Plenary Session VI.

Agroforests

'Jungle rubber, covering over 2 million ha. In Indonesia, has its origins in enrichment planting of Havea brasiliensis into swidden fields during the cropping period. After about a 30 year 'economic fallow', the rubber is cleared for another phase of annual cropping and the cycle begins anew.

Plenary Session VI. Agroforests

Oral Presentations:

Talun Kebun System: Conflict and Prospects. A Case Study in the Upper Citarum River Basin, West Java

By Nani Djuangsih*, Payat Ruchiyah*, Parikesit*, and Oekan S. Abdoellah*

The *talun-kebun* system is a traditional agroforestry found in rural areas in West Java which evolves from slash and burn agriculture. It is a piece of land planted with various annual and perennial plants that have diverse functions such as source of water and food, firewood, building materials, traditional medicine either for commercial as well as for subsistence purposes.

Market economy and population growth are among major factors that have resulted in the evolution of the *talun-kebun* system through introduction and selection of various plants as part of the overall process of human adaptation over time. The *talun-kebun* system has economic as well as ecological importance in rural ecosystem since it provides resources for rural people and at the same time it contributes significantly in soil conservation.

Rotation pattern practiced in the *talun-kebun* system acknowledges a fallow period known as '*talun*' which is usually dominated by perennial plants with dense canopy cover. Despite the talun vegetation is hardly managed for large scale commercial purpose, its presence in rural ecosystem still contributes to some extent for the fulfillment of needed resources of the owners.

The dynamic of land use changes and rapid economic development, particularly in agricultural-with more capital input and market-oriented -- and industrial sectors, has caused the sustainability of the *talun-kebun* and talun system questionable. Therefore, alternatives are needed with emphasis on the preservation of these systems that have been believed as an ecologically sound agricultural practices.

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From Shifting Cultivation to Sustainable Jungle Rubber in Indonesia: A History of Innovations Integration for Smallholders in the Peneplains of Sumatra and Kalimantan Since the Turn of the Century

By Eric Penot*

The peneplains of Sumatra and Kalimantan below the altitude of 500 meters (our study area) were scarcely inhabited at the turn of the 19th century with a population density inferior to 4 inhabitants/km², mainly relying on shifting cultivation of upland rice. The introduction of rubber by private Dutch estates in the 1910's triggered a radical change in the landscape evolution but not in farmers practices, at least at the beginning. As estates adopted monoculture right from the beginning, trying to maximize rubber production, farmers saw and exploited immediately the possibility of growing rubber on a very extensive way by enriching their fallows (belukar in Indonesian) with unselected rubber seedlings that was available and free. Planting rubber during, or after, upland rice was a very marginal supplementary amount of work, with no risks and more important: no cost. Rubber used to grow with the secondary forest in a complex agroforestry system called 'jungle rubber".

Productivity was sufficient to raise a very incentive income however rubber taping occurs with a delay compared to rubber monoculture in estates.

The advantages of jungle rubber are clear: no cost, no labour required for maintenance during immature period, income diversification with fruits, rattan, timber and other NTFP (non timber forest products) from the agroforest. Indirect benefits are environmental with soil conservation and rehabilitation of degraded lands. Originally, the adoption of this system did not change farmers practices and, beside rubber production, they continued to slash and burn new plots every year. At that stage on can still consider jungle rubber as an "enriched fallow with rubber ".

Estates began to raise their own research programme in the 1920's leading to the adoption of several important innovations, fertilization, weeding level, exploitation systems among them improved planting material, the clones, has been the most important in terms of yield. Meanwhile farmers began to produce several innovations, with no cost, called "endogenous innovations" such as planting in lines, a minimum weeding (once a year)...mainly through the improvement of some rubber farming practices. At that stage as the aim was definitely to establish a rubber system minimizing capital and labour investment, farmers shifted from an "enriched fallow with rubber" to a real "complex rubber agroforestry system".

The productivity of jungle rubber being low (500 kg/ha/year of rubber) compared to that of estates using clones (1500 to 2000 kg/ha/year), and after having completed the possibilities of endogenous innovation production, farmers began to be interested to include "external innovations" such as clones, fertilization and good tapping systems.

Some who had access to clonal rubber in monoculture began also to develop innovations such as intercropping during immature period and planting of perennial trees (or selection of those from natural regeneration) such as fruit and timber trees creating therefore an "improved rubber based complex agroforestry system" where the original aim of improving the fallow has disappeared before the willingness to establish a real

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cropping system. These practices were still forbidden in rubber development project 5 years ago only. Population increase, land scarcity in some areas and other more productive crop opportunity force farmers to move to a more productive Rubber Agroforestry System (RAS).

Research in agroforestry has been very recently focused on how to integrate indigenous knowledge with jungle rubber and external innovations to raise productivity conserving benefits of agroforestry practices in terms of environment and biodiversity.

Keywords: shifting agriculture, complex agroforestry systems, jungle rubber, rubber cropping patterns, innovations adoption process

Lacquer Agroforestry System of Lemo in Yunnan, China

By Long Chun-Lin*

Lacquer tree (*Toxicodendrom vernicifera*) planted in swidden field by Lemo people in NW Yunnan of China is reported to the outside world for the first time. The lacquer agroforestry system is tentatively studied. The seedling breeding, cultivation and management of lacquer trees, and lacquer tapping are carried out by individual household. Only the men have the rights to cultivate lacquer seedlings and tape lacquer in Lemo society. The lacquer agroforestry system afford the Lemo people 70-85% cash income and better environmental value. This unique agroforestry system is being threatened by lacquer price dropping. In additional, the Lemo's traditional swidden cultivation is briefly introduced in the present paper.

