

Plenary Session IV.

Retention-Promotion of Volunteer Spp. with Economic / Ecological Value



A Batak farmer in Palawan, the Philippines, continues to revisit swidden fallows to gather Piper beetle and other crop remnants.

Plenary Session IV. Retention-Promotion of Volunteer Spp. with Economic / Ecological Value

Oral Presentations:

Relict Emergents on Fallow Swiddens of the Lawa in Northern Thailand: Ecology and Economic Potential

By Dietrich Schmidt-Vogt*

The paper is based on an intensive survey, from 1990 to 1992, of the ecology and economic potential of secondary vegetation on fallow swiddens of various ethnic groups in Northern Thailand, among them the Lawa. The Lawa form a small ethnic group, which has become famous for its conservation-oriented form of rotational swidden farming with short cultivation and long fallow periods. The most conspicuous characteristic of this type of swiddening is the practice of retaining a relatively dense cover of relict emergents on their swiddens by a process of selective felling in the course of clearing swiddens. These emergents contribute to the structural complexity of secondary forests, once they are established. In order to take advantage of the opportunities provided by the improved transport situation in the north, many Lawa villages have abandoned swiddening, at least partially, planting cash crops under the cover of the relict emergents. The village, where this study was carried out, was still practicing the traditional Lawa swiddening system at the time when field work was being carried out, but efforts were already under way to introduce cash cropping. Options were discussed with the villagers to utilize fallow forests and relict emergents for the transformation of swiddening to agroforestry or to a forest use system for the production of forest and non-forest products based on their practice of selective felling.

Keywords: swidden farming, protection and use of coppices, fallow forests, northern Thailand

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Successional Forest Development in Abandoned Swidden Plots of Hmong, Karen and Lisu Ethnic Groups

By Chaleo Kanjunt^{*}

The Sam Mun Highland Development Project (SMHDP) has involved local forest communities, the Royal Forest Department and other agencies in efforts to achieve both community development and forest protection. Under SMHDP, the scope of local participation in forest land management activities has been expanded from the field level to include community and watershed levels. During this process, the importance of forest succession has taken on new significance as areas previously used for agriculture are re-designated for land uses to provide other service functions for the community that require permanent forest cover.

This paper describes plant succession on formerly-cultivated agricultural fields of three different ethnic groups practicing different types of shifting cultivation in the highlands of northern Thailand: the Karen, who practice a short cultivation-long forest fallow system, and the H'mong and Lisu, both of whom practice a long cultivation - very long forest fallow or 'abandonment' systems. Survey plots were laid out in a chronosequence of sites up to 18 years since crop cultivation. Location, height, girth, basal area, species of trees and stand structure were investigated and analyzed.

Distinct differences emerged between fields of different ethnic groups. Development of vegetation toward a forest structure is very rapid for the Karen, and slowest for the Lisu. Karen management produced well-established and well-tended growth of trees with good options for future use after 10 years, whereas the Lisu management system had not produced closed cover even after 12 years due to the manner of cropping, weeds and frequent fires after abandonment. The Hmong management system produced intermediate results.

Agricultural practices prior to and during cultivation, as well as interventions after abandonment of crop cultivation, all appear to have an influence on the successional process of forest re-establishment. Traditional Karen management practices aim to rapidly re-establish forest cover for future agricultural use, whereas Lisu and Hmong management practices do not. Thus, establishment of secondary forest cover for watershed functions or community forest purposes appears to be more rapidly attained in areas of Karen management.

Keywords: fallow management, natural forest regeneration, hilltribes, highlands, northern Thailand

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**Wildfood Plants: Alternative Species from Fallow Lands
of the Cordillera Region, Philippines**

By Fatima T. Tangan^{*}, Philippines

Wildfood plants are abundant in the upland communities of the Cordillera region, Philippines. They are utilized by the indigenous dwellers of the region who practice swidden farming within the buffer zones of forest reserves and even in national parks.

The practices employed by the different tribes in the Cordilleras on how wildfood plants are used during fallow periods in their kaingins shall be presented.

