Albizia procera*

This species has a wide distribution through tropical Asia in savanna and deciduous forest habitats. It is regarded as a good fodder tree for all ruminants, the leaves being highly palatable and high in protein (Parrotta undated). However, there does not appear to be any published result from an actual feeding trial. Like siris, it is deciduous and the fallen leaf would be expected to have similar feed value. Leaf is the only feed supplied from the canopy. The biomass of the flowers is insignificant, while the pods are produced much more sparingly than siris. Isolated trees would be expected to have a promotional effect on pasture like that of siris and this appears to be happening with wayside trees but this has yet to be investigated. The wood has been described as follows: '*The timber is strong, elastic, tough and hard. Compared to teak it is 10% stronger in modulus of elasticity, 25% more resistant in compression parallel to the grain, and twice as hard . . . The heartwood is moderately durable . . . Moderately hard work and saw by hand, but the wood planes to a smooth surface more readily than* A. lebbeck *due to the less oblique grain angle . . . Uses: furniture, and table and counter tops*' (TRADA 1979).

Yemane–*Gmelina arborea*

This is a well-known timber tree of India and Burma. The suggestion that it could have a dual-purpose agroforestry role is novel and arises from observations of its leaf phenology in Townsville. The trees were completely deciduous in the late dry season, the large membranous leaves forming a considerable carpet on the ground. This fallen leaf turned out to have a 24-hour intraruminal digestibility of 80%. This was quite improbably high, but has since been confirmed. A single publication from India reports a feeding trial (Majgaonkar et al. 1987) in which the leaf had a dry matter digestibility of 57%, a crude content of 11.5%, and the protein was 55% digestible. Animals showed a very high dry-matter intake of 2.6% body weight, indicating it was palatable as well as digestible. All these parameters indicate the leaf is an excellent feed. These results suggest that if yemane was grown at wide spacings in pasture in the wet-dry tropics, there would be a substantial dry-season leaf fall with a digestibility so high that it could be regarded as an energy supplement. The plantation-grown timber is described as: '*. . . one of the best and most reliable timbers found in southern Asia. The sapwood is not distinct from the heartwood, yellowish brown, lustrous, with a smooth oily feel . . . works readily to a smooth finish and takes stain and polish well*' (TRADA 1979).

Rain tree, monkey pod *Samanea saman* (*Albizia saman*)

This is an excellent shade tree in much of the tropics. The timber is best known for wooden handicrafts but has a range of uses. The rain tree has been already documented as a fodder tree (NAS 1979). This is mainly in relation to a high production of nutritious pods. However, the species is also deciduous in August-September and has quite large leaflets. When the fallen leaf was fed to sheep it had a very low digestibility but this was offset by a surprisingly high intake (Lowry 1995). The material would probably be utilised if falling into mature pasture. The rain tree is also one of the species that can unequivocally promote grass growth (Jagoe 1949).

White cedar–*Melia azedarach*

Clear wood from white cedar is of very high value. The tree is found over a very wide range of habitats, including semi-arid areas. The leaf has an exceptionally high digestibility (Vercoe 1986) and is known as a fodder tree in India. In drier areas of Queensland, it has been said to be fed to dairy cows (Everist 1986). White cedar is conspicuously deciduous but the leaf drop occurs rather early in the dry season and this may detract from its feed value.

Leucaena–*Leucaena leucocephala*

Leucaena is usually hedged or otherwise managed for browse, and the question of sawn timber production does not arise. However, in the search for new lines, one of the most productive ('Tarang', K636) proves to be strongly arboreal (M. Shelton, pers. comm.). This opens the possibility of using it in a dual-purpose regime.

References

Belskey, A.J. 1992. Effect of trees on nutritional quality of understorey graminaceous forage in tropical savannas. Tropical Grasslands, 26, 12–20.

Belskey, A.J. 1994. Influences of trees on savanna productivity: tests of shade, nutrients and tree-grass competition. Ecology, 75, 922–932.

Everist, S.L. 1986. Use of Fodder Trees and Shrubs. Information Series QI 85015. Queensland Department of Primary Industries, Brisbane.

Jagoe, R.B. 1949. Beneficial effects of some leguminous shade trees on grassland in Malaya. Malayan Agricultural Journal, 32, 77–87.

Keating, W.G. and Bolza, E. 1982. Characteristics, Properties and Uses of Timbers. Vol. 1. Southeast Asia, Northern Australia and the Pacific. Division of Chemical Technology, CSIRO. Inkata Press, Melbourne.

Liano, J. 1990. Tree legume canopy effects on pasture production and quality: The case of *Albizia lebbeck*. Thesis, James Cook University, Townsville.

Lowry, J.B. 1989. Agronomy and forage quality of *Albizia lebbeck* in the semi-arid tropics. Tropical Grasslands, 23(2), 84–91.

Lowry, J.B. 1995. Deciduous trees: A dry-season feed resource in Australian tropical woodlands? Tropical Grasslands, 92, 13-17.

Lowry, J.B. and Seebeck, J. 1996. Trees for wood and animal production: Assessment of the potential for an agroforestry system for the wet-dry tropics based on trees that support both wood and animal production. Rural Industries Research and Development Corporation, Project CSZ-1A, Final Report. 77 p. Unpubl.

Lowry, J.B., Lowry, J.B.C. and Jones, R.J. 1988. Enhanced grass growth below canopy of *Albizia lebbeck*. Nitrogen Fixing Tree Research Reports, 6, 45–46.

Lowry, J.B., Prinsen, J.H. and Burrows, D.M. 1994. *Albizia lebbeck* — A promising forage tree for semi-arid regions. In: Gutteridge, R.C. and Shelton, H.M., ed, Forage Tree Legumes in Tropical Agriculture. CAB International, 75–83.

Majgaonkar, S.V., Patil, S.S. and Toro, V.A. 1987. Chemical composition and nutritive value of *Gmelina arborea* tree leaves. Indian Journal of Animal Science, 57, 1235–1236.

NAS (National Academy of Sciences) 1979. Tropical Legumes: Resources for the Future, Washington, D.C.

Parrotta, J.A. (undated). *Albizia procera* (Roxb.) Benth. White Siris, Tall Albizia. Institute of Tropical Foresters, SO–ITF–SM–6. 4 p.

TRADA (Timber Research and Development Association) 1979. Timbers of the World, Longman Inc., New York.

Vercoe, T.K. 1986. Fodder potential of selected Australian tree species. In: Australian Acacias in Developing Countries. ACIAR Proceedings Series No. 16, ACIAR, Canberra.

Wilson, J.R. 1996. Shade-stimulated growth and nitrogen uptake by pasture grasses in a sub-tropical environment. Australian Journal of Agricultural Research, 47, in press.

Bioeconomic Modelling to Assess Possible Improvements in Upland Animal Production Systems

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Abstract

Shortening fallow lengths decreases farm profitability within shifting cultivation farming systems and makes such systems unsustainable, due to soil degradation. Although this is a widely accepted view, the lack of long-term data hinders empirical analysis of the issue. The need for a reasonable length of time-series data, quarantined from uncontrolled influences, virtually dictates the need for a modelling approach to the empirical analysis. Such an approach is followed here, making use of the SCUAF model. Economic and livestock dimensions are added to that model. A quantification of shifting cultivation systems for typical *Imperata*-dominated areas of Southeast Asia is undertaken. A particular example of an 'improved fallow', involving a *Gliricidia* plantation for soil quality enhancement and as a source of livestock feed, is then analysed. The potential of such a system to improve profitability and sustainability over the levels achievable with shifting cultivation is clearly revealed. With both the improved and unimproved fallow, animals can make a positive contribution to profitability, albeit with some additional soil degradation. However, the soil erosion consequences from animals were found to be far less severe than those from cropping. A modelling approach to address these issues has certain advantages, especially where existing models can be adapted at low cost. Data for modelling were obtained from farmer surveys, experiments, or researcher estimates. Modelling and field experimentation are complementary and can be interactive.

Bioeconomic Modelling and its Advantages

Bioeconomic modelling is a form of analysis that combines an appropriate mixture of biological and economic realism. It is usually computer-based for ease of calculation. Modelling can be undertaken either in an optimising framework, or in a simulation framework. A conventional economic budgeting exercise might be regarded as bioeconomic modelling, but most economic budgets do not include much biological detail.

Compared to field experimentation, bioeconomic modelling has two major advantages. It is relatively inexpensive, and can produce results in a short period. In Laos, bioeconomic-modelling expertise may be limited. However, standard computer spreadsheets can provide more than enough computing power as well as the flexibility to facilitate a good degree of realism. Alternatively, prototype models are often available for adaptation and use.

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In addition to providing analyses of specific issues, bioeconomic modelling provides a useful framework to enhance cooperation between economists and biologists.

A bioeconomic model

The core of the work described here is the model SCUAF (Soil Changes Under Agroforestry). Despite the name, SCUAF is quite a general model, and is not restricted to agroforestry applications (Young and Muraya 1990). SCUAF is a simple, deterministic model, designed to predict the effect of various tree or crop combinations on soils and commodity outputs, based on average-year climate and soil characteristics. It has the facility for long-run analysis, including details of soil parameters relevant to shifting cultivation in the uplands, including erosion.

Two previous applications of SCUAF give confidence in the simulation capacity of the model. Vermeulen et al. (1993) used SCUAF to simulate soil nutrient dynamics and plant productivity for the

Miombo woodlands and adjacent shifting cultivation systems with maize in Zimbabwe. SCUAF was judged to provide reasonable predictions for maize and tree growth, although it had no facility to attenuate growth as the woodland approached maturity. The attenuation of growth is not important in this analysis, due to regular harvesting and the short growth cycle. In the second case of hedgerow systems in the Philippines, Nelson et al. (1996a) compared the results from SCUAF with the results from a more complex dynamic process model, APSIM. They found SCUAF produced similar estimates of trends in medium term yield. However, SCUAF is an average year model, which abstracts from seasonal conditions. Short-term yield fluctuations cannot be predicted.

No economic or animal components were explicitly included in the original versions of SCUAF. Instead, the inputs and outputs of SCUAF were incorporated by the authors of this paper into a companion spreadsheet that contains information on those economic and animal components. These structures of the modelling framework and data sources are presented in Figure 1.

Bioeconomic Analysis of Shifting Rice Cultivation on a Typical *Imperata* Grassland Site Without Animals or Fertiliser (Indonesia)

The SCUAF model was used to trace changes in soil and other site characteristics, under a range of shifting cultivation regimes, for 'typical' Southeast Asian sloping upland site conditions (Menz and Grist 1996). This research focused on smallholder annual rice cropping/*Imperata* fallow systems in Indonesia, for a range of land availabilities.

Carbon and nitrogen in the soil profile are affected by erosion, uptake by plants and recycling of plant material. By simulating these parameters, SCUAF first predicts changes in soil fertility, and then changes in crop yield and *Imperata* biomass over time. The economic spreadsheet is then brought into operation to calculate the fallow length that gives the greatest economic return.

With reductions in land area availability, the economically preferred fallow lengths are reduced

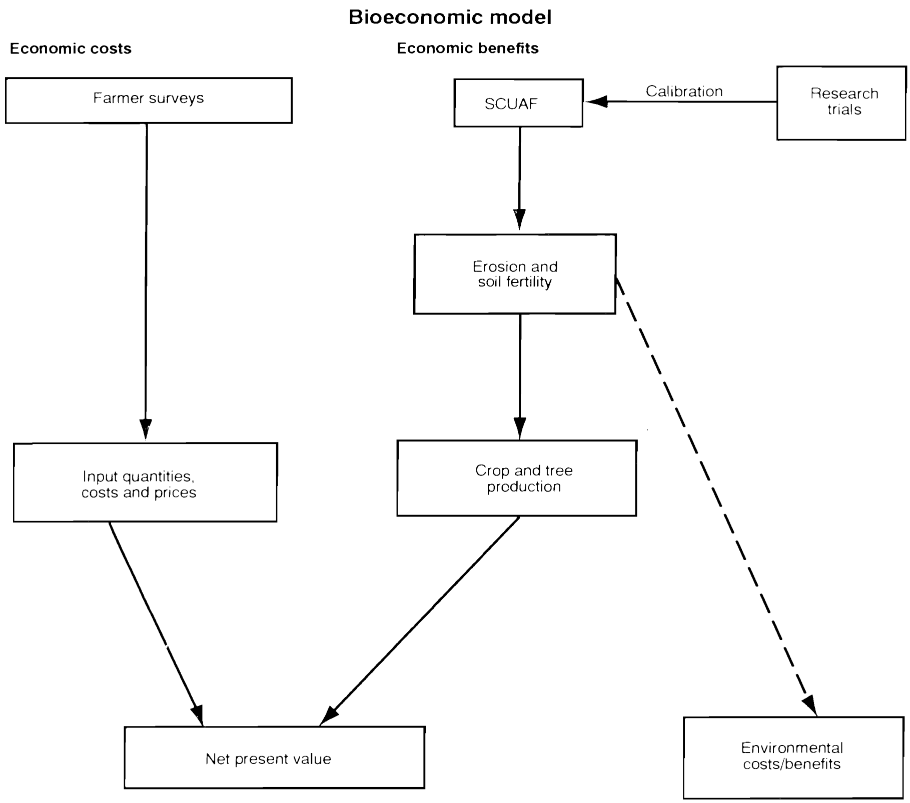


Figure 1. Processes of the bioeconomic model.