Keywords: Lemo, lacquer, lacquer agroforestry system, swidden fallow, Kŏngji, alder

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'Ma Kwaen' (Zanthoxyliem limonella): A Jungle Spice Used in Swidden Intensification in Northern Thailand with Indigenous Technology

By Peter Hoare*, Borpit Maneeratana**, and Wichai Songwadhana**

"Ma Kwaen" (*Zanthoxylum limonella*) is an indigenous jungle spice which has been used by the northern Thai people (Khon muang) as a flavoring in met dishes and soups for many generations. It is little used by other ethnic groups in Thailand. Most of the recent literature on forest trees of Thailand do not contain references to the tree.

"Ma Kwaen" grows to about 8 meters in height. After 3 to 4 years it bears clusters of flowers. The dried seed pod is used a spice. Over the last 15 years the farm gate price has steadily risen about US $0.10 to US $2 per kg. fresh weight. The tree is difficult to propagate due to the hard seed coat, and up to half the seedlings die in the first year following heavy rain and insect damage. Indigenous technology developed by farmers has been mainly in relation to improving propagation techniques and fitting the tree into a wide range of agroforestry systems for swidden intensification.

The tree has become considerable economic importance in some areas of the Chao Praya watershed in north Thailand. For example, in the song Kwae sub-district in Nan Province 155 households have about 140 ha of bearing trees in agroforestry systems and last year grossed over US $120,000. A number of highland villages in Chiang Mai Province also receive significant income from the spice. One great advantage of including the tree in swidden intensification is that farmers control dry season fires, as it is easily killed by fire.

With improvements to the existing technology and market research "Ma Kwaên" could become more important in swidden intensification and increasing farm income in a larger number of villages in north Thailand.

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The "Tagui Gru" System and Other Karen Fallow Management Practices in Thailand: Building on Indigenous Technologies as a Strategy for Land Use Intensification

By Payong Srithong*

The paper is a report of the participatory monitoring and evaluation of the agroforestry support plan of AGRECO/PGRC. The study was conducted in complex fruit-tree based agroforest (FTA) farms of 30 Karen swidden cultivators in western part of Thailand. The Karen as well as other indigenous communities in Thailand and their cultivation are now facing 3 major constraints which are limitation of cultivation areas, degradation of natural environments and misunderstanding of the society.

FTA is an introduced agricultural system which is built upon Karen's traditional agricultures. It employs integral principles of traditional cultivation of upland rice and traditional home garden. Karen's swidden cultivation is preoccupied by several varieties of upland rice and a large number of food crops, herbs, medicinal plants, etc. Plant genetic diversity is a dominant characteristics of Karen's swidden cultivation. Traditional home garden is smaller in both area and number of plants grown but the system - which is generally dominated by betel palm and some perennial fruit trees - is more stable. Many agricultural technologies whether indigenous or newly introduced such as soil and conservation are employed in the system.

The paper shows that most of the Karen swidden cultivators participating in the development of FTA give priority to growing food crops in order to meet internal consumption. This explains the reason why they grow a great deal of plant species but each in a small amount. However, since all the communities in the study are already exposed to the market economy, many of them while keeping diversity of plant species in their farms, tend to grow fruit trees in larger amount and expect that FTA will be an alternative source of additional cash income in the near future.

Although FTA is a spearhead and positive example of permanent cultivation developed as a solutions of limited cultivation areas, majority of the household in the communities are still accustomed to traditional cultivation practices which need areas for fallow and rotation. The paper indicates that if the communities want to survive current constraints, it is a challenge for development agencies as well as the Karen themselves to improve FTA properly to needs and limitations of the communities on the one hand; and to start developing and searching for agricultural technologies and practices essential for management of the fallow in a more productive manner on the other hand.

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Does Tree Diversity Affect Soil Fertility? A Critical Hypothesis and Initial Findings in the Alternative Fallow Management Systems of West Kalimantan

By Deborah C. Lawrence*, Dwi Astiani, Marlina Syazhaman-Karwur, and Isabella Fiorentino

Intensification of management to achieve more efficient and productive fallows in the uplands of Southeast Asia is likely to alter the species composition and structure of the tree community in traditional fallows. Consequent changes in nutrient cycling may compromise the sustainability of the fallow system and the future productivity of the land. Understanding the influence of the tree community on nutrient dynamics is critical to formulating long-term solutions to fallow degradation, especially in systems with low potential inputs of capital and labor.

We studied tree diversity and soil properties in three alternative fallow systems employed by Dayaks in the Gunung Palung region of West Kalimantan: unmanaged secondary forest fallows, rubber gardens, and fruit gardens. The introduction of selected tree species during the swidden period transforms a traditional 15-20 year fallow into a 30-40 year rubber-based fallow, or a 50-100+ year fruit-based fallow. Our objectives were) to compare the tree community and soils within and across these three potential fallow types, and ii) to investigate possible links between tree diversity and soil nutrient stocks. To quantify species richness, we measured and identified trees > 10 cm dbh in 0.10 ha plots in 32 stands. Productive rubber gardens, aged 12-30 years (n=11), were compared with "mature" fallows, aged 15-35 years (n=11), and fruit gardens, at least 50-100 years old (n=10). To assess differences in soil properties, we collected matched samples in fallows, fruit gardens and rubber gardens that were at least 15 years old and no more than 150 m apart (n=7 sites).