Likewise, the different wildfood plants and their economic importance, their uses in the daily lives of the people (food, raw or processed) shall be discussed.

The role of men and women relative to wildfood protection and utilization shall be mentioned.

To support the paper, a slide show shall be presented during the delivery of the paper.

Kammu Fallow Management in Lao P.D.R.

By Damrong Tayanin^{**}

The paper deals with the Kammu swidden fields which are used in an 11 years cycle. The field are used one year only for growing rice. The first and second year fallow is described in some detail. The fields are very wide and cannot be used to any larger extent for other crops. Apart from that people do not want to use the fallows too long, partly in order to let the trees grow up again, partly because the paths get overgrown, partly also because the users are regarded as responsible for the field as long as it is used. Problems with landslides and Imperata grass are also touched upon. Finally garden plots and the acquisition of vegetables are briefly described.

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Farmer-Initiated Forage Management for Stabilization of Shifting Cultivation Systems

By Viengsavanh Phimphanhongsod* and Peter Horne**

In Laos, increasing population pressures in shifting cultivation areas have resulted in shorter fallow times between subsequent rice crops (down from 15+ year fallows to 4-6 year fallows now). With shorter fallow periods, soil fertility declines, crop yields decline, weeding requirements increase and the area cultivated by each family becomes smaller. The net result is reduced food security (in some areas farmers can only produce enough rice to feed their families for 6-8 months each year). Farmers in this situation are forced to rely more heavily on other sources of income or food. Livestock, especially cattle and buffalo, often provide the major source of cash income into rural households in shifting cultivation areas. Livestock are also increasingly valuable as the only source of fertilizer (manure) that can be used to maintain or increase soil fertility in small irrigated areas or homegardens.

With declining traditional feed resources, some shifting cultivators in Laos are developing new ways of managing native forages as part of their swidden systems. In addition, some selected forage species have potential to improve fallows (both as feed and as green manure), but until now they have not been used by farmers. This paper describes both farmer-initiated and potential forage strategies and addresses the question "how can the best features of both be brought together?"

This is the story of Ban Phousi, in the remote hills of Phoukout District of Xieng Khouang Province, as told by the villagers. During the [Vietnam] war, their village area was heavily bombed. The villagers fled, returning only after the situation became safe. All the forests on the hills surrounding their village had been destroyed by bombing and fires. The stream that flowed past their abandoned rice fields flooded in the wet season and stopped flowing during the dry season. Few fish, a staple food, could survive. The villagers had little choice but to slash the weeds growing on the hills and plant upland rice to survive. However, they could not farm all of the hills and they noticed that, as the forest started to grow back, the stream started to flood less in the wet season and flow more during the dry season. They also knew that if they could reclaim their small lowland rice fields, there would be less need for the laborious and unrewarding task of shifting cultivation.

As their livestock numbers slowly increased, they were able to use the manure to increase the fertility of the lowland soils and to expand the area of paddies. By 1993, most farmers were able to stop slash-and-burn agriculture and rely on the production from their paddies. However, during the wet season, their cattle are always let loose in the hills to graze so they don't damage the irrigated rice. This meant losing much manure, which is now a valuable cash earner in the village. They decide they needed to keep their animals penned close to home as often as possible, but what to do about feeding them? Several farmers heard of forage trials that were being conducted nearby and they collected some plants of *Brachiaria decumbens* to try for themselves. Now they have started to spread *Brachiaria decumbens* around their village in the hope that they can provide more feed for their animals closer to home and therefore have more manure for their fields or for sale.

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Poster Presentations:

Commercialization and the Stimulation of Economically Valuable Species in the Fallow Vegetation by Bidayuh Shifting Cultivators in Sarawak, Malaysia

By Paul Burgers*

The fallow vegetation and surrounding primary forest has always been managed by shifting cultivators based on avoiding the over exploitation of forest resources.