(from a 20-year initial point in the analysis). Economic returns fall with declines in land area availability. For fallow lengths below seven years, economic returns began to fall dramatically (Figure 2). The explanation is revealed in terms of total soil loss and soil carbon and nitrogen losses (not shown here), which are reflected in reductions in crop yield (Figure 3).

All fallow lengths below 20 years result in unsustainable rice yields — dramatically unsustainable for fallow lengths of seven years or less. However, for most smallholders, it is not an economic proposition to reduce cropped area to the low level required to maintain the 20-year fallow length associated with sustainable yields and soil parameters. For example, farms of five hectares can achieve four times the level of profitability with a two-year fallow as they can with a 20-year fallow (Table 1). This is so, despite the negative implications of the two-year fallow for biological sustainability.

Thus, an economic imperative exists for upland smallholders to engage in shifting cultivation systems that are patently unsustainable. In the absence of the application of new technology or inputs, most of

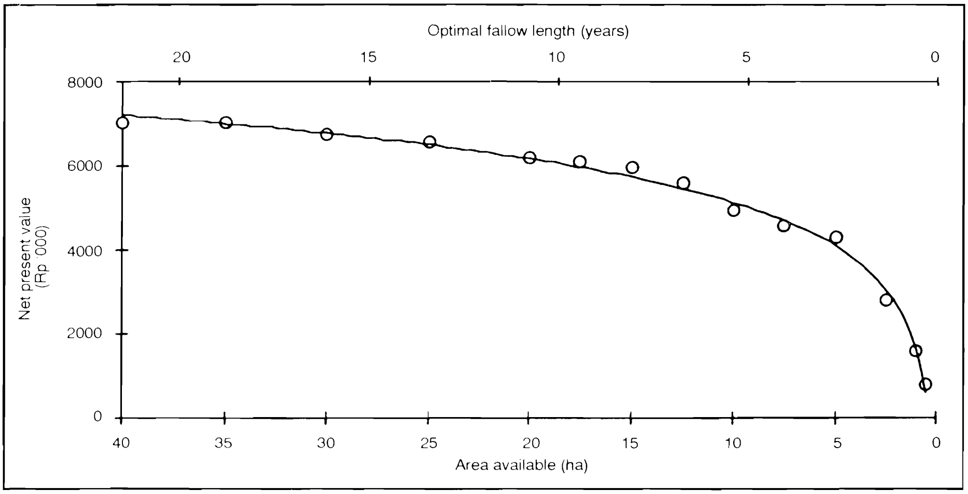


Figure 2. Net present value and the economically preferred fallow length corresponding to various land area availabilities.

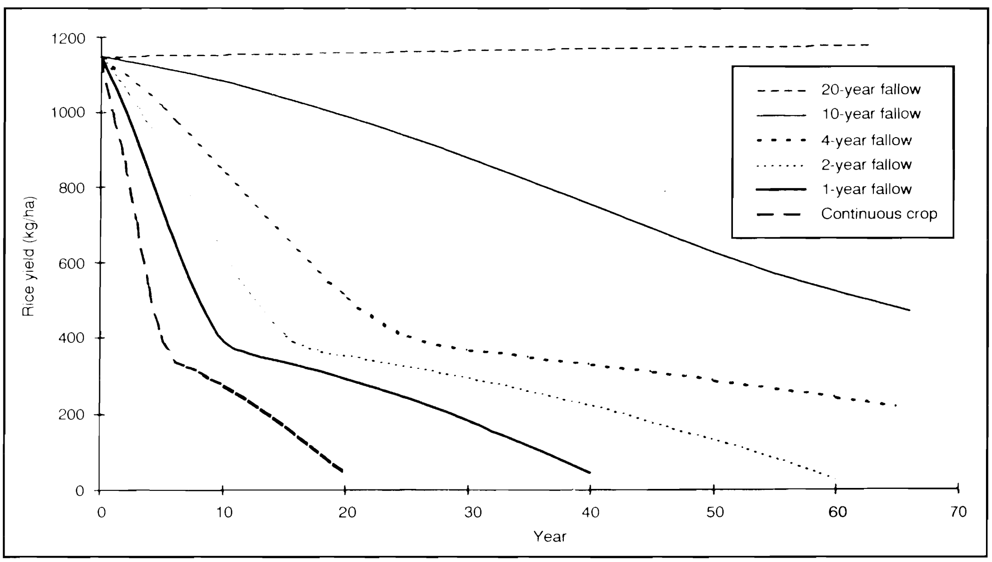


Figure 3. Annual rice yields corresponding to various *Imperata* fallow lengths.

these upland smallholder farms will cease to be viable.

Table 1. Profitability comparison between economically optimal fallow length and biologically sustainable fallow length (for a five hectare farm).

	Fallow length (years)	Profitability* (Rp '000)
Economically optimal	2	4260
Biologically sustainable	20	1065

*Profitability is the economic returns to land and labour — no costs have been assigned to either in the calculations. The interest rate used to discount future cost and revenue streams was 12%.

Improving Shifting Cultivation Systems — the Role of Fodder Crops and Animals (Northern Mindanao, Philippines)

Can sustainability *and* profitability of shifting cultivation systems be enhanced? This question was addressed via modelling a range of upland farming systems at Claveria, Northern Mindanao, Philippines.[2] Information on a range of possible interventions to improve fallows was available at that location. Only one particular form of intervention is examined here — a *Gliricidia* plantation fallow, with and without animals. Analyses of other systems are reported elsewhere (e.g., Nelson et al. 1996a, b).

The baseline: five-year *Imperata* fallow/one year maize cultivation, initially without fertiliser or animals

The baseline for comparison was a five-year *Imperata*/one-year maize shifting cultivation system. In traditional shifting cultivation systems, the fodder available for cattle consists mainly of grasses such as *Imperata* and crop residues. These are generally of poor quality, limiting the number of animals that can be supported (Nitis 1985). Without either an animal or fertiliser component, this system was found, using the modelling framework outlined above, to be marginally profitable at prevailing input and output prices (Table 2).

Table 2. Profitability of introducing cattle within a shifting cultivation regime for a 2 hectare farm, Claveria, N. Mindanao, Philippines[3]

Number of cattle	NPV per hectare ('000 pesos)
0	1950
1	8390
2	9850

In this case profitability was calculated net of labour costs (cf. Table 1). In both Tables 1 and 2, a discount rate of 12% was used to bring future values to present values.

Adding an animal (livestock) to a five-year *Imperata*/one-year upland rice system is quite profitable, while adding the second animal is less so (Table 2). A small-holding of about two hectares usually supports from zero to two animals (Franco et al. 1996), typically with low productivity (Moog 1991). The addition of the second animal reduces the soil-restoring capabilities of the *Imperata* fallow. This is reflected in a reduced crop yield and crop revenue.

Intervention via a *Gliricidia* plantation fallow for soil fertility improvement and fodder

The potential of an improved fallow component within a shifting cultivation system was recognised by Garrity (1993) and MacDickens (1990). Planting leguminous trees in fallow periods offers potential to

[2] Claveria is a municipality of Misamis Oriental, Mindanao, 40 km northeast of Cagayan de Oro. It lies in an undulating plateau between a coastal escarpment and a mountainous interior, ranging in elevation from 200 to 500 metres above mean sea level. Soil from Claveria is classified as acid-upland (fine mixed, isohyperthermic, Ultic Haplorthox) with a depth of more than one metre. There are two pronounced seasons in the area: wet season (May to October) and dry season (November to April). The majority (79%) of the upland farms in Claveria are situated on moderate to steeply sloping land, thus soil erosion is a concern of the farmers. The dominant crop planted is maize. Maize production has prospered in Claveria because of its adaptability to local conditions and also as it is considered a staple food.

[3] In cattle grazing trials in the Philippines, Payne (1985) and Calub (1995) reported low productivity in cattle grazing Imperata — annual gains of around 50 kg per animal per year, or approximately 0.15 kg per animal per day. At current beef prices in the Philippines of 40 pesos per kg, this annual beef production is worth P40 × 50 or 2000 pesos per year. In this analysis, an average body weight of cattle of 300 kg is assumed. The average feed requirement is 2.3% of body weight (seven kilograms of dry matter per day, or three tonnes of dry matter per animal per year). The quantity of manure produced by cattle is approximately 40% of the dry matter ingested. Thus, for an animal fed three tonnes of dry matter per year, the manure produced is approximately 1.2 tonnes. As fodder passes through the animal, there is a significant change in its composition. The Bureau of Soils at University of Philippines, Los Baños, found that the carbon:nitrogen ratio of manure is 2.8%, or 1.1% of the dry matter fed to animals. This information was used in the modelling of the animal component of the system.

improve soil fertility and to provide wood products. *Gliricidia* foliage also has potential as a feed supplement for cattle.

The effects of improved animal and soil nutrition were analysed within the context of the SCUAF model. A diet for cattle, composed of 50% *Gliricidia* and 50% *Imperata* was assumed to be provided from the on-farm production of *Imperata* and *Gliricidia* leaf from a *Gliricidia* plantation. A weight gain of 0.52 kg per animal per day was taken to be the result of feeding with this particular mixture (Morbella et al. 1979). A two hectare farm size was assumed to be divided into six plots, or parcels. The number of *Gliricidia* plots required to supply the animal feed requirements depends upon the number of animals to be carried (Table 3). Although SCUAF does not directly model the animal enterprise, the biophysical effect of animals can be simulated by harvesting (removing from the system) the animal fodder requirements.

Each plot is rotated on a six year cycle, and two maize crops (wet and dry season) are planted per plot per year. Figure 4 presents a schematic diagram of the improved fallow system. Resources flow between the three land use types — *Imperata* fallow, *Gliricidia* fallow and maize crop. Three products are derived — cattle, firewood and grain.

Table 4 presents a summary of unit costs and unit returns for the *Gliricidia* fallow system with animals. These numbers were derived from farm surveys.

Modelled Results from Introducing a *Gliricidia* Fallow

Biophysical aspects

Improvements in soil fertility from a *Gliricidia* fallow can be observed pictorially in the modelled levels of soil nutrients (carbon, nitrogen and phosphorus) in Figure 5. (The top lines of each graph represent the 'without animals' scenario). The improved maize yield associated with this increase in soil fertility can be seen in the top line of Figure 6.

Feeding *Gliricidia* prunings to animals, rather than using them as mulch, removes nutrients from the system. Three animals per two-hectare farm (organised as indicated in Table 3) have a significant impact on the sustainability of the farming system, as only a small amount of *Gliricidia* is available for mulching. Soil nutrients are predicted to fall to

Table 3. Partitioning of land use for a *Gliricidia* fallow system with animals, on a two-hectare farm.

Number of animals	Maize		*Imperata*		*Gliricidia*	
	Area (ha)	Plots	Area (ha)	Plots	Area (ha)	Plots
1	0.33	1	0.33	1	1.33	4
2	0.33	1	0.67	2	1.00	3
3	0.33	1	1.00	3	0.67	2

Table 4. Unit costs and returns used in the analysis.

Labour cost of smallholder		₱40 / day	
Maize seed cost		₱6.50 / kg	
Maize grain value	Wet season	₱5.60 / kg	
	Average season	₱5.90 / kg	
Firewood		₱1,000 / tonne	
Cattle	Initial purchase	₱6,000	(150 kg @ ₱40/kg)
	Annual maintenance cost	₱1,882	
	Net annual change in Inventory value of cattle	₱7,600	(190 kg @ ₱40/kg)
Interest rate	Social opportunity cost	12%	
	Market borrowing rate	25%	

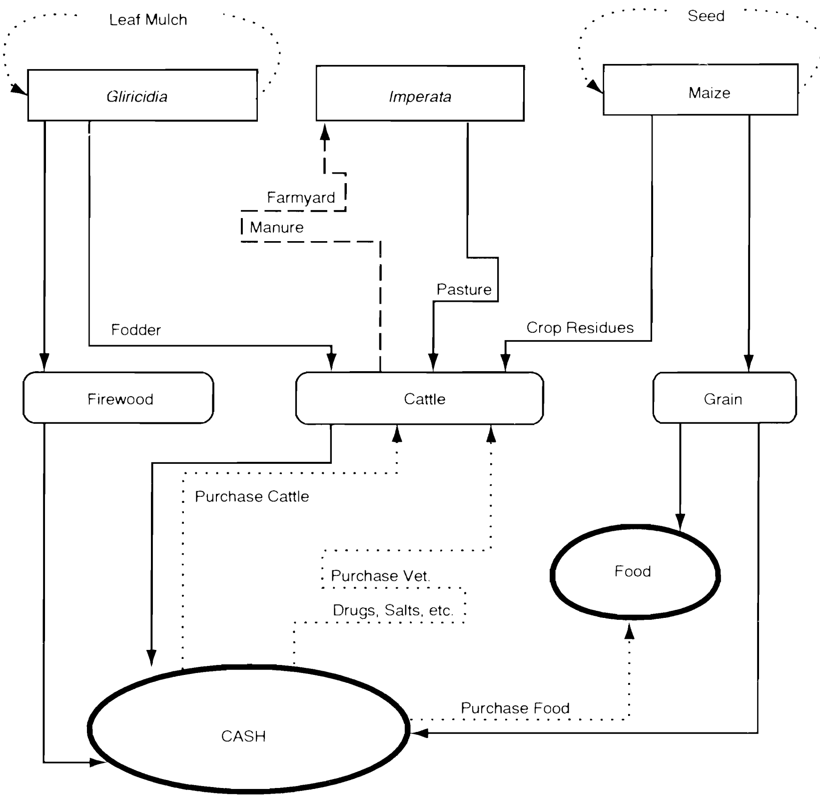


Figure 4. Flow of resources in the *Gliricidia* plantation fallow system with animals.