Mean species richness per plot was significantly higher in fallows and fruit gardens (each with 22 species) than in rubber gardens (with 6). The range of variation was much greater in fallows (3-42 per plot) than in fruit gardens (14-32). Soil organic matter, caution exchange capacity, total nitrogen, 3 M HCl-extractable phosphorus, silt and clay content and pH were higher in fallows and fruit gardens than in rubber gardens. Soils in rubber gardens had higher percent base saturation and sand content. Fruit gardens had the highest levels of calcium, magnesium, and sodium. Available (Bray) phosphorus and potassium did not vary significantly across the three types.

Our data indicate that soil nutrient status is considerably more favorable in the more species-rich fallow alternatives. We suggest that a positive relationship may exist between diversity and soil fertility. This hypothesis deserves further investigation because the success of fallow intensification depends on the ability of the system to sustain itself without large inputs of labor and capital by farmers.

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Preliminary Study on Rubber Plantations as a Local Alternative to Shifting Cultivation in Yunnan Province, China

By Guangxia Cao* and Lianmin Zhiang**

Yunnan province, of southwestern China, with a total area of about 390,000 square kilometers, can be geographically classified as the northwest of Southeast Asia, where the distribution of shifting cultivation in the region reaches its limit. The shifting cultivation is carried out by many ethical groups on less than 1/7 of Yunnan land. Historically (before 1950) most local farmers practiced more than 10 years of fallow period, and rationally rotate their fallow field to maintain the field productivity. As the population increases, the fallow is shortened to 3-5 years and the soil fertility declined, which threatens the food production accordingly. Local farmers develop a wide range of strategies to cope with the problem, and one of the management strategies is to convert fallow vegetation to rubber plantation to increase economic return. This paper hopes to understand some of the essential context of local intensification of shifting cultivation through study of rubber plantation established by local farmers. The underlying hypothesis is that the role of the trees and other perennial crops determines the fallow management practices by local farmers, and local people tend to preserve and actively cultivate trees that can contribute significantly to their daily livelihood. To test the hypothesis, the rubber fallow management in southern Yunnan particularly in Xishuangbanna, is reviewed and studied through both literature and field survey. The rubber plantation carried out by local farmers in the low altitude areas is mainly attributed to the market factor. Farmers' adoption of the system is clearly characterized by their trial and experimental process and by their observation on their surrounding neighbor's success. The farmers' motivation is not limited in the food subsistence itself at all, rather being due to the increasing living standard and demand owing to the continuous changing social economic condition, and the rubber tree therefore serves the role that the local people want the species to play. The village surveys reveal that the economic comparative advantage is rather significant and farmers are satisfied with their intensive labor input currently. For increasing the return and perhaps reducing the risk in rubber plantation, local farmers also raise other cash crops such as vegetables to diversify their output. Although the rubber plantation is economic for local farmers, its ecological effect is still in debate regarding its uniform plantation form, which is poorer than the natural vegetation to conserve soil and water. As an important fallow management practice, rubber plantation is increasingly adopted by local farmers, therefore the further studies on its cultivation techniques and the cold resistance varieties are necessary. It should be noted that the promotion of rubber plantation here is favored by the current national policy and economic condition, thus may become the constraints for the same practices in other countries. The rubber plantation suggests another important aspect of the study on the indigenous strategies for intensification of shifting cultivation, because, rubber as an alien and cash tree crop that has already distributed beyond its normal biophysical limit, can still be adopted by local farmers as their life integration. The implication would be that the indigenous strategies are strongly influenced by the surrounding social and economic condition. Despite that local farmers are developing many strategies involving indigenous species and techniques, outside techniques and species are equally valued by local farmers and therefore incorporating into their practices. It suggests that the definition of sustainability in view of local farmers is the dynamic rather than the static term.

Keywords: indigenous strategy, rubber, shifting cultivation

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Alnus - Cardamon Agroforestry System: Potential for Stabilizing Upland Shifting Cultivation in the Eastern Himalaya

By Rita Sharma*

Shifting agriculture or jhum is the major economic activity in the north-eastern India. The practice was in harmony with the environment as long as the jhum cycle was long enough to allow the forest and the soil fertility lost during the cropping phase to recover. The jhum cycle is shortening and the shifting cultivation is turning less productive and unsustainable in recent years. Areas of operation for a shifting cultivator has also decreased substantially. In this situation fallow management by planting large cardamom with *Alnus* tree could be promising. Large cardamom (*Amomum subulatum*) is a high-value low-volume non-perishable perennial cash crop, while *Alnus nepalensis* is a N_2-fixing fast growing tree.

Large cardamom based agroforestry is a traditional practice and cultivated in about 26000 ha area in the Sikkim Himalaya producing 4 million kilograms of capsule fetching cash equivalent of about 8 million US dollars. This cash crop is a native of the eastern Himalaya and cultivated usually on hill slopes under tree cover either in natural forest or plantations which forms an age old agroforestry system in the region. This is an excellent practice-fitting the mountain niche. The overall benefits from cardamom agroforestry systems are: (1) high economic return, (2) less labour intensive, (3) non-perishable crop with established market, (4) low volume crop resulting into less nutrient exhaustive, (5) basic resources such as fuelwood, timber and fodder are available in the system, and (6) soil and nutrient loss are minimum from the system.