Forest products play an integral part in the rural economy of shifting cultivators, providing the household with "free" basic needs, from food to construction materials, inputs for agriculture, firewood and a necessary cash income from selling forest products. But a loss of forest areas through large scale commercial logging and other forms of large scale exploitation has affected this indigenous fallow management systems. While the collection of some products diminish and are gradually replaced by the collection of others, commercialization of shifting cultivation, market demand for "natural" products and shortage of natural supply increased the commercial value of forest products.

A case-study has been carried out on this topic among a number of such communities in Teng Bukap Subdistrict, Sarawak, Malaysia, in the framework of a larger study on the process of commercialization of agriculture. One particular feature of the research area is that it comprises both accessible areas and areas of poor access. The accessible areas can be reached by road, areas of poor access can only be reached by foot. It was assumed that the accessibility factor would have a significant influence on the nature of fallow management, because the capital of Sarawak, Kuching, is relatively nearby and accessibility offers possibilities to sell products in its markets, which have a divers market function. Respondents in the "accessible area" are able to sell "fresh" products like ferns, bambooshoots, and insects. On the other hand, the distance to this market limits the type and quantity of forest products in the areas of poor access. The main crops sold in this area are less perishable like rattan and bamboo.

Hindered by a limited, decreasing natural supply, households are looking for ways to improve their subsistence and cash economies by incorporating vital forest products into the fallow vegetation on a more commercial scale. Rattan and bamboo are planted and the fallow vegetation is manipulated to promote "vegetables" like ferns. A more active and individual fallow management has developed to ensure a sustainable harvest from forest resources.

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The Potential of Wild Vegetables for Permanent Cultivation or as Fallow Management Crops in Shifting Cultivation, Sarawak, Malaysia

By Ole Mertz^{*}

Wild plants are extensively used by shifting cultivation communities in Sarawak and represent an immense economic potential. Research into the cultivation potentials of selected species is a priority of the Sarawak Department of Agriculture and the present study looks into the potential of five vegetables in one community. On-farm trials with selected households were designed to test the acceptability of cultivating wild plants and the results were assessed mainly through interviews and observation of practices. Supportive research on the agronomic and market potentials of the same crops was also carried out. It is concluded that the community has a genuine interest in including these vegetables in their production system which may improve the regularity of household vegetable supply and income levels, and that there is good potential for their cultivation as fallow crops or intercropped with cash crops. Moreover, the demand of local urban markets is substantial and export to the large East Asian markets could become important. The dissemination of information on these vegetables should be encouraged through the agricultural extension system when more research results on crop husbandry, cropping systems and post harvest technologies are available.

Keywords: non-timber forest products, domestication of vegetables, improved fallow, on-farm trials, ferns

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Selling *Imperata*: Managing Grasslands for Profit

By Lesley Potter^{*} and Justin Lee^{**}

Imperata cylindrica has been viewed widely as a troublesome weed and an inefficient land cover, requiring replacement by exotic plantations of timber or other cash crops. It is portrayed as resulting from shifting cultivation, an indicator of "critical lands" and exhausted field, impeding the forest regrowth essential for soil regeneration.

Imperata has been defended by anthropologists who argue that local people have encourage and maintained its presence, especially for hunting and grazing and for use as thatch. The contribution of these uses to smallholder livelihoods, however, continues to be overlooked or minimized by many experts and agencies. The benefits of *Imperata*, it is argued, are insubstantial and compare poorly with other land uses and crops. There are more nutritive fodder grasses and better alternative roofing materials. Governments and agencies have also ignored *Imperata's* silent retreat as it replaced in many sites by *Chromolaena odorata* or tough grasses. The decline of a weed of little value is seen as being of no consequence.

Smallholders, however, may be more dependent upon and value *Imperata* lands more strongly than we have been led to believe. This paper details the results of preliminary research showing that in numerous places in Southeast Asia, *Imperata* made into roof thatch is not just being used for household purposes but is generating crucial income for families and in some instances is becoming a highly valued commodity of the construction industry. Many local people, rather than celebrating the decline of *Imperata*, are making efforts to preserve its place in their communities. The methods farmers use to manage this 'crop', the patterns of its trade and various social, tenurial and biophysical reasons for its popularity are detailed.