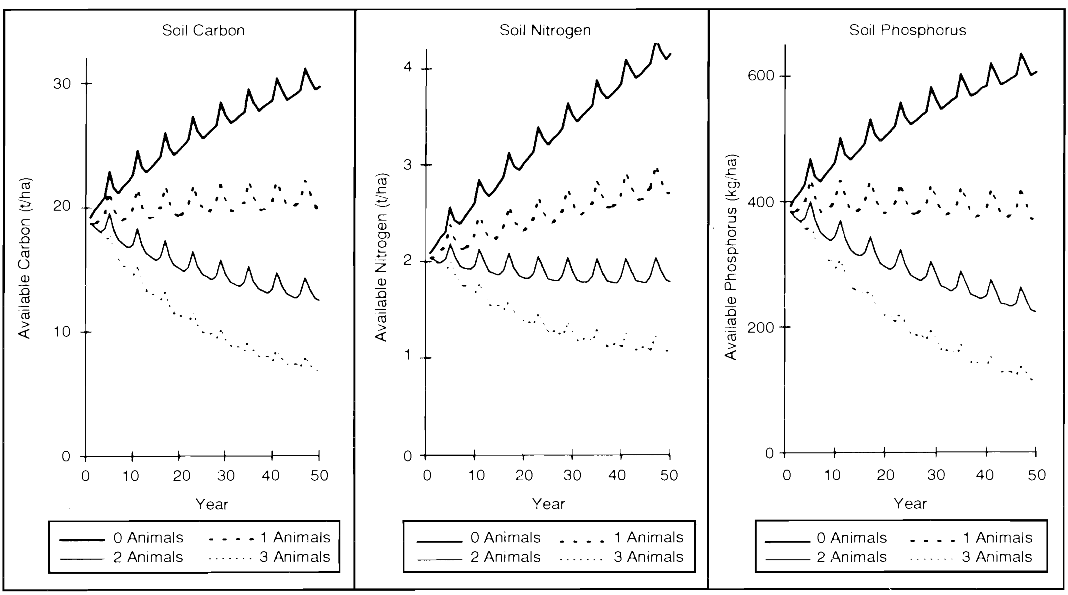


Figure 5. Change in soil nutrient levels with increasing animal numbers in the *Gliricidia* fallow system.

below 50% of their initial levels (Figure 5), and there is a 25% reduction in maize yield (Figure 6).

The introduction of cattle into the *Gliricidia* fallow system (with one crop per cycle) increases soil erosion by removing ground cover and nutrients from the system, making the soil more susceptible to erosion. Cumulative soil erosion, modelled over eight six-year cycles, is shown in Figure 7. The model predicts that each animal will increase total soil erosion by more than 75%. This effect of cattle on soil erosion is akin to the nutrient removal by crops — no direct effect of trampling by cattle was included in the model. The latter effect may be significant when stocking rates are high relative to feed supplies, but should not be an issue if stocking rates are within the limits set by feed supplies.

A comparison was made of the relative effects on soil erosion of cattle (Figure 7) and cropping (Figure 8). The latter shows that increasing cropping intensity has a greater effect on soil erosion than increasing cattle numbers. In Figure 8, 'number of

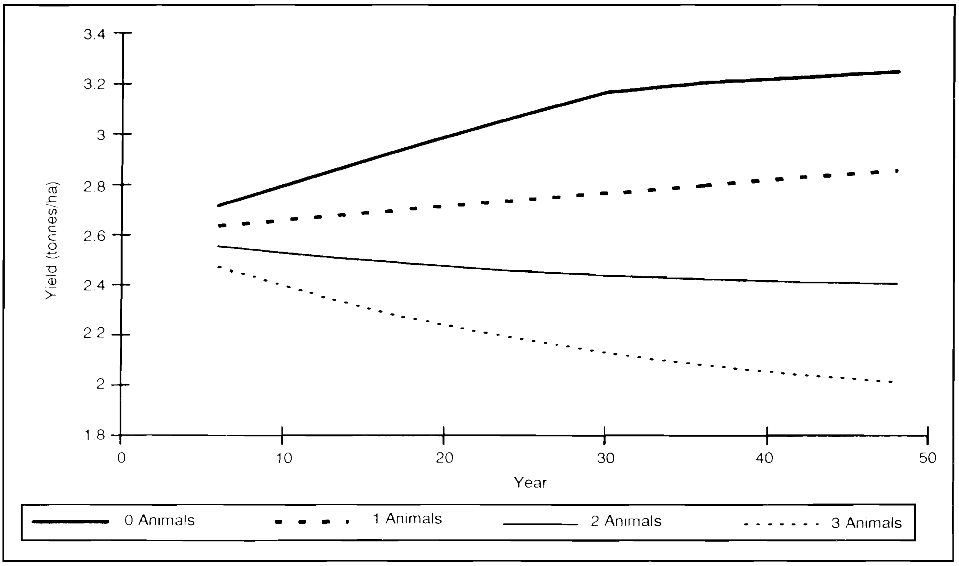


Figure 6. Change in maize yield with increasing animal numbers.

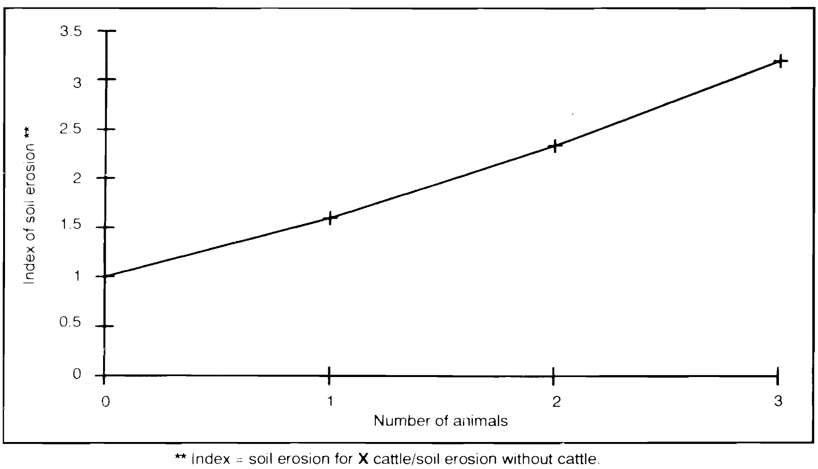
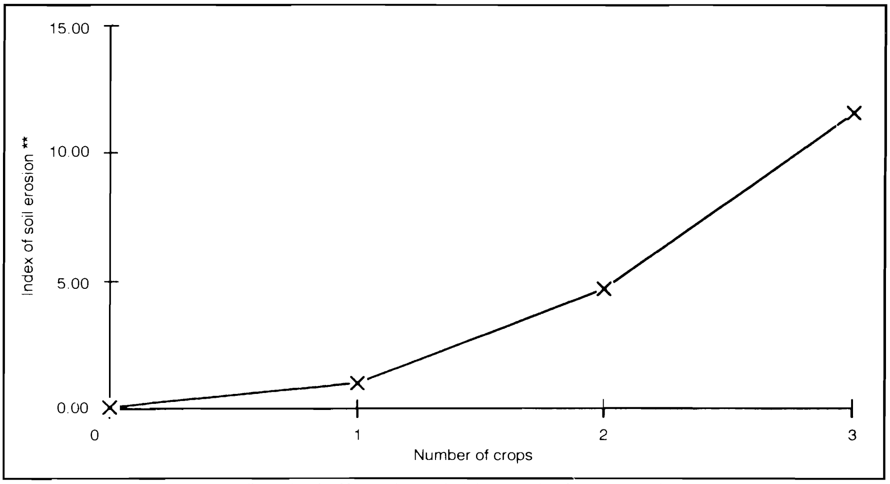


Figure 7. Relationship between the number of cattle and the level of soil erosion for the five year *Gliricidia* fallow/one year maize cropping system.



** Index = soil erosion for X cropping periods/soil erosion for one cropping period.

Figure 8. Relationship between the number of crops per crop/fallow cycle and the level of soil erosion for the five year *Gliricidia* fallow/one year maize cropping system.

crops' refers to the number of years of cropping (within a six-year crop/fallow cycle).

Economic analysis

The establishment of a *Gliricidia* plantation can increase revenue from the higher maize yield, complemented by returns from firewood. This result is relevant at prices currently perceived by smallholders in Claveria, and generally held even after simulating significant increases in the wage rate, or decreases in product prices (Grist et al. 1997).

Two discount rates were used in this analysis — a social opportunity cost and a market borrowing rate. An interest rate of 12% was chosen to represent the social opportunity cost of capital for the Philippine economy. A higher interest rate of 25% was also used. This was chosen to represent the market borrowing rate. It is based on an estimate of the borrowing interest rate, obtained from a farmer survey (Nelson et al. 1996b).

Given beef prices of ₱40/kg and a discount rate of 12%, the *Gliricidia* fallow system is more profitable with animals included. When compared to the no animal case, net present value increased by 50% with one animal, 110% with two animals, and 170% with three animals. However, even without animals, a *Gliricidia* fallow is far more profitable than a shifting cultivation system based on an *Imperata* fallow (Table 2).

These calculations are based on a discount rate of 12%, which may approximate the social opportunity cost of capital. Actual interest rates facing farmers in Claveria are between 16% and 30%, with 25% seen as the most representative interest rate for borrowing (Nelson et al. 1996b). At this discount rate, the overall profitability of the *Gliricidia* fallow and of introducing animals into that system is reduced. However, the general trends shown in Table 5 are maintained.

A barrier to the adoption of the *Gliricidia* fallow system could be the initial income losses during the transition period. Analysis by Grist et al. (1997) indicated a loss of approximately ₱850 in the first year of the transition period between an *Imperata* fallow system and a *Gliricidia* fallow system (without animals). It would take four years for smallholders to recover this initial loss, and for cumulative profitability to become higher than with an *Imperata* fallow system. The inclusion of cattle within the *Gliricidia* fallow system increases these initial transition costs. Unless upland farmers can bear these initial losses, via using savings or borrowing money at reasonable rates, adoption of the *Gliricidia* fallow system will be difficult (more so with animals).

Summary and Conclusions

Shifting cultivation systems with short, unimproved fallows such as *Imperata*, are biologically unsustainable. Yet they are often undertaken for reasons of economic imperative. Animals can provide an economic return during the fallow period and seem capable of playing a positive economic role, even in an unimproved *Imperata* fallow situation.

Table 5. Total revenue, total costs and net present value for the Gliricidia fallow system, with and without animals.

Discount rate 12% Beef price, ₱40 kg		0 Animals (₱ '000)		1 Animal (₱ '000)		2 Animals (₱ '000)		3 Animals (₱ '000)	
Revenue									
	Firewood	47.4		37.4		27.7		18.3	
	Maize	57.0		48.8		46.1		43.4	
	Cattle	0.0		70.6		141.3		211.9	
	Total revenue		104.4		156.8		215.1		273.6
Costs									
	Maize/fallow system	46.9		44.4		41.9		39.4	
	Cattle	0.0		26.0		52.1		78.2	
	Total cost		46.9		70.4		94.0		117.6
Net present value			57.5		86.4		121.1		156.0

Improved fallows, such as *Gliricidia*, offer the prospect of income gains and enhanced biological sustainability. Those outcomes are enhanced by the introduction of cattle into the system (at a moderate level).

The introduction of cattle into a *Gliricidia* fallow system involves a trade-off between the amount of *Gliricidia* foliage used as mulch, and the amount fed to animals. Reducing mulch decreases soil fertility levels, and increases soil erosion (thus lowering plant yields). The rate of increase in erosion is approximately in proportion to the number of animals. Although at Claveria, erosion is low relative to other sites in the Philippines, maize and firewood yields are still affected. In other locations, where soils are more erodable, adding animals is expected to have more serious consequences for soil erosion and maize yields.

Limited availability of savings or restricted access to capital may make adoption of improved systems difficult. To encourage adoption by upland farmers, governments could consider policies that facilitate long term loans, or otherwise lower the cost of credit to upland farmers. However, even at prevailing interest rates of around 25%, the *Gliricidia* fallow system with cattle appears to be superior to traditional shifting cultivation systems in *Imperata* areas.