Influence of N_2-fixing *Alnus nepalensis* in cardamom agroforestry was studied by selecting stands with (*Alnus*-cardamom) and without (forest-cardamom) this tree. Benefits of planting *Alnus* as shade/nurse tree are: (1) stand biomass, productivity and agronomic yield of large cardamom increased by 1.3, 1.5 and 2.2 times, respectively, under the influence of *Alnus* in *Alnus*-cardamom compared to the forest-cardamom stand, (2) nitrogen accretion by *Alnus* through biological fixation in *Alnus*-cardamom stand was 65 kg/ha/yr. Mean N_2-fixation rate was 55 µmol N/g nodule dry wt/day, (3) nitrogen and phosphorus cycling was accelerated under the influence of *Alnus*, (4) *Alnus* effectively helped in the maintenance of soil fertility in fragile slopes, (5) poor nutrient conservation and low nutrient use efficiency of *Alnus*, and malleability of nutrient cycling under its influence make it an excellent associate promoting higher availability and faster cycling of nutrients, and (6) annual income from large cardamom yield increased to US$ 1000 under the influence of *Alnus* compared to US$ 450 under mixed forest species.

Alnus-cardamom system has potential of adoption for fallow management in jhum. It is stable, self-sufficient and ecologically sound that also provides high economic return. Both, *Alnus* and cardamom, perform well upto 20 years age. A jhum cycle of 15-20 years with *Alnus*-cardamom system during fallow can fetch high annual income for tribals and simultaneously maintain the soil fertility. Fragmented jhumias could be reunited if *Alnus*-cardamom system is adopted during fallow to go back to longer cycles. This system would provide additional economic benefit and also the basic resources. The *Alnus*-cardamom can also be practiced as stabilized system as evident in Sikkim. It is not a labour intensive and fertilizer demanding practice. Slight modification in the indigenous fallow management by incorporating large cardamom with *Alnus* would be a step towards sustenance.

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Impetus and Trend of Agroforestry Economic Plants Development at Village Level

By Chen Ai Guo*, Guo Huijun** and Cui Jinyun

Increasing efforts are being made to adopt a system research approach to rural agroforestry development. In this case study, three villages, which represent three typical nationalities (Dai, Aini and Jinuo) and conditions in tropical mountain of southern Yunnan, China, have been selected for permanent research, for understanding agroforestry and its relationship to land-use system, especially shifting cultivation, agroforestry and perennial crop. For system research, 8 kinds of agriculture patterns, protected forests, second forests, shifting cultivation land, perennial crop land, annual crop land, agroforestry systems, wet rice land and water land, have been studied in proper order.

Eight agriculture patterns influence each other. In a certain village, the development of a pattern are linked to other seven patterns. The richness of patterns trends towards the same number, because of farmer to farmer exchanging among different nationality villages. The eveness of patterns has been controlled by landforms. The dominance of patterns always changes with the tide of market. The relationship among 8 agriculture patterns has been analyzed quantity in the paper.

As an agriculture pattern, agroforestry system are influenced by not only other seven patterns but the economic viability of agroforestry systems. 14 species perennial crops, such as rubber, tea, Chinese cardamom, pomelo, citrus, tagasaste, and so on, have been applied in agroforestry systems since 1970s in the three villages, but some species have disappeared and are replaced by other species. In this paper, this 14 agroforestry species are appraised in terms of development impetus and trend. Some suggestions for further developing agroforestry are put forward.

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Fallow Management with Styrax tonkinensis for Benzoin Production in Upland Cultivation Areas in Northern Lao P.D.R.

By Sianouvog Savathvong, Manfred Fischer* and Khongsak Pinyopusarerk

Styrax tonkinensis is a partly deciduous tree which is indigenous in the mountainous provinces of northern Laos and northern Vietnam. It is a pioneer species which makes it capable of invading gaps in the forest. Thus, it is able to occupy sites previously used for slash and burn agriculture and became an integral part of the shifting cultivation system, in northern Laos.

The main economic importance of *Styrax tonkinensis* derives from its capability to produce the resin 'benzoin'. already for several centuries benzoin is exported from Laos to be used as an incense, fragrant or traditional medicine. Domestic use in Laos is minimal.

To produce benzoin, a fallow period of at least eight to ten years is necessary. In the swidden fields *Styrax tonkinensis* germinates together with the glutinous rice, which is the main agricultural crop in northern Laos. After the one-year cultivation period, the area becomes a fallow. At the age of about six years the tapping of the *Styrax* trees starts and is continued until the age of 10 to 14.

The use of *Styrax tonkinensis* as a fallow plant offers a potential to generate cash income and assures a minimum fallow period of at least six to eight years. However, due to dropping farmgate prices, the interest of peasants to produce benzoin became increasingly less. Additionally, through increasing land pressure caused by migration and population increase, the fallow periods reduce considerably.