The *Gliricidia* fallow system was chosen as an example of an improved fallow system. It has not been extensively practised and the results presented here would require verification, or pilot testing in particular environments, before being promoted as recommendations. However once model templates of the kind presented here have been established, promising systems and management strategies can be tested with relative ease. This can be done in a manner that is far less expensive, and can give earlier results than traditional field experimentation. It is suggested that modelling at this practical level be conducted simultaneously, or at least interactively, with biophysical experimentation, as a two-pronged attempt to improve shifting cultivation systems.

References

Calub, A.D. 1995. Livestock in agroforestry systems. Paper presented at the First National Grassland Congress. Manila, Ecosystems Research and Development Bureau.

Franco, M.A., Reithmuller, P. and Smith, D. 1996. Characteristics of backyard cattle producers in the Philippines. Discussion Paper on the Philippines Beef Industry. Brisbane, Department of Economics, University of Queensland.

Garrity, D.P. 1993. Sustainable land use systems for sloping uplands in Southeast Asia. In: Technologies for Sustainable Agriculture. ASA Special Publication 56. Madison, American Society of Agronomy.

Grist, P., Menz, K. and Nelson, R. 1997. Multipurpose trees as an improved fallow: a bioeconomic analysis using SCUAF. Imperata Project Paper (1997/2). CRES, ANU, Canberra.

MacDickens, K.G. 1990. Agroforestry management in the humid tropics. In: MacDickens, K.G. and Vergara, N.T. Agroforestry: Classification and Management. New York, John Wiley and Sons.

Menz, K. and Grist, P. 1996. Changing fallow length in an *Imperata*/upland rice farming system. Imperata Project Paper (1996/6). CRES, ANU, Canberra.

Morbella, J.L., Pineda, C.I., Bulay, R.N., Castillo, A.C. and Moog, F.A. 1979. Utilisation of rice straw and Ipil-ipil in cattle fattening at Magalang, Pampanga. Philippine Journal of Animal Industry, 34, 81–87.

Moog, F.A. 1991. Role of fodder trees in Philippine smallholder farms. In: Speedy, A. and Pugliese, P.L. eds., Legume trees and other fodder trees as protein sources for livestock. Animal Production and Health Paper 102. Rome, FAO.

Nelson, R., Cramb, R., Menz, K. and Mamicpic, M. 1996a. Bioeconomic modelling of alternative forms of hedgerow intercropping in the Philippine uplands using SCUAF. Imperata Project Paper (1996/9). CRES, ANU, Canberra.

Nelson, R., Grist, P., Menz, K., Paningbatan, E. and Mamicpic, M. 1996b. A cost benefit analysis of hedgerow intercropping in the Philippine uplands using SCUAF. Imperata Project Paper (1996/2). CRES, ANU, Canberra.

Nitis, I.M. 1985. Present state of grassland production and utilisation and future perspectives for grassland faring in humid tropical Asia. In: Proceedings of the XV International Grassland Congress. The Science Council of Japan.

Payne, W.J.A. 1985. A review of the possibilities for integrating cattle and tree crop production systems in the tropics. Forest Ecology and Management, 12, 1–36.

Vermeulen, S.J., Womer, P., Campbell, B.M., Kamukondiwa, W., Swift, M.J., Frost, P.G.H., Chivaura, C., Murwira, H.K., Mutambanengwe, F. and Nyath, P. 1993. Use of the SCUAF model to simulate natural Miombo woodland and maize monoculture ecosystems in Zimbabwe. Agroforestry Systems, 22, 259–271.

Young, A. and Muraya, P. 1990. SCUAF (Soil changes under agroforestry). Version 4. Nairobi: ICRAF.

Problems and Opportunities for Livestock Production in Xieng Khouang Province: Field Observations 1993–1995

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Abstract

The major problem with large livestock production in the infertile, pine-tree grasslands of the Xieng Khouang Province is extreme phosphorus deficiency. Symptoms and procedures for identification and correction of phosphorus deficiency are outlined. The applicability of locally made bone-char and readily available fertilisers are discussed. Opportunities for the immediate improvement of large and small livestock at the village level in both the infertile and fertile areas of the province are outlined.

THIS PAPER reports on some aspects of the livestock component of the LAO/UNDCP/IFAD Xieng Khouang Highland Development Program. The period covered is November, 1993 to May, 1995. The Program was executed by UNDP/OPS.

The major initiative of the livestock component was a Cattle Bank. Native cattle cows were distributed to villagers; mature females weigh 150–180 kg and are more fully described by Bouahom (1993). The rationale for the Cattle Bank was to replenish cattle numbers which had been greatly reduced in the Province as a result of the Vietnam War. Xieng Khouang is a Government priority area for cattle development.

Other initiatives were the enhancement of the animal health service, the trialling of improved forages and farmer and technician training.

This paper is mainly concerned with the discovery and correction of extreme phosphorus deficiency in parts of the province. The improved forage programme is described elsewhere (Gibson 1996; Horne, these Proceedings). Other aspects of the project may be found in project reports. The paper concludes by listing some perceived opportunities for an immediate improvement in livestock production at the village level. The environment of Xieng Khouang is briefly described.

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Environment, Land-use and Animal Husbandry

Long-term climatic data are available for one station only in Xieng Khouang, that of Phonsavanh town (19° 53′ N, 102° 08′ E; 1100 m elevation). The average annual rainfall in Phonsavanh is 1484 mm, 89% of which falls in the six months from April to September. The average daily maximum and minimum temperatures are 25.6 °C and 15.3 °C. Frosts occur in the higher valleys during the middle of the dry-season. There are four major, obvious agro-ecological zones in the province:

The pine-tree grassland zone

This zone occurs mainly in the central west of the province between about 1000 and 1400 metres elevation. The zone is characterised by the presence of pine trees (*mai pek*) and by extensive grassland areas. The grasses are collectively known locally as acid grasses (*ya som*); they consist mainly of *Themeda* spp. (*ya chin chik*). Soils are mostly derived from siltstone, sandstone and shale. Soils are acid with a surface pH (in water) of about 5.0.

The main agricultural activity is rain-fed, paddy rice-growing in the shallow valleys. The uplands are not cultivated, but are used extensively for cattle grazing. The cattle are returned to sheds in the village each night. Manure from the sheds is placed onto the rice paddies. Villagers report rice yields of about two tonnes per hectare with manure and less without it.

The fertile valleys

This zone occurs throughout the province in non-pine tree areas from about 600 m to1300m elevation. The zone is characterised by the absence of pine trees; there are no extensive grassland areas. *Themeda* is not obvious. Oak and chestnut trees (*mai kor*) and bamboo occur. However, the non-cultivated areas are often covered with unpalatable semi-woody weeds e.g. *Chromolaena odorata*. Soils are generally derived from basic rocks (mainly limestone). Soils are slightly acid to alkaline (surface pH 6-8.5).

Rain-fed or irrigated paddi is grown in the valleys. The uplands are intensively used for shifting cultivation; maize and dry-land rice are the main crops grown. Cattle and buffalo are reared but are not generally brought back to sheds at night. Manure is generally not placed on paddies and the yield of unmanured paddi is reported to be 3–4 t/ha.

The high, fertile mountains

This zone occurs mainly near the borders of the province from about 1400 m to 1700 m elevation. This zone is similar to the fertile valley zone. *Bauhinia* trees are often obvious and there are often grassland areas sometimes with *Imperata cylindrica* (*ya kha*) grass dominance. Opium growing is generally an important cash-crop in backyard and shifting cultivation fields.

The dense forest

This zone occurs to 2600 m altitude. There is little agriculture or animal husbandry in this zone.

Strange Diseases of Cattle and Buffalo

Informal interviews were conducted in several villages in 1993–94. In pine-tree grassland areas, villagers often reported strange disease symptoms of cattle and buffalo for which there was apparently no cure.

Cattle, and more especially buffalo, sometimes developed lameness (*kha han*). Lameness was generally more obvious towards the end of the dry season. Lameness could be so extreme that animals could not walk and sometimes died. This was particularly important in ploughing buffalo which were needed in the early wet season for paddy preparation. Lameness was characterised by long hooves whereby the ends of the hooves would overlap. Lameness did not respond to antibiotic treatment. Lameness was also occasionally reported in pigs.

In the dry-season in pine-tree grassland areas, cattle and buffalo can often be seen eating or chewing non-food items such as rope, plastic shoes, rocks, scrap iron, cardboard, bones, etc. The rumen of dead animals will often contain large amounts of undigested rope, plastic, etc.

Farmers in the pine-tree grassland areas often reported an abnormal incidence of broken bones in cattle and buffalo. Animals would break bones while shoving one another, while jumping across small gullies and even while ploughing.

Cattle and buffalo were reported to sometimes suddenly die (within a few days) without any apparent symptoms except for lethargy. Even animals routinely vaccinated against *Haemorrhagic septicaemia* and blackleg died; antibiotics did not seem to be effective.

Calves born in the middle of the dry-season often died. Such calves were often born small in size and weak. Their mothers were thin and often produced little or no milk. Sometimes cows aborted. Cattle often had hunched backs (*lang kong).*

These diseases and symptoms were not reported from the fertile agro-ecological zones. Generally, there was more native grass available in both the wet and dry-seasons in the pine-tree grasslands than in the fertile areas so that lack of forage per se could not explain the incidence of the diseases. Farmers generally reported a calving percentage in cattle of about 80% and a weaning percentage of about 70% in fertile areas. By contrast, farmers from pine-tree grassland areas often reported calving and weaning percentages of about 60% and 40%. The production parameters actually achieved seemed to depend on the proportional access cattle had to surrounding fertile areas. Cattle banks operated by three projects in the pine-tree grassland areas also reported similarly poor production parameters. At May, 1995, the four oldest cattle bank villages of the Xieng Khouang Project which had been operating for 17–31 months had yearly average calving and weaning percentages of 42% and 33% (total 192 breeders). Twenty per cent of calves had died during this period.

Evidence of Extreme Phosphorus Deficiency

All of the above symptoms can be explained by severe phosphorus deficiency (Morrison 1959; Hall 1977; Minson 1990). The unexplained deaths may well be due to botulism poisoning from the ingestion of putrefied bones. Further evidence for extreme phosphorus deficiency includes the following:

Bone thickness

The long leg bones of about 10 cattle and buffalo cows that were killed at Phonsavanh abattoirs or in villages were cut transversely. The proportion of the bone cross-sectional area that was true bone was determined by measuring diameters of the whole bone and of the lumen (the hole in the centre of the bone). True (cortical)/whole bone ratios for animals known to be reared in pine-tree grassland areas were markedly less than those of animals reared in fertile areas. Ratios were as low as 0.54, indicating very severe phosphorus deficiency by the criteria of Little (1984). Animals reared in fertile areas had ratios of 0.7–0.8 which indicate very satisfactory phosphorus status.

Soil phosphorus content

Soil (0–15 cm depth) was analysed at the Incitec Laboratory in Brisbane from three sites. Two sites were in typical pine-tree grasslands. The third was in an abandoned opium field on limestone. Pertinent results are shown in the Table 1.

The grassland soils had much lower extractable phosphorus than the limestone soil. This was related to lower pH and exchangeable calcium in the grassland soils and a very high exchangeable aluminium content. In tropical Australia, Kerridge et al. (1990) reported that cattle liveweight gains were greatly decreased in areas of extractable phosphorus (0.5M Na bicarb) content less than 5 ppm.

Observations of forage introduction trials support the conclusion of very low available soil phosphorus in pine-tree grasslands. In pine-tree grasslands, renowned low soil phosphorus tolerant species such as *Andropogon gayanus* and *Stylosanthes guianensis* did not make satisfactory growth unless fertilised with phosphorus fertiliser. Unfertilised native and introduced forages in pine-tree grasslands often have an intense purple coloration on the older leaves suggestive of soil phosphorus deficiency. By contrast, the phosphorus demanding forage, *Desmodium intortum* cv. Greenleaf, made excellent growth in a limestone soil without phosphorus fertiliser.

Animal response

No quantitative measurements have been made on animal response to phosphorus supplementation. However, there have been numerous anecdotal responses.

Several farmers have been given either bone-char or triple-super-phosphate (TSP) fertiliser to feed to buffalo and cattle. Farmers consistently report that feeding 12 grams of phosphorus per day to buffalo as either bone-char for about 14 days or TSP for about 10 days results in a marked improvement in lameness. Buffalo that could not walk previous to feeding phosphorus supplement could graze in the field after been fed phosphorus. Feeding 6 grams of phosphorus supplement per day resulted in similar benefit to lame cattle. There are also anecdotal reports of phosphorus supplementation being of benefit to lame pigs and to the condition of cattle and buffalo when fed for longer periods over the dry-season.

Recent Occurrence of Extreme Phosphorus Deficiency

The pine-tree grasslands were greatly depopulated (of villagers and livestock) during the Vietnam War ending in 1975. Villagers report that the symptoms of extreme phosphorus deficiency have only occurred since resettlement. Villagers attribute symptoms to residues and ordnance from the War. However, since resettlement after the War, the human population density is much greater and much of the wetter and more fertile shallow valleys have been developed for wet-rice growing. Previously, cattle and buffalo made intensive use of the greener and better quality forage in the valleys in the dry-season. But now, the valleys consist mainly of dead rice stubble in the dry-season which may be assumed to be of greatly reduced phosphorus content. This is a possible explanation for the recent occurrence of very obvious deficiency symptoms.

Animal Phosphorus Supplements

Cheap, waste bones are available in Phonsavanh from either the abattoirs or from noodle shops (where the bones are used to make soup). The most practicable method of preparing bone-char appears

Table 1. Some soil analytical data (0–15 cm).

Zone	$pH_{1:5}$ soil:water	Extractable P (ppm) 0.5 M Na bicarb	0.01 N H_2SO_4	Exch. Al (% ECEC*)	Exch. Ca (meq/100 g)
Grassland	4.8	5	3	74	0.36
Limestone	5.7	23	43	0	5.52

* Effective cation exchange capacity.

to be the charring of bones in open fires (for example, during whisky distillation in villages). The charred bones can be easily crushed in traditional wooden rice-dehullers and passed through fly-screen mesh to obtain the bone-char.

The most readily available chemical phosphorus supplements in Xieng Khouang are TSP from Thailand and SSP (single-super-phosphate) from Vietnam. All three sources of phosphorus have been analysed at the Incitec Laboratory (with cadmium analysed by the Queensland Department of Primary Industries) and the results are presented in Table 2.

Table 2. Laboratory analyses of some phosphorus supplements.*

Supplement	N (%)	P (%)	Ca (%)	S (%)	F (%)	Cd (ppm)
Bone-char	2.8	12.4	26.4	0.04	NA	NA
TSP	NA**	20.3	16.0	1.3	1.9	11
SSP	NA	8.9	20.1	10.0	0.8	8

* Only one sample of bone-char was analysed. Two samples of TSP were analysed; each sample was a composite of grab samples from a few 50 kg bags of TSP. Only one sample of SSP was analysed; it was a composite of grab samples from 2 × 25 kg bags. The variation between batches is not known.

** Not available.

Villagers normally feed phosphorus supplement wrapped with a little salt in a banana leaf.

Fully charred bone may be expected to contain about 17% phosphorus (and negligible nitrogen) so that phosphorus content of locally made bone-char will be variable depending on the amount of heating. All three supplements contain appreciable phosphorus and calcium; SSP also contains appreciable sulphur which will be important especially for dry-season urea supplementation of cattle and buffalo.

A 300 kg cattle, either lactating or gaining a moderate amount of liveweight per day, requires about 6 grams of supplemental phosphorus per day to maintain body phosphorus content if reared in areas of acute phosphorus deficiency (McCosker and Winks 1994).

Excess fluorine is harmful to cattle and buffalo if fed for long periods of time (Morrison 1959; McCosker and Winks 1994). The recommended long-term maximum daily intake is 1 mg F/kg liveweight. A 300 kg buffalo, fed at 6 grams phosphorus supplement per day would ingest about 2 mg F/kg liveweight per day from either TSP or SSP. Thus, either TSP or SSP should not be fed alone at 6 grams of phosphorus per day per adult buffalo (or 3 grams for adult native cattle) for more than 6 months of the year. The safe level of TSP and SSP feeding is further reduced by the amount of fluorine in drinking water (and in other components of the feed).

Cadmium accumulates in kidneys and liver and is harmful to human health. The recommended maximum level of cadmium in supplements is 100 mg Cd/kg of phosphorus (McCosker and Winks 1994). SSP contains about 90 mg Cd/kg of phosphorus and TSP contains about 55 mg Cd/kg of phosphorus. Thus cadmium content in TSP and SSP should not cause serious harm to human health.

Bone-char does not contain significant contents of either fluorine or cadmium.

To May, 1995, farmers had fed about 1.5 tonnes of TSP and about 500 kg of bone-char to cattle and buffalo in Xieng Khouang. Some of the TSP had been purchased from retail outlets established by the project. However, farmers only readily paid for phosphorus when their animals showed very obvious symptoms of phosphorus deficiency (i.e., limping). Farmers were reluctant to purchase phosphorus (or to make bone-char) for routine supplementation.

Opportunities for Development

Clearly, no livestock nor forage development can be contemplated in the pine-tree grassland areas without phosphorus fertilisation of forages or phosphorus supplementation of grazing animals and pigs. Locally prepared bone-char and easily obtained SSP are the most practicable phosphorus sources. Routine phosphorus supplementation can be vigorously extended.

Once the phosphorus supply to animals is satisfactory, other improvements may be profitably promoted. Cattle numbers may be most conveniently increased in areas of few cattle by an improvement in weaning percentages which should result from improved phosphorus nutrition.

Soils of the province are very low in sodium (unpublished data) and a marked improvement in cattle and buffalo productivity can be expected from feeding salt routinely (Falvey and Mikled 1980). Twenty grams of iodised salt (39 ppm iodine) per adult cattle cow per day would supply adequate supplementary sodium and iodine.

The project successfully demonstrated the making of urea-treated-rice-straw in several villages. This may be usefully promoted in the dry-season for recently calved cows which would normally be fed untreated rice-straw. The feeding of urea-treated-straw may result in improved survival and growth of calves. Otherwise, the economic benefits of urea treatment may not be obvious to villagers.

Buffalo and cattle calf survival and growth should be greatly improved by routine anthelmintic drenching soon after birth. Kingston (1992) applied data from the Thai-German Animal Health Project to northern Laos and concluded that drenching with piperazine had a benefit/cost ratio of 79:1 for cattle and 69:1 for buffalo. Pigs and poultry would also probably greatly benefit from routine drenching.

The best opportunities for immediate extension of improved forages appear to be (Gibson 1996): back-yard plots of Gamba grass, Calliandra, Glenn joint vetch and Greenleaf desmodium as higher quality dry-season feed supplements in the infertile savannah zone (other species are also applicable in the fertile zones); rehabilitation of abandoned opium/resting shifting cultivation fields in fertile areas by oversowing with Greenleaf desmodium (see also Gibson 1983); establishment of dry-season areas of oats, vetch and persian clover in rice paddies with dry-season water (or, in high altitude fertile soils, in resting cultivation fields) to provide a high quality feed supplement.

The death rate of pigs and poultry is very high. There is great opportunity to greatly improve animal productivity by an improved vaccination program. Previous attempts by several projects to improve vaccination in Xieng Khouang have generally not been very successful. It is suggested that extension methodologies could be improved by following successful strategies adopted in other parts of Laos and in neighbouring countries.

References

Buoahom, B. 1993. Cattle production systems – results of the national survey. In: Proceedings of International Workshop on Cattle Production Systems at Nam Souang, Vientiane. Dept. Livestock and Veterinary Services/ IDRC/ACIAR

Falvey, L. and Mikled, C. 1980. Sodium and Phosphorus Studies of Rangeland Cattle in the Thai Highlands. In: Proc. First Asian-Australasian Congr. on Animal Science, Kuala Lumpur, Malaysia.

Gibson, T.A. 1983. Towards Ley Farming in *Imperata cylindrica* Grasslands in Northern Thailand. Mountain Res. Development, 3, 378–385.

Gibson, T. 1996. Forage Introductions in Xieng Khouang Province, Lao PDR. SEAFRAD News, Issue 3. Dept. Livestock and Fisheries, Vientiane.

Hall, H.T.B. 1977. Diseases and Parasites of Livestock in the Tropics. Longman, England.

Kerridge, P.C., Gilbert, M. A. and Coates, D.B. 1990. Phosphorus and Beef Production in Northern Australia. 8. The Status and Management of Soil Phosphorus in relation to Beef Production. Tropical Grasslands, 24, 221–230.

Little, D.A. 1984. Definition of and Objective criterion of Body Phosphorus Reserves in Cattle and its Evaluation *in vivo*. Canadian J. Animal Science, 64 (suppl), 229–231.

Kingston, J. 1992. Livestock and Fish Development; Suggestions of Development for 3 Northern Provinces. Dept. Livestock and Fisheries, Vientiane.

McCosker, T. and Winks, L. 1994. Phosphorus Nutrition of Beef Cattle in Northern Australia. Meat Research Corporation/Queensland Dept. Primary Industries, Brisbane, Australia.

Minson, D.J. 1990. Forage in Ruminant Nutrition. Academic Press, California.

Morrison, F.B. 1959. Feeds and Feeding. 22nd edn. Morrison, Iowa.

Animal Diseases in Upland Areas — The Development of an Animal Health Information System for Lao PDR

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INFORMATION on the disease status of livestock is critically important for a number of reasons. An understanding of the types of disease present and the levels of their occurrence is needed to help establish priorities for animal health programs. Measures of the economic impact of diseases are needed to justify expenditure on control programs. Knowledge of the distribution and epidemiology of diseases is needed to formulate sound disease control programs. Information on the presence and levels of major diseases is necessary to meet international disease reporting obligations of the OIE as well as to provide information to neighbours and potential trading partners. Reliable information on the number of livestock and the major problems present is needed for the targeting of governmental resources to those people that need them most.

An information system for animal health is therefore very important to enable government animal health policy decision-makers to be better informed and to have a clearer understanding of the disease situation. However, different forms of animal health information are needed not only at the upper levels of government but also at all levels of society, from the livestock owners to village veterinary workers (VVWs), district officers, provincial staff, central government veterinary authorities and the wider international community.

Animal health problems faced by livestock owners in upland farming systems are likely to be more significant, but this group has access to fewer veterinary services to address these problems due to their generally remote location. Information on the problems faced in upland farming systems is an important component of the national animal health picture, but it is more difficult to obtain.

Currently in Lao PDR, the amount and quality of information on diseases affecting animals from many parts of the country are inadequate to developing a realistic idea of the impact of diseases, or to formulating effective disease control programs. Efforts are currently underway to improve the quantity and quality of disease information.

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Passive Surveillance

Two keys to the current system of information collection are the use of disease outbreak reports from the provinces, and the use of information from diagnostic laboratory submissions sent to the Central Research and Diagnostic Laboratory in Vientiane. Due to infrastructure problems, these diagnostic samples are received almost exclusively from Vientiane Municipality. Outbreak reports appear from around the country, but are usually late and contain inadequate detail. The majority of disease outbreaks go unreported.

This type of reporting system uses passive surveillance, in which animal health authorities make no active efforts to discover the presence and levels of disease. Instead, they depend on the livestock owner or VVW to report a disease problem to district staff. This type of system is used by countries worldwide as the main source of disease incidence data. If working effectively, it can provide a great deal of useful information. However, all such systems suffer from a level of under-reporting, and as a result, they invariably underestimate the amount of disease present. In the case of upland farming, communications are often difficult and disease outbreaks may be impossible to report. The result is that passive surveillance figures may falsely indicate that there are few disease problems in these areas, compared to areas that are more accessible.

Factors that need to be addressed to improve the passive reporting system include:

- increasing the reporting rate;
- improving the quality of information contained in disease reports;

- increasing the number of laboratory specimen submissions to allow definitive laboratory diagnosis of disease problems.

Livestock owners, VVWs and district veterinary officers are the key links in the information chain. Public education campaigns on the importance of livestock diseases and the value of reporting them are needed for owners and VVWs. In addition, district officers need more training in disease outbreak investigation, specimen submission and disease reporting. To this end, a new disease report and specimen submission form has been developed for use by district officers to clarify what information is required when reporting.

Active Surveillance

Passive surveillance can provide information on which diseases are present in which parts of the country. It cannot provide reliable measures of the levels of disease (such as prevalence or incidence), nor can it provide any basis for claims of the *absence* of disease from a certain area. In order to gather reliable population-based information about disease prevalence or incidence, active surveillance based on statistically valid epidemiological surveys is needed. As its name implies, active surveillance means that veterinary authorities actively investigate the levels of disease in the livestock population. Information gathered in this way is much more reliable, and can give valid measures of the prevalence, incidence and economic impact of diseases. Surveys of this sort may be more expensive than passive surveillance systems.

Appropriate techniques for active surveillance have been developed in Thailand and Lao PDR. These techniques use a two-stage random sampling scheme to select animals. Blood is collected and analysed to produce estimates of seroprevalence to relevant diseases. A new technique using retrospective participatory village interviews and survival analysis allows incidence of village outbreaks of major diseases to be quickly and cheaply estimated. These active surveillance techniques have been successfully piloted in Vientiane Municipality, and there are plans to train provincial and district staff and to implement the techniques in three further provinces later in 1997.

Active surveillance requires a greater expenditure of effort, and higher skill levels by more staff than a passive reporting system, but gathers much better information. The main challenges to the national implementation of such a system are provincial and district staff training, and funding and infrastructure constraints. Survey teams need to be able to access remote areas for interviews and blood collection.