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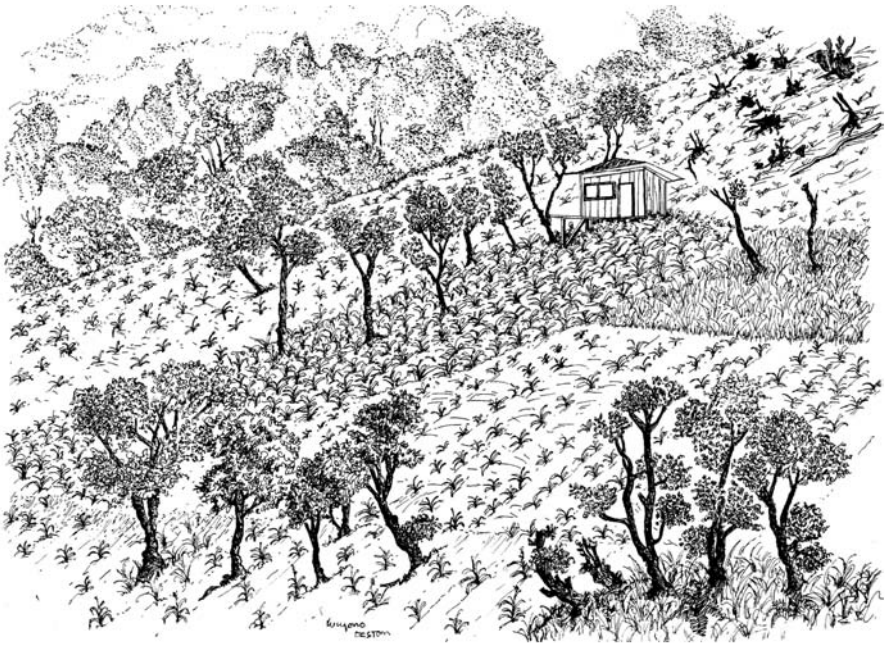
Plenary Session VII.

Multi-System Papers Cutting Across Categories



Bhutanese farmers often maintain Ficus spp. and other preferred fodder trees on their tseri (swidden) land.

Plenary Session VII. Multi-System Papers Cutting Across Categories

Oral Presentations:

Hani Practices of Intensification of Shifting Cultivation in Xishuangbanna, Southwest China

By Xu Jianchu*

Many Hani people are still living under the absolute poverty condition simply because of too many people and too little arable lands in mountainous areas of Southern Yunnan. The Hani people in Xishuangbanna, however, have innovatively practiced a range of activities for landuse intensification in swidden agroecosystems through intercropping, crop rotation, fallow management for planting tea, rattan, rubber and other crops for soil fertility replenishment and income generation. Swidden agroecosystem is perhaps the most dynamic system in term of ecological succession and socio-cultural innovation in the world.

The landuse intensification of shifting cultivation practiced by Hani people in Xishuangbanna has been observed in the following: (a) Rattan cultivation in fallow fields. The case study in a Hani community of Mengsong shows that open access to rattan resource had resulted in depletion in the wild, sanctioned rattan forest as a communal property by presence of customary institutions, and eventually cultivation of rattan in the swidden-fallow fields; (b) Tea plantation in fallow fields. The tea plantation in the natural forest has been extensively practiced by many ethnic groups, such as Hani, Bulang, and Jinuo, in Xishuangbanna for several hundreds of years. However, the Hani people in Nanuoshan have converted many swidden-fallow fields into tea garden by contour planting tea and multipurpose trees in order to increase tea productivity with limited land; (c) Rubber plantation in fallow fields in Mamushu. Rubber as a commodity plantation was introduced into Xishuangbanna in 1958 through establishment of state farm. The small-hold rubber plantation was started in early 1980s while a shift from collective system to household responsibility system. The local Hani farmers in Mamushu often cultivate a variety of short-term crops, such as upland rice and pineapple in early stage of rubber plantation in the swidden fields. Rubber becomes a chief income for local farmers in transition to market-economy; (d) Sugarcane plantation in fallow fields. Sugarcane was introduced into swidden-fields by local farmers in early 1990s with establishment of many sugar processing plants in Xishuangbanna. However, access to capital and road is essential for sugarcane plantation in the swidden fields. Therefore, revival of traditional mutual help in inevitable for land reallocation and construction of road and irrigation system.

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Rebuilding Soil Properties During the Fallow Period: Indigenous Innovations Practiced in the Highlands of Vietnam

By Hoang Xuan Ty*

The State has been making great effort to restrict shifting cultivation but there are still about 3 million people in the uplands associated shifting agriculture. Due to increasing pressure of population growth, measures for quick soil rehabilitation in short fallow period is very important. The paper makes know some local experiences of high significance for Vietnam today.

- Using Cassava for soil cover during fallow period: When the soil is much degraded and maize, rice can no longer be raised, Cassava is planted with a density of 10.000 plants / ha and harvesting is done 3 -4 years after planting. By this way soil is better protected against erosion and 3-4 years there after maize or rice will be able to be grown, meanwhile farmer do have more food. This method must be further perfected by leguminous species mixed-planting.
- Soil cover by *Eupatorium odoratum*: This species is wide distributed with abundant seed source and quick covering of the soil. Apart from high Kalium content, this species is highly capable of weed suppression in the fallow period. The paper presents some measures for promoting the regeneration of this soil improving species.
- Leaving over small trees during land clearing: in Southern provinces where the temperature in summer is very high the farmer leave over the stumps 1.2 - 1.5 m high of small and medium trees. Due to ability of cropping, they create a suitable shadow for maize and rice and they can create just after the fallow begins a soil cover better than that by the species regenerated from seed.
- Techniques for promoting bamboo regeneration and protection in slash-and-burn cultivation description is made of the farmer's experiences in protecting *Dendrocalamus patellaris* and *Neohuzeaeaua dulloa* to create a soil cover in a 4-5 years fallowing.