Information Management

Another constraint to the establishment of an effective animal health information system in Lao PDR has been problems with information management. Until recently, this has been conducted in an inefficient paper-based system. A new computer system has been developed for the entry, storage, analysis and reporting of a broad range of animal health information. The system is inexpensive and able to run on virtually any IBM-compatible computer. It integrates data on livestock populations, field disease reports, laboratory submissions, vaccination production and distribution, the village veterinary worker network, active surveillance, and livestock movement. It is also linked to a simple mapping program for the production of disease maps, and is able to be linked to a more sophisticated geographical information system.

With final implementation of this program, the management of disease information will no longer be a constraint. Instead, the challenge of the collection of disease information from the field will be the main obstacle for the future.

Conclusion

In this paper, there has been no reference to specific livestock disease problems in upland farming systems. The reason is that no reliable specific information on the levels and impact of these problems is available to the central veterinary services. To maintain and to improve the health and productivity of livestock in upland farming systems, it is necessary to understand the disease problems that exist. The collection of animal health information from remote areas will be a continuing challenge. However, it is hoped that the combination of improved passive reporting systems and effective active surveillance may soon provide a source of reliable, population-based information — information that will provide a basis for the formulation of a sound disease control program.

Summary and Recommendations

Summary

'Controlled grazing practices (timing, numbers of livestock etc.) which are optimal for both fallow management and livestock production have not yet been determined. On-farm studies are needed to develop grazing systems utilising improved fallows. Livestock and crop scientists will need to work together with farmers and village leaders to find systems that work'.

Keith Fahrney, Soulasith Maniphone and Onechanh Boonnaphol (in these Proceedings)

THIS Workshop was designed to be a review of progress at both research project and development project levels, towards the achievement of increased livestock production in the uplands of the Lao PDR. To this end, the Organising Committee brought together more than 70 invited participants from different scientific backgrounds and with different research and development project experience in Lao PDR and neighbouring countries. The Workshop was characterised by continuing lively discussions in the formal sessions, at coffee breaks, over meals and during the two days spent in the field in three working groups. The summary below is an attempt to record the main issues from these wide-ranging discussions.

As the Workshop proceeded, there was ready recognition of the challenges now confronting the Lao authorities in the uplands. In his opening speech, the Minister for Agriculture and Forestry, H.E. Dr Siene Saphangthong, emphasised his Government's concern with both the alleviation of poverty in upland farming communities and with the eventual elimination of 'slash and burn' cultivation. At the same time, the Government was concerned about long-term food security, the protection of natural resources, soil conservation and about sustainability in all its aspects. In subsequent discussions, participants recognised many considerations which influence the frame within which proposals and plans must be formulated. They include:

- The continuing rapid growth of the Lao population at 2.2–2.5% per annum, implying a near-doubling of the national population to about 8 million in the next 30 years; upland communities are likely to have even higher growth rates, with consequent increasing pressure on land resources and farming systems, unless massive net out-migration occurs.
- The extreme ethnic and linguistic heterogeneity of the Lao population (more than 60 separate ethnic groups), particularly in upland areas. The problems of cultural isolation for more remote communities are often compounded by their physical isolation, due to the mountainous terrain in much of rural Laos and the limited road system.
- The current transitional situation of swidden farming in the uplands, particularly in the northern region. In the past 20–30 years, the traditional rice-dominant swidden economy has come under a combination of pressures, leading to reduction in fallow length, declining soil fertility and lower yields. But now there is convincing evidence of ways in which many farmers are adapting their farming systems in order to achieve increased productivity, notably in areas favoured by better transport access.
- Even as upland farming is now gradually changing from subsistence-centred shifting cultivation towards small scale, subsistence-and-commercial agriculture involving livestock as a main component, food security remains a constant concern of farm households, as it does for regional and national authorities. In consequence, proposals relating to livestock production, rice production or any other on-farm developments (e.g., orcharding, vegetable production or the planting of teak trees) need to be considered within a 'household livelihood' or 'whole farming systems' approach (see Demaine in these Proceedings).
- The Lao PDR has experienced remarkable growth in its livestock sector in the 1990s and there is continuing promise for the years ahead, following implementation of the market-oriented New Economic Mechanism (1986) and in response to both domestic and export demand. Warr (these Proceedings), emphasised that in the period 1990–1995 the value of livestock production grew at an average annual rate of 6.4%, far outstripping the rate of population growth (2.2%), the growth of the crops sector (1.4%) and of rice production (1%). The future of the uplands looks even more promising, given the increasing changeover in the lowlands from animal power to hand tractors, and reduction in the numbers of cattle and buffalo.

Discussions of many issues continued after the Workshop. Staff from the Livestock Development Division, Department of Livestock and Fisheries (DLF) visited Luang Prabang, Xieng Khouang and

Oudomxai Provinces for discussions at district level, particularly about on-farm research (see below) and the possibilities for expansion of small livestock production among poorer households. Later in 1997, there were consultations with headquarters staff of the Lao Women's Union about their role in village-level small livestock production. Later also, there was discussion of the early progress being made in the ACIAR-funded 'animal diseases' project (ACIAR Project # 9438, noted further below), now being developed in conjunction with DLF.

In the conclusions below, references to particular authors are all to papers in these Proceedings unless otherwise stated.

Conclusions

Policy Issues

1. The World Bank's review (1995: 55–57) of the agricultural sector in Lao PDR drew attention to the proliferation of uncoordinated donor projects, the lack of a national strategy to guide donor projects and the weakness of the Ministry of Agriculture and Forestry (MAF) in policy formulation and the development of coherent sector strategies. Several years have passed since the World Bank Mission investigating the agricultural sector was in the Lao PDR (1993). By 1997, there was a firm Ministry policy for upland development and a sectoral 'Livestock Sub-Sector Policy Framework for Upland Farming Systems', both outlined at the opening session of this Workshop (Saphangthong; Phonvisay). Government approval has also been given (with the endorsement of the World Bank, the EU and several other foreign donors and NGOs) for an 'area-based' upland development strategy which will take account of particular combinations of opportunities and constraints in different geographic situations (Mr P. Parisak Pravongviengkham, Deputy Permanent Secretary, MAF, pers. comm.). Accessibility will be a critical factor.

Upland Farming in Transition

2. Laos, like Thailand and Vietnam in recent decades, is seeing its traditional, rice-dominant, swidden farming system in the uplands changing under a combination of pressures, as evidenced by increasing weed problems (with higher demands on farm labour), declining rice yields and shortening fallow periods. In consequence, many upland farmers are diversifying their farm production in various ways, including tree planting (notably teak in the northern provinces), the production of maize and other crops, and more emphasis on the production of buffalo, beef cattle, pigs, goats, poultry and fish. In doing so, they are using small-scale commercial livestock production as a means of intensifying land use and supporting increasing farm populations. As the process continues, feed resources are becoming critical. With respect to large ruminants (buffalo and cattle) this is leading towards increased 'backyard' fodder production and indigenous fallow management, and also to the risk of over-grazing in communal rangelands. There is scope for greater emphasis on small livestock, notably pigs, goats, chickens and fish, in the smallholder farm economy (Bouahom; Carson; Cheva-Isarakul; Rerkasem; Rambo and Cuc in the Proceedings), but much depends on the effectiveness of disease control and feed production.

'There are three requirements for expansion of upland livestock production: disease control, feed production and management.'

(Comment by a Workshop participant visiting Luang Prabang)

3. The first two requirements, specified above, are not in dispute. Villagers strongly agree with them (Pravongviengkham). They are both technological improvements, but the issues of 'management' are wide-ranging and more problematic. Certainly the first priority, if increased numbers of large and small livestock are to be produced, is the establishment of a more effective disease-control program, through vaccination and worming. High mortality rates of pigs and chickens are common, usually attributed (normally without laboratory verification) to Hog Cholera (HC) and Newcastle Disease (ND) respectively. Mortality rates are commonly much lower for buffalo and cattle, in outbreaks of *Haemorrhagic septicaemia* (HS) and Foot-and-Mouth Disease (FMD), but any deaths of the relatively high-valued large livestock are often immensely significant for smallholders having only a few head.

4. The national vaccination program, managed by DLF, clearly needs comprehensive reconstruction, province by province. Vaccines are produced in Vientiane and supplied on a cost-recovery basis, but cost is only one of a complex of factors that continues to limit the effectiveness of the program. Delivery of vaccine to the 17 provinces and then to districts and villages in good condition is the chronic problem. The main factor is the poor (but gradually improving) rural infrastructure, so that more distant villages are not well served. In addition, the cold chain delivery systems are sometimes broken down, particularly at the village end of the delivery system; para-veterinary staff (Village Veterinary Workers, VVWs) are inadequately trained and often poorly equipped. Moreover, inadequate farmer education

about livestock diseases leads to low vaccination rates (Stöber; Hansen; World Bank, 1995: 67).

5. Of equal priority, if livestock production in the uplands is to be expanded, is the development of feed resources to offset the dry season decline in communal grasslands and to meet the fodder needs of an increasing population of ruminants. Where survival rates of buffalo and cattle are improving, many households in northern Laos are turning to forage production (e.g., napier grass, *Pennisetum purpureum*), to provide supplementary feed in the dry season. Communal grasslands are also coming under increasing pressure. The 'Forages for Smallholders' project is a timely effort which encourages farmers to make their own decisions towards intensifying farm production, but it remains uncertain how significant fallow improvement of this kind will prove to be for village communities in the immediate future (Fahrney et al.; Horne; Pravongviengkham).

6. The implications of the shift towards livestock-centred upland farming are likely to be significant. Fodder production requires the farmer's labour and also requires fencing to keep buffalo, cattle and goats *in* or *out*. As the human population of villages increases, fodder production is likely to lead to competition with crops for the available land, leading sooner or later to alienation of communal grazing land and to individual land ownership. One consequence, already happening, is the breakdown of the traditional village regulatory systems which have managed land resources with a strong concern for equity between households (Pravongviengkham).

7. It is doubtful whether the intensification of upland farming will benefit the poorer 50% (or more) of households in most villages, unless special efforts are made. A major policy objective of the Lao Government is the alleviation of poverty in upland communities. Already there are marked economic disparities between households in many upland villages, with the wealthier households commonly owning a disproportionate part of the village herd of buffalo and cattle (Chapman 1995; Cohen; McLaren). In this context, it is inevitable that the main beneficiaries of an effective livestock vaccination program will be the relatively wealthy, rather than the poor. Similarly, poor households are unlikely to be keenly interested in fodder production opportunities, because they lack the means to own or buy buffalo and cattle and have more difficulty in obtaining access to farm credit. The repayment of loans is also a major problem, as project experience in Luang Prabang Province since 1991 has demonstrated (Sodarak; Va Ya; Souliyavongsy; Ditsaphone and Hansen).

8. It is clear that efforts to intensify production of large livestock in upland swidden systems are likely, sooner or later, to have complex economic and social implications. The problems may be less if more attention is given to pigs, goats, poultry and fish. Many upland smallholders now recognise the potential of small livestock, not least because of the lower capital investment required. In his four-district study area, investigated in 1996, Pravongviengkham (these Proceedings) found a strong preference for future household farming systems combining upland rice and fish (for subsistence), small livestock, maize and other cash crops. And yet, as Stöber found in village vaccination campaigns in Bokeo Province in 1996 (and others have found also), average vaccination rates for pigs and chickens were low. Despite vaccination campaigns, 7 out of 14 villages did not vaccinate any animals at all (Stöber).

The Significance of Foreign-funded Development Projects to Livestock Production?

9. In this decade, there have been more than 110 donor-assisted projects working in the agriculture and forestry sector in Lao PDR, commonly for 3–5 year periods in one or more provinces, rather than throughout the whole country. Some focused on livestock and improvements to the vaccination delivery system in particular provinces or districts, mainly in the early 1990s. Few projects focused on shifting cultivation, or the development of upland farming. Often the long-term legacy of these projects appears to have been small, but this is not an unusual situation. In three Workshop papers concerned with highland development in northern Thailand in the 1970s, 1980s and 1990s foreign-assisted projects are considered to have ignored opportunities for livestock in the earlier years; and it is reported that only recently villagers themselves have reassessed the importance of livestock in the rural economy (particularly cattle, pigs and chickens), often with the help of NGOs (Carson; Cheva-Isarakul; Rerkasem).

10. In the Lao PDR, in 1997, five continuing donor-funded projects appeared to have special significance for future upland livestock production. These were:

- the Shifting Cultivation Research Sub-Program (SCRS) in Luang Prabang, supported by the Swedish International Development Co-operation Agency (SIDA), described by Sodarak et al. (these Proceedings);
- the Lao-IRRI Northern Region Upland Crops Research Centre in Luang Prabang Province (Fahrney, Maniphone and Boonnaphol in these Proceedings);

- the CIAT/CSIRO 'Forages for Smallholders' Project funded by AusAID (Horne in these Proceedings);
- the ACIAR-funded project for 'Improved Diagnostic and Control Methodologies for Two Major Diseases (FMD and HC) in Lao PDR and Yunnan Province, PRC' (Cameron; also Westbury and Blacksell in these Proceedings);
- and the EU-funded project for ' Strengthening of Livestock Services and Extension Activities', approved in October 1997.

11. The EU-funded project (1998–2004) has seven components. Its central components provide for the establishment, nation-wide in Lao PDR, of an Animal Health Information System, together with support for three diagnostic laboratories, including the central laboratory set up by ACIAR-DLF in Vientiane in 1997. The project plans to reconstruct the vaccine delivery system in 30 districts of the northern provinces, mainly in Luang Prabang and Luang Namtha Provinces, before expanding about threefold in the last two years of the project. The combined effect of the EU and ACIAR projects should be to reduce dramatically the disease problem which plagues livestock production throughout the Lao PDR. Improvement of the delivery system for vaccines, including the further training of VVWs, will be critical.

12. Of the five major projects listed above, only two are clearly *national* in scope and both (the ACIAR-funded 'Animal Health' project and the EU-funded project) are focused on the reduction of livestock diseases. Within the next few years, the combined impact of these two projects could be reflected in large increases in the numbers of livestock throughout the Lao PDR. If so, how will these animals be fed? In the uplands, the 'Fodder for Smallholders' Project is directed specifically at more innovative farmers who are feeding ruminants, mainly in Luang Prabang and Xieng Khouang Provinces (Horne). The prospects, nationally, of reduced mortality rates for livestock are that over-grazing by large livestock may become a serious risk in some areas and that the potential growth of pig and chicken production (with special benefit for poorer households) will be curtailed if feed supplies are inadequate. There will be exceptions, of course: in favourable situations, notably in many Hmong communities at higher elevations (for example, in Nong Het District visited by a group of Workshop participants) a maize-pig farming system is already well established. More widely in the uplands, there is much less opportunity for cereal grain production to feed pigs and chickens. A satisfactory low-cost alternative which Gibson (1997) has recommended in Bokeo Province, with enthusiastic responses by Lao Soung smallholders, is the preparation of high-protein meal for pigs and poultry, using legume grains such as pigeon pea (*Cajanus cajan*) and black bean (*Vigna unguiculata*), supplemented by high-protein leaf (cassava, leucaena and sweet potato leaves), tubers (cassava and sweet potato) and rice bran. Pigeon pea and black bean (a vine) are easily grown on fallows after rice.

Beyond the Lao PDR: Reports on Livestock in Upland Farming Systems

13. The need for more attention to forage crop production in upland farming systems, as outlined above, was a common strand in Workshop papers reporting experience from other Southeast Asian countries, as well as the Lao PDR. In their papers on northern Thailand (Carson, Cheva-Isarakul, Rerkasem), on Vietnam (Rambo and Cuc) and on Indonesia (Potter and Lee), the role of livestock in livestock-and-crop farming systems in the uplands was seen as being 'squeezed' by the expansion of food crops and forestry, by mechanisation following the advent of 'walking tractors' and by the effects of globalisation leading towards a reduction of smallholder production of pigs and chickens. Nonetheless, as Dr Suchint Simaraks concluded in his valuable overview of the role of animals in farming systems in Southeast Asia 'the key to sustainable upland farming is maintenance of soil fertility' and this is best achieved by the 'integration of crops and livestock where manure can be used in combination with nitrogen-fixing crops (which) can sustain soil fertility while at the same time the nitrogen-fixing crops contribute fodder for livestock'. Dr Simaraks' emphasis on fodder crop production as a key area for applied research in the uplands, both on-farm and off-farm, was made in the first session of the Vientiane Workshop. His recommendation was reinforced in subsequent discussions, in several other presentations by participants and by field observations of Workshop groups visiting Luang Prabang District (Luang Prabang Province), Poukout District and Nong Het District (both in Xieng Khouang Province).

14. Implicit in the Workshop's recognition of the importance of increased feed production was optimism concerning the long-term future of livestock production in the uplands, notably for beef cattle and to a lesser extent for pigs, goats and chickens. Buffalo are now seen as a gradually diminishing breed, being displaced by 'walking tractors' in the lowlands and to a small extent in the uplands. This trend was first evident in Thailand in the mid-1980s, in southwest Yunnan in the early 1990s (Chapman

1995) and in Laos since the mid-1990s. Apart from the region-wide decline in buffalo numbers, better control of livestock diseases is of course essential if significant increases in other livestock are to be achieved. In that case, however, there is no doubt about the strong demand now and in the foreseeable future for beef, pork, chicken and goat. This is reflected, in the Lao PDR, in the continuing stability (1994–1997) of farm-gate prices for cattle and buffalo, in US$ terms; it is evident again in the persistent strength of the Vientiane market for meat; and it is evident in recent efforts by Luang Prabang, Luang Namtha and other northern provinces to restrict the 'informal' export of cattle and buffalo (or meat) to Thailand and Yunnan, in order to ensure continued supplies for local consumption. Even more spectacularly, the region-wide demand is evident in Thailand's massive cattle imports (mostly illegal) from Myanmar, believed now to be in excess of 500 000 head annually; and evident again in the smaller, legal movements of cattle across the Myanmar-Yunnan border, to help supply towns in western and southwestern Yunnan, and Kunming.

15. Workshop participants from Laos and neighbouring countries recognised that upland farming systems have been changing throughout the region in the 1990s, more in some areas than in others, and in response to a range of causal factors. Dr Kanok Rerkasem's paper is particularly interesting in this regard, tracing the transformation of mountain land use in northern Thailand over the past 20 years as intensification (including intensification of livestock production) has proceeded. At the other end of the 'transformation spectrum', Ramsay and Maclean reported the 'pioneer' level of livestock production in Ratanakiri Province, Cambodia, where those animals which survive the high incidence of disease are often destined for sacrifice. The livestock components of different farming systems vary greatly, often between and within villages. In this context, there was keen interest at the Workshop in the individual project and research reports for different areas of the Lao PDR, from Bokeo Province (Stöber), Luang Namtha Province (McLaren), Luang Prabang Province (Fahrney et al.; Hansen; Sodarak et al.; Pravongviengkham), Xieng Khouang Province (Gibson) and Huaphan Province (Bott). These reports differed in their focus and scale, but taken with the reports from regions outside the Lao PDR they emphasised *how little is known in detail of farming systems in the uplands as a whole, and of changes taking place from Myanmar to Vietnam and from Yunnan to Cambodia. The Lao PDR is central to this broad region.*

16. Recognising the important role that the uplands are likely to play in future livestock production in the countries of Indochina, under increasingly more intensive farming systems, it seems timely to begin a *Farming Systems Database (FSD) and Mapping Program*, centred on the Lao PDR. The database might begin in the Lao PDR by collecting primary and secondary information on farming systems and then be expanded using Participatory Rapid Rural Appraisal (PRRA) methods. The relevance of the database to an expanded 'Fodder for Smallholders' project, for example, would be to indicate areas where farming systems are under greater or less pressure, together with information on population and ethnic groups, livestock numbers and ownership, the incidence of health problems (for human and animal populations), ranges of household incomes and the movements of both people and livestock. It would become a basic tool for planning purposes. If, on first consideration, this concept seems altogether too difficult to implement, it may be appropriate to examine the *Agricultural Systems-Land Management Project for Papua New Guinea (PNG)*, funded by ACIAR, carried out mainly by the Department of Human Geography at the Australian National University, and largely completed in the 1990s. The description and analysis of agricultural systems and agricultural intensification in PNG began in a modest fashion in the 1970s and 1980s. A less ambitious and less detailed project is currently being planned for Vanuatu (Dr Michael Bourke, pers. comm.). There are broad similarities between the Lao PDR and PNG in area, difficulty of terrain, population numbers, population growth, ethnic complexity etc. There are major differences also, not least in the greater importance of livestock in the uplands of the Lao PDR.

17. The early value of a *Farming Systems Database* prepared in the 5 years 2000–2004 for the Lao PDR is seen to be:

- As a planning tool, indicating where farming systems are under special pressure (areas where there are relatively few livestock, few households with livestock, high livestock mortality, low yields of upland rice, low median household incomes etc.);
- As an information source for Government authorities on the progress of land use intensification, so leading to the reduction of swidden (shifting) cultivation;
- As an information source for Government authorities on the geographic incidence of rural poverty, and so helping development planning at local and national levels.

Tasks Ahead for Intensifying Livestock Production in the Uplands of the Lao PDR

18. In the next few years, the effect of the hoped-for technical advances for livestock production in upland areas, namely increased disease control and the development of feed supplies, will be to offer many smallholders financial rewards and greater security for intensifying livestock production. But what hope is there for smallholders who do not have the capital to buy buffalo or cattle, or even goats, do not have surplus cereal grain to feed to pigs, are not familiar with the preparation of high-protein meal for feeding to pigs and poultry (as described above) and are long accustomed to their chickens dying from Newcastle Disease and other causes?

To cope with these problems, who will advise smallholders on their farming options and services (e.g., farm credit) that will be needed? Who will monitor over-grazing and soil erosion, when livestock numbers build up? Who will be alert to market opportunities, even in relatively remote locations? Who will have contact with providers of better quality livestock for breeding purposes and in all these respects provide links between village chiefs, local communities and district-level services. To meet these needs a small force of Farming Advisers (extension agents) should be recruited, trained and supported, to work closely at district level with provincial veterinary staff, local communities, village leaders and VVWs.

Priorities

19. The Workshop's sponsors asked for guidance as to priorities for livestock development in the uplands in the next 5–10 years. In the Workshop discussions and in field visits, there was no attempt by participants to develop a rank order of priorities, although the first and second below would probably have topped any list. Other proposals, for example, proposals for breed improvement of cattle and pigs in the provinces before the disease and feed problems have been greatly reduced, and using animals untried in Laos, would certainly have been questioned.

- **Improving animal health and survival.** Earlier paragraphs in this Summary noted the necessity for an effective disease-control program through the improvement of vaccination for buffalo, cattle, pigs, goats and poultry. It was noted also that the ACIAR-funded animal diseases project is establishing the systematic diagnosis of strains of Foot-and-Mouth Disease (FMD) and classical hog cholera (HC), nation-wide; and that the EU-funded project (1998–2004) promises to improve the delivery system for vaccines and to improve the training of VVWs, again nation-wide in Lao PDR.

  Even with these improvements, however, there will still be major gaps in knowledge. Workshop participants pointed out that relationships between animal nutrition and morbidity/mortality from major diseases need to be researched; that the benefits of non-fodder mineral supplements (e.g., sodium and phosphorus, as reported by Gibson from project experience in Xieng Khouang, in these Proceedings) need wider consideration; the vaccination of poultry against Newcastle Disease, using heat-stable vaccine, is seen to have immense potential; and smallholders need to be convinced of the benefits accruing from better management of livestock, including better housing (penning of pigs and goats) and drenching for buffalo, cattle, calves, pigs and poultry.
- **Improving feed production.** Workshop participants repeatedly emphasised the constraint on buffalo and cattle production from the seasonal decline of native pastures, and in this context applauded the work of the pilot-scale 'Fodder for Smallholders' Project (FSP) outlined by Horne (these Proceedings). The benefits of the FSP have initially been limited to ruminants, particularly buffalo and cattle, and to this extent may be seen as contributing to the continuing 'large livestock bias' in the development of livestock production in the Lao PDR. Some goat-raising smallholders are also benefiting from the FSP's encouragement of backyard forage production.

The apparent challenge for this project after 1999 (assuming its continuation by AusAID and/or other donors, in conjunction with DLF) is, firstly, its upscaling to new localities in Luang Prabang, Xieng Khouang and Oudomxai Provinces, as proposed, and secondly, its greater project emphasis on feed supplies for small livestock, particularly goats, pigs and chickens.

- **Applied Research: alternative upland farming systems.** In discussions at the Workshop, it was recognised that in the 1990s the relatively attractive financial returns from buffalo and cattle have encouraged many smallholders to build up their small herds, using communal grazing-lands and often supplementary fodder production. On the other hand, there are now pressures for the de-stocking of cattle in some areas, because of damage to crops and because small livestock and other enterprises sometimes give higher financial returns on land, on labour and on the capital invested. The recommendation was made that in further on-farm agricultural research in the uplands (perhaps by DLF/ACIAR in conjunction with Lao-IRRI) attention should be given to intensive, diverse combinations of livestock with field crops, pastures, tree crops and forestry.