These are experiences successfully applied by farmers and further study in needed.

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Strategies of Shifting Cultivators in the Intensification Process

By United Nations Office for Project Services, Asia Office*

1. The projects supported by IFAD in Asia (Vietnam, Laos, Bhutan, Nepal and peninsular India) with which UNOPS is closely associated as the co-operating institution, have promoted a variety of strategies of intensification and introduced multiple systems of fallow management (multipurpose tree species, different versions of sloping agricultural land technologies - SALT). The apprehension that project driven interventions could be unsustainable led to the exploration of the farmer's own responses (indigenous strategies) to the pressures for intensification.

2. The strategies are of two types:
   - more 'effective fallows', where the biological efficiency of allow function is improved;
   - more 'productive fallows', where the farmers add perennial species with economic value, i.e.,, with marketable products.

3. The preparation of the paper would involve two stages. Firstly, data would be collected documenting various examples of indigenous intensification of shifting cultivation areas. This would involve review of existing secondary, mainly anthropological studies of the Project areas and the indigenous people inhabiting them, to be followed by field study. The field study would document the changes in the cultivation process, differentiating between those who were supported by the Project and those that were taken up by farmers themselves. The field study would include individual and group interviews, guided field walks and observation. The focus would be on women and older persons. The analysis of the data would focus on economic, social and technical factors that have facilitated or retarded the adoption, spread and success of the indigenous innovations that have contributed to the process of intensification.

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Poster Presentations:

Fallow Management Strategies in the Cordilleras, Philippines

By Montañosa Research and Development Center*

Objectives of the study:

Documenting indigenous farming systems to learn from farmers is a task MRDC has taken upon itself. Specially, the above mentioned study was conducted to:

a) inventories fallow management systems in MRDC project and service areas;

b) assess the fallow management systems in terms of its strength weaknesses and potentials and

c) to put forward recommendations to possible improvements of the system.

Scope and Methods:

Mainly, the study was conducted in mid-zone and upland areas with elevation approximately 200-2,500 above sea level. Its limitation is on the method used which relied on key informant interviews, actual observation and actual participation and the fact a few people are knowledgeable on said subject matter.

Main Findings:

Most of the management systems are tied to beliefs and rituals, some of which have scientific basis and others have direct relation to the social aspect and environment of the community.

Many aspects of the system can still provide a solid foundation in improving not only the indigenous fallow management but the whole shifting cultivation system.

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Recent Changes and Farmer Innovations in the Management of Shifting Cultivation Land in Bhutan

By T. Dukpa[*], P. Wangchuk[**], Rinchen[*], K. Wangdi[*] and W. Roder[*]

Shifting cultivation remains an important land use practice in the mountainous country of Bhutan. Depending, on climate, soil, and the natural vegetation developing during the fallow period, two distinctly different systems have evolved. The grass fallow system (*Pangshing*) mostly occurs at elevations above 2500 m while the slash-and-burn system (*Tseri*) is limited to elevations below 2000 m. Both systems are well adapted to the hilly topography and the available resources. Yet, increasing population density and rising expectations demand more productive systems, and reducing the area under shifting cultivation is an important objective of the Ministry of Agriculture, Royal Government of Bhutan.

Profitable alternatives available to farmers practicing grass fallow system include potato cultivation, white clover based pasture development, timber production, or combinations of them. Under favorable conditions, potato and apple cultivation is also possible. The fast growing blue pine (*Pinus wallichiana*) in grass fallow shifting cultivation can produce annual increments of 8-15 m3. Options available for the slash-and-burn systems include conversion to dry land agriculture, paddy cultivation, orange orchards, cardamom, private forestry and pasture.

These alternatives have become possible through the combined effects of farmers' innovations, access to markets, changes in rules and regulations, and government development programs.

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Changing Land Use Practices by Farmers in Luang Prabang Province, Lao P.D.R.

By Rogier Eijkens* and Phanthong Masixonxay*

The subject of this study is to investigate land use changes in four villages in Luang Prabang Province, which were involved in the FAO / UNDP project "Forest Development and Watershed Management in Northern Laos" from 1982 to 1989. The major goal of this study is to make an assessment of the perception of farmers in the above mentioned villages concerning the need to change land use practices from traditional shifting cultivation to a more stabilized agricultural system and the ideas they have to achieve this. This is facilitated by asking them about their project involvement, usefulness of its activities and suggestions for improvement of land use practices.

During the survey to collect data for this study it became clear that farmers seem to agree on the fact that continuation of the traditional shifting cultivation practices in the area will cause further decrease of forest cover, increased soil erosion and deteriorating living conditions.

Although, the situation and responses in the villages were somewhat different most farmers showed appreciation for the assistance by the project mainly because of: introduction of new agricultural techniques, increased awareness and provision of means to better protect forest resources and purchase of food supplies in exchange of work carried out for the project. Most of their suggestions for improvement of the kind of activities implemented by the project reflected the overall lack of taking into account village specific needs and rather using a blue print method. Ideas expressed by the farmers concerning improving land use practices (real improving agricultural practices) mainly comprised: continuing improvement of agricultural techniques, introduction of new (cash) crops, better accessibility to credit and donor assistance to provide them with more specific case to case needs.