- **Applied Research: Managing fallows with livestock.** The upland agricultural systems of Laos will continue to involve combinations of livestock with crops (notably rice), and it is assumed that when fallows are re-cultivated the crops will benefit from the dung deposited in fields, or spread there by smallholders. Research personnel argued that too little is known about the synergism of cropping and livestock in the wet-and-dry tropics, particularly on the significance of dung to maintenance of levels of organic matter and consequent soil fertility. (See the quotation from Fahrney et al. at the heading of this summary). It was recognised that dung retrieval will be advanced at some cost in labour by rotational location of feeding pens and other aspects of livestock management (e.g., tethering). In this respect, there may be scope for modelling studies of alternative on-farm management strategies (Menz and Grist). In the context of fallow management also, investigations of suitable tree species providing both feed supplements and timber were warranted (Lowry) and tree-planting could also provide 'living fences' (Fahrney et al.).
- **Achieving and maintaining sustainability in upland agricultural systems.** In theory, smallholders who develop 'backyard' fodder production, including legumes to feed livestock, will be better placed to maintain the fertility of their fields when fallows are re-cultivated. As just noted, a critical factor also will be dung deposition and livestock management. But if the uncontrolled grazing of buffalo and cattle continues on communal grazing land, it is likely that over-grazing will become more evident. In both these respects — and others — an important responsibility of Farming Advisers working at village level should be to monitor land-use changes taking place as intensification proceeds, with particular concern for over-grazing, erosion risks, soil conservation and the long-term sustainability of the upland farm economy.
- **Farming Systems Database.** In Paragraph 16 above, commenting on the lack of a comprehensive body of relevant data on upland farming systems in the Lao PDR, the suggestion was made for setting up (under MAF?) a Farming Systems Database and Mapping Program, using existing primary and secondary data which would then be extended and brought up-to-date by reconnaissance surveys (Participatory Rapid Rural Appraisal) in the field.

References

In addition to references to papers included in the Workshop Proceedings (authors in brackets), the following have also been cited:

ACIAR Project ASI/1994/038. Improved diagnostic and control methodologies for two major livestock diseases in Lao PDR and Yunnan Province, PRC. Project Documentation ACIAR, Canberra. 65 p.

Chapman, E.C. 1995. The recent cross-border livestock trade between Yunnan (China), Laos and northern Thailand. A report to ACIAR. Canberra, mimeo. 45 p.

European Communities, 1997. Strengthening of Livestock Services and Extension Activities (Financial Agreement between the European Communities and the Lao People's Democratic Republic) signed at Brussels, 13 October 1997.

Gibson, T. 1997. Consultancy report: Livestock and Veterinary Services. A report for the Rural Development Project (Lao-GTZ), Bokeo Province, Lao PDR. 91 p.

The World Bank, Agriculture and Environment Operations Division. 1995. Lao PDR. Agricultural sector memorandum: an agricultural sector strategy, Washington. 192 p.

Recommendations

The final session of the Workshop addressed recommendations drafted by a working group of participants. After discussion then and much more discussion subsequently, including consultations with the two sponsors of the Workshop (DLF and ACIAR), the following were seen to encompass key proposals:

1. Upland Development Strategy of the Lao PDR. *Discussions should be undertaken with the responsible Government authorities as to ways in which the Government's upland development strategy can be advanced, employing an area-based (or 'focal site') farming systems approach to guide research and development activities.* It is envisaged that expansion of the existing 'Fodder for Smallholders' project or any new projects should take closely into account the work of government agencies such as the Shifting Cultivation Program of the Ministry of Agriculture and Forests (MAF), other agencies and departments under MAF, the Lao Women's Union, and donor-funded projects notably Lao-IRRI, the ACIAR-funded 'Animal Health' project and the EU project for 'Strengthening of Livestock Services and Extension Activities'.

2. Intensification of Livestock Production. This Workshop noted that smallholders in some upland areas of the Lao PDR are already pursuing opportunities for the intensification of land use, for both subsistence production and to generate higher cash incomes. Livestock production is playing a major role which has good prospects of continuing. The immediate benefits are in higher cash incomes for better-off households owning buffalo, cattle and pigs. If the intensification of livestock production continues at a rapid pace, it has the potential to contribute significantly to major objectives of the Lao Government, notably the reduction of shifting cultivation and the alleviation of poverty in upland communities. The challenge to the MAF and DLF in the next decade, with donor support, is to implement widely at village level the opportunities which are now emerging for more effective control of major livestock diseases in buffalo, cattle, goats, pigs and chickens, together with opportunities for expanded feed production.

Recommendation: That the government authorities of the Lao PDR (particularly MAF and DLF), recognising the prospects for significant expansion of livestock production following early improvements in disease control and feed production, should now plan a wider program for the intensification of smallholder livestock production in the uplands, beginning in 2000–2004 in 3–4 provinces where changes are already taking place or there are special opportunities (e.g., Luang Prabang, Oudomxai, Xieng Khouang and Bokeo or Luang Namtha) and invite the support of foreign donors for its implementation.

3. Farming Advisers. If the intensification of livestock production in the uplands of Lao PDR is to be achieved, in the first instance through the combination of an effective disease-control program and an effective feed production program, it will require a major 'extension' effort at province, district and community levels. The strengthening of vaccine delivery services to villages through VVWs (according to the EU-funded project) is essential, but by itself it will not be enough. Much more will be needed, if smallholders are to receive practical and continuing advice on a range of matters such as alternative approaches to feed production for pigs and chickens, suitable grass and legume species for 'cut-and-carry' feed production, alternative fallow management systems involving livestock, pasture species, shrubs and trees, and a range of other important matters such as advice on credit facilities and animal banks.

Recommendation: It is recommended that the formation and training of a team of Farming Advisers (extension officers) be considered by MAF and DLF, to work in conjunction with provincial staff and VVWs. Farming Advisers will also have an important role in monitoring the sustainability of upland production.

4. Applied Research: In discussions during the Workshop (reported in Paragraph 19 of the preceding Summary), a number of problems for research were identified which have critical effects on the existing levels of livestock production and on the transition from swidden cultivation in the uplands:

- ***Environmental constraints.*** Workshop participants emphasised that the relationships between seasonal aspects of animal nutrition and morbidity/mortality from major diseases need to be thoroughly investigated; and that the benefits of non-fodder mineral supplements (e.g., sodium and phosphorus, as reported by Gibson) deserve wider consideration;
- ***Alternative upland farming systems.*** The focus of this Workshop was on 'problems and opportunities for livestock' to the extent that they affect the

intensification of land use and so affect the shift from swidden cultivation towards permanent farming systems. It was argued that there was need for more research into crop combinations, crop-livestock combinations, crop-livestock-forestry combinations etc., in which livestock might play an ancillary, but critical role;

- ***Managing fallows with livestock.*** In different presentations (e.g., Simaraks; Fahrney et al.) and a number of discussions, Workshop participants emphasised the importance of future on-farm investigations into the synergism of cropping and livestock in the wet-and-dry tropical environment (see particularly under Paragraph 19).

Recommendation: That in any future Review and Planning Mission which ACIAR and AusAID may consider appropriate to conduct, jointly with DLF, other elements of MAF and with other possible donors in the livestock sector, consideration be given to these and other research investigations where the outcomes promise to be significant for the intensification of land-use and the reduction of smallholder poverty in the uplands.

5. Farming Systems Database (FSD) Program. The value of a Farming Systems Database (with maps) for upland areas in individual provinces in the Lao PDR, later to be extended to include upland areas in northern Thailand, Vietnam and Cambodia, has been discussed under Paragraphs 16 and 17 above. It is envisaged that compilation of the database from primary and secondary sources, supplemented by field reconnaissance surveys, might begin in the Lao PDR in the period 2000–2004 and be extended as a co-operative task involving professional colleagues in other countries of the Greater Mekong Sub-Region (GMS).

Recommendation: That the establishment of a Farming Systems Database Program be discussed with the MAF and DLF authorities most likely to be involved in the core area of this undertaking, with ACIAR as a possible donor and with possible Australia-based executing agents. At an appropriate time, discussions should then follow with authorities in the other five GMS countries (Thailand, Vietnam, Cambodia, Myanmar and Yunnan Province, PRC).

6. Timing and Scope of a Subsequent Workshop. Participants at the Vientiane Workshop expressed warm appreciation of the hospitality and enterprise of the organisers of this meeting, including the efforts made to make the field visits so successful. The many participants from particular projects in the Lao PDR and neighbouring countries (Thailand, Vietnam, Malaysia and Cambodia) welcomed the possibility of a further Workshop and suggested that the meeting might be scheduled for early in the Year 2000. It was suggested that objectives might then be narrower than for the 1997 Vientiane Workshop. In particular, the next Workshop might focus on:

- exchange of information between project personnel and research staff on the on-going intensification of livestock production, particularly concerning feed production (related to Recommendation 2 above);
- a review of the progress being made at province, district and community level in the program for control of livestock diseases, and of plans for its further development;
- how a planned progam of applied research, on-farm and off-farm, would be developed (Recommendation 4 above); and
- a review of plans for the Farming Systems Database Program.

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Acknowledgment

In concluding this volume it is appropriate for us to acknowledge the generous support provided by ACIAR for the funding of the Vientiane Workshop and publication of these conference papers. Many participants were also assisted by supplementary funding from different sources. In this context one editor (E.C. Chapman) wishes to acknowledge supplementary assistance provided by a large grant project of the Australian Research Council (1995–97), concerned with trans-Mekong development. Beyond financial assistance however, the success of the Workshop and the publication of this volume reflect the vision, support and patience of the co-Chairmen, Director-General Singkham Phonvisay (DLF) and Dr John Copland (ACIAR).

The Editors

Appendix

ACIAR Project ASI/1994/038

Improved Diagnostic and Control Methodologies for Two Major Livestock Diseases in Lao PDR and Yunnan Province, PRC

Harvey Westbury and Stuart Blacksell[1]

AN animal health laboratory able to undertake modern diagnostic and surveillance techniques for foot and mouth disease (FMD) and classical swine fever (CSF), and potentially other diseases, was established in Vientiane in 1997. Technologies currently practised include direct detection of virus and antibody using the enzyme-linked immunoassay (ELISA) technique, virus isolation by cell culture and molecular epidemiology. A provincial diagnostic sample delivery network was developed progressively with 12 provinces participating. Those involved in 1997 and to mid-1998 are Phongsali, Bokeo, Xieng Khouang, Vientiane Province, Vientiane Municipality, Borikhamxai, Khammouan, Savannakhet, Saravan, Xekong, Attapu and Champasak. Planning to bring the remaining provinces into the sample delivery network is underway.

Diagnostic samples – tissues or blood – are collected in villages and farms and sent in special transport containers to the Vientiane laboratory through the post. More than 30 strains for CSF virus have been collected from throughout the country in this way and these are currently being characterised in Lao PDR and Australia. Some samples for FMD testing have also been received, though this will increase with the onset of the 1998 wet season, the customary peak season for FMD outbreaks.

A statistically valid survey of the prevalence of FMD was conducted in 1997–98 in Vientiane Municipality, Borikhamxai, Khammouan and Champasak with over 3000 sera collected from cattle, buffalo and pigs. The survey showed, not unexpectedly, that FMD is endemic, though there are differences between provinces in the main FMD virus serotype circulating at the time of the survey; and some provinces recorded a very low occurrence of FMD. A similar survey for the occurrence of CSF is being undertaken in 1998.

Project work in China has concentrated on establishing diagnostic technologies at the Yunnan Tropical and Sub-Tropical Animal Virus Disease Laboratory (YTSTAVDL) in Kunming, and on the training of staff at YTSTAVDL and the Yunnan General Veterinary Station (YGVS), Kunming in these technologies. Training sessions have been held at YTSTAVDL for FMD and CSF ELISA tests and four staff from YTSYAVDL and YGVS have visited the Vientiane laboratory for more prolonged training in laboratory practice and methodology.

Work in the next phase of the project in Yunnan Province, to the end of 1999, will concentrate on assessing the effectiveness of immunisation using the FMD vaccine produced at the Baoshan Vaccine Plant in Yunnan, diagnostic investigation of suspect outbreaks of CSF, analysis of CSF virus strains isolated in Yunnan and comparison of these strains with others obtained from the region.

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Lao People's Democratic Republic
Peace Independence Democracy Unity Prosperity

LaoBase Animal Health Information System

DISEASE REPORT FORM

Report date / /	**Report Number (Lab use only)**

Part 1: Submission Information

Location	Reason	Form completed by	Disease reported by
Village District Province Owner Name Address	❑ Disease Report ❑ Diagnostic ❑ Surveillance ❑ Export ❑ Accreditation ❑ Research ❑ Regulatory ❑ Disease Control ❑ Eradication	Name Address ❑ District Officer ❑ Provincial Officer ❑ Central Officer ❑ VVW ❑ Owner ❑ Other	Name ❑ District Officer ❑ Provincial Officer ❑ Central Officer ❑ VVW ❑ Owner ❑ Other
Previous report ID			

Part 2: Animal Information

Species	Sex	Number of Animals
❑ Cattle ❑ Buffalo ❑ Pig ❑ Chicken ❑ Goat ❑ Sheep ❑ Horse ❑ Shrimp ❑ Fish ❑ Dog ❑ Cat	❑ Male ❑ Female ❑ Castrated male ❑ Speyed female ❑ Mixed ❑ Unknown **Age** ❑ Days ❑ Weeks ❑ Months ❑ Years	Sick Dead Total in Village **History and clinical symptoms**

Part 3: Specimen information

Specimens No.	Lab tests
❑ Whole Blood ❑ Serum ❑ Faeces ❑ Fresh tissue ❑ Fixed tissue ❑ Swab	❑ Serology ❑ Bacteriology ❑ Histology ❑ Virology ❑ Parasitology ❑ Haematology

Laboratory use only

Test type	Test results	Pos	Neg	?
Final Diagnosis				

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