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Improved Fallow Techniques in San Jose, Occidental Mindoro, Philippines: A First Step Toward Upland Management Based Primarily on Perennial Species

By Michael Robotham*

In the Philippines, most studies of local upland management systems have focused on ethnic minority groups. However, members of lowland-based ethnic groups who have migrated into the uplands make up the fastest growing segment of the upland population in many parts of the country. Although some are more recent arrivals, a significant number of these migrants have lived in upland areas for as long as two or three generations. In this time they have developed systems using a variety of alternative practices to successfully, productively, and sustainably manage their land holdings.

Data collected from field observations and farmer interviews is used to describe and analyze the current land management systems in two upland communities in San Jose, Occidental Mindoro, Philippines. The traditional management system, based on shifting cultivation of annual crops, is changing to a more intensive but potentially more sustainable system through the incorporation of several alternative practices including: retention of useful tree species during the shifting cultivation cycle, planting of leguminous perennials at the end of the annual-crop cultivation period, and planting fruit trees or fast-growing timber trees during and at the end of the annual crop cultivation period. Nearly all residents are using one or more alternative practices on at least part of their land holdings, but very few have completely shifted away from the traditional shifting cultivation system.

All of the alternative practices address residents' desire for additional cash income within the local environmental and socio-economic constraints, and some (fruit orchards and timber plantations) have extremely high estimated net returns. However, the most commonly adopted alternatives (species retention, leguminous perennials and scattered fruit trees) produce net returns similar those from the traditional system. These results and discussions with residents suggest that the timing and diversification of income sources may be important additional considerations. Other factors such as initial investment capital, infrastructure, information availability and management skill also need to be addressed to facilitate the shift toward upland management systems that are more ecologically sustainable but depend on information and materials flows from outside the individual family and the local community.

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Local Knowledge of Traditional Shifting Cultivation in the Midlands of Northern Vietnam's Mountainous Regions

By Nguyen Thi Thanh Nga*

With regard to the relation between natural environment and the ethnic distribution as well as the living way ethnic groups, this region may be classified in both theory and practice, in two manners, according to the altitude or the west direction of the territory.

1. Classification according to the altitude.
   - After this classification to the altitude, we have three distinct areas: Highlands: Hmong - Yao Midlands; Midlands: Tibeto - Burmese; Lowlands: Tay Thai and Viet - Muong.
2. Climatic, topographic and ethnic particularities of each area.
   - Each ethnic group lives in an area with peculiar geographic conditions. Its behavior is adaptable to the living environment, and its farming methods are suitable to its subsistence.
   - Most interesting to us is the rotation farming (cropping), an aspect of intensive cultivation of traditional swiddens much to the liking of some Mon - Khmer groups and a number of Yao. In this paper, we would like to concentrate on this matter.
3. Uniformity of the cropping mode with ethnic groups living on sloping hills (midlands).
   - Swidden farming is most convenient to local population since water does not stagnate on sloping hills (midlands), and exploitable land is uneven.
   - Not only ethnic groups of the Mon-Khmer linguistic family and a number of Yao in Vietnam but also practically all Mon-Khmer and Malayo-Polynesian groups in the Pacific are partial to shifting cropping as their staple farming mode for subsistence and development.
4. Farming implements.
   - Farming implements are: knife, machete, axe, poking stick.
   - (The farming process is illustrated through the use of farming implements by the Yao, Khmu, Mang, Xingmun. The knowledge and the adaptability of these people is described in the paper).
5. Different stages of production.
   - These stages are described in the strength of:
   - The selection of land destined for swiddens, for rotation cropping, planting in alternate rows.
   - Farming experiences of various ethnic groups.
   - The rotation process, nourishing the forest to eat the forest.
   - Slash-and-burn skills.
6. Experiences in selecting varieties of plants suitable to the land so as to ensure a stable productivity for swiddens.
   - Swing techniques
   - Planting in alternate rows (a feature revealing the knowledge of the ethnic groups)
   - Weather and climate forecast on the strength of natural phenomenons
   - Care given to swiddens and crops
   - Harvesting of paddy, maize and other cereals.

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7. Agricultural rites concerning
   - The protection of land
   - The protection of forests
   - The protection of crops
   - The prayer for rich harvest
8. Summing up of what has been presented in the paper:
   - The behavior of local population in face of the environment of each locality.
   - A few ideas expressed about the preservation and development of the farming knowledge of various ethnic groups as precious cultural heritage. Minorities should be helped to develop their economy and society while safeguarding a healthy environment for their native place.

Improving and Uses of Fallow Lands in Barren Hills of Sandiu People in Luc Ngan District of Bac Giang Province of Northern Vietnam

By Ta Long*

Before 1989 barren hills here was in fallow fore the purpose of buffalo herding. Since 1989 household and market economy have been introduced , therefore barren hills have been reclaimed for fruit tree, mainly litchi tree.

This paper represents as in the following sectors:

- The application of traditional cultivating system and newly-introduced crops aiming at improving and exploring of land fund of Sandiu people in local.
- The economic productivity and effect of improvement on fallow caused by cultivation systems (beans, subsidiary dry crops and fruit trees). As a result these effectiveness control the select of cultivated strategy.
- Agricultural consequences of litchi tree planting and weakness in improving and using capacity of fallow.

The above mentioned studies would be represented in the tables of graphs.

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Agroforestry Production Practices of Minority Groups in Vietnam's Northern Mountainous Region

By Tu Quang Hien*

The report includes 4 sections:

The first section introduces briefly socio-economic situation of Vietnam's Northern Midland and Highland: 1) Natural background; 2) Socio economic situation; 3) Policies considerably affecting mountainous region.

The second section introduces ethnic minorities inhabiting in Vietnam's Northern mountainous region, household systems, farming system of some main groups such as Hmong, Yao, Tay, Thai, etc.

In terms of household system, three sub-systems will be mentioned, namely: 1) Shifting cultivation of wanderers, 2) Shifting cultivation and sedentary abode, 3) Sedentary farming and abode.

In terms of farming system of each group, the report will focus on: socio-economic situation of the group, traditional farming system, the system's characteristics and the improvement of the system. These contents will cover in detail indigenous strategies for intensification of shifting cultivation in the region.

The third section will present typical Agro-Forestry combination system in Vietnam in which the following contents will be mentioned: 1) Agro-Forestry combination systems, 2) Advantages and shortcomings of the systems, 3) Improvement direction and the project of the systems.

The fourth section will present further research orientation and direction of expanding typical systems accepted by farmers and direction of promoting research co-operation.

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Shifting Cultivation in the Central Highlands of Vietnam: Existing Problems and Suggestions for Control

By Phan Quoc Sung* and Tran Trung Dung*

Central Highlands is one of the 8 economic zones of Vietnam. The region covers a natural area of 5.6 million hectares. Total population of the area consists of 3.1 million people, 30% of which are ethnic minorities from 37 ethnic groups, whose livelihood is essentially based on swidden agriculture.

Shifting cultivation is traditional land use method of ethnic minority people and is one element of their traditional culture. In the Central Highlands of Vietnam it was intelligent way of ethnic minority groups to manage tropical rain forest for long time, and adapted to their self-sufficiency. Traditional slash-and-burn practice in the Central Highlands characterized by rotational cultivation.

At this time social economic situation in Vietnam and in the Central Highlands become unsuitable for shifting cultivation activities. Nowadays shifting cultivation became a deteriorating factor to the natural and environment, and could not meet the food demand of local communities living by this practice.

To improve physical property and fertility of the soil by organic matters through chemical fertilizer is suitable. Planting green manure legume crops and incorporating into the soil of all biomass or using other organic fertilizers are necessary to meliorate degraded soil

The studies of shifting cultivation of each ethnic groups in different ecology - economic zones are necessary for sedentarization and making economic development program for each group.

Concentrate investment of resettlement program for the reducing of shifting cultivation around national parks, nature reserve and protected areas or where have enough condition (transportation, market, knowledge of local community ...) to change this practice to the other kind of land use as development of industrial trees, paddies rice, livestock basing on concrete natural and social conditions of the area and suitable with traditional customs of ethnic groups.

Improve knowledge of local community on environment and sustainable development through establishment of training and education activities. To turn development activity in to auto-development of the community by supporting needed condition for them, such as: credit activity, extension activities on both of technical and economic management knowledge.

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PNG Highland Experiences and the Future of Shifting Cultivation

By Bire Bino*

Most areas of the Papua New Guinea highlands is experiencing the most dynamic change from the low intensive shifting cultivation to more intensive semi-permanent to permanent cultivation. This was brought about by rapid increase in population densities especially in the central highlands valleys caused by movement of people from marginal areas to the more fertile valleys. About 80% of the highlands population obtain their living from subsistence farming.

The most obvious changes are in the intensity of cultivation and cropping pattern. In densely populated areas, there are already signs of decline in productivity and shortage of basic needs (food, fuel, etc.) to support a farming households because of the human pressure on the natural resources.

This problem has necessitate people to adopt changes in the farming practices in order to sustain subsistence productivity. These innovations include planted fallows, crop rotations and soil conservation techniques.

Native forests on hillsides have been pushed back as a result of the pressure for farming land. After farming, these areas are normally taken over in some cases by secondary forest but in most cases by grassland. Many areas which once had forest are not given the chance to regenerate forest trees due to more intensive frequent cultivation and regular burning of grasslands.

Farmers have realized the importance of forest fallow in maintaining the crop productivity as such in highly densely populated areas, people are selectively using certain tree species for following the land and or in agroforestry systems. The most common tree in the highlands in *Casuarina oligodon* which is planted for variety of purposes. These include planted fallow, shade tree for coffee, in agroforestry systems and as ornamental around homesteads.

Other tree species that worth mention *Eucalyptus grandis* in swampy areas, *Pinus* species in grassland areas and *Parasphonia spp.* In the cooler high altitude areas. Farmers have selected particular tree species and adopted them for particular environmental conditions. These trees play both service and productive functions to the farmer.

The Government of PNG have realized this problem and under the government white paper have given the mandate to Agriculture Research to undertake studies to improve and develop low input sustainable farming practices. As such agroforestry research is currently undertaking research along that line to improve upon farmers practices. Agroforestry research in the highlands is quite recent and past studies include evaluation of multipurpose tree species, soil fertility maintenance studies and intercropping studies. The programme had its setback due to irregular government funding but it is hoped that with the establishment of PNG National agriculture Research Institute, this programme will play a major role in researching these problems.

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