Conclusions refer to situation where managing *Imperata* for sale is likely to be attractive to smallholders. It often occupies a spatial or temporal niche in the farming system which should be respected. Thus efforts should only be made to eliminate the grass after dependence on it by communities near and far has been thoroughly assessed.

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When Shifting Cultivators Migrate to Work in the Cities, How to Rehabilitate the Grasslands?

By Peter Hoare^{*}, Wichai Songwadhana^{**} and Borpit Maneeratana^{**}

The theme of the workshop is "trying to understand the array of farmer-generated solutions that have successfully permitted the intensification of shifting agriculture in the face of increasing land use pressures".

However, these farmer-generated solutions usually result in marginal increases in agricultural productivity, that become unattractive to shifting cultivators and their children once off-farm employment opportunities in the cities increase. Once the daily wage rate in the cities is double the village daily rate (and also more than double the return to family labour from most annual swidden crops) a rapid reduction in population pressure in shifting agriculture will occur. In Bangkok the minimum daily wage rate is now around \$5 to \$6 (U.S.) and in the villages in Nan about \$3 per day. Most people of working age in the 44 villages in the 912 square kilometers of the Upper Nan Watershed Management Project, in one of Thailand's most important watersheds, have migrated to work Bangkok and regional cities.

In the project area most of the shifting cultivators have no legal title to the land. After many years of shifting cultivation to produce subsistence hill rice, and corn and cotton cash crops, grassland dominated by *Imperata* results. The remaining older farmers who are habitual fire lighters. The development challenge now how to develop participatory fire management strategies that combine the limited resources of Government, the private sector NGO's, and the declining labour resources of the villages in the project area.

Considerable progress has been made in fire management in watershed areas where previously most of the grassland area was burnt annually. Where fire is excluded for 3 to 4 years natural forest regeneration begins. Some enrichment planting is also done,

The Royal Forest Department/Danish Cooperation for Environment and Development (DANCED) and NGO participatory fire management strategies include:

- creating awareness on the benefits of fire management by RFD, NGO's and project Community Coordinators
- ordination ceremonies with Buddhist monks to protect areas of remaining forest
- the definition of boundaries for each village to accept responsibility for fire management (including areas of forest reserve for which they have no legal title)
- the appointment of village fire volunteers with some financial assistance for fire fighting equipment and subsidy for village labour
- the making of fire breaks in December-January by Royal Forest Department around reforestation area and remaining forest areas
- the making of fire breaks by village people around areas for community forestry

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- a campaign for the remaining shifting cultivators to make fire breaks around fields before burning, and take water tanks and sufficient labour to control fires to fields before burning
- strong financial pressure exerted by village committees by developing their own rules and high fines for farmers who light fires that damage neighbors crops

Natural Forest Regeneration from an *Imperata* Fallow: The Case of Pakhasukjai

By Janet Durno^{*}, Tuenjai Deetes^{**} and Juthamas Rajchprasit

Imperata cylindrica is a pervasive vegetation in fallows that are subject to frequent fire. However, if fire is prevented, natural forest regeneration can occur in *Imperata*-dominated fallows which contain viable tree seeds and root stock. Within four to five years the regenerating trees will begin to shade the *Imperata* which eventually dies back under the forest cover. The succession of fallows to forest is utilized by upland farmers as an integral component of the shifting cultivation cycle.

Akha villagers who migrated to Pakhasukjai village in the Mae Chan watershed of Chiangrai province in the mid-1970s were forced to settle in an area dominated by *Imperata*, with small scattered patches of forest and bamboo. Requiring a community forest to supply basic needs as well as to fulfill spiritual requirements, the villagers delimited an area of *Imperata* fallow around their new village and protected it from fire through the annual construction of a fire break and the institution of fire-fighting teams. Eighteen years later, when the study on forest regeneration, management and use was carried out, the village was surrounded by a diverse forest comprised of evergreen and deciduous tree species characteristic of both primary and secondary forest types. However, while villagers continue to rely on the forest for many daily needs, forest resources are becoming insufficient to supply the needs of a growing population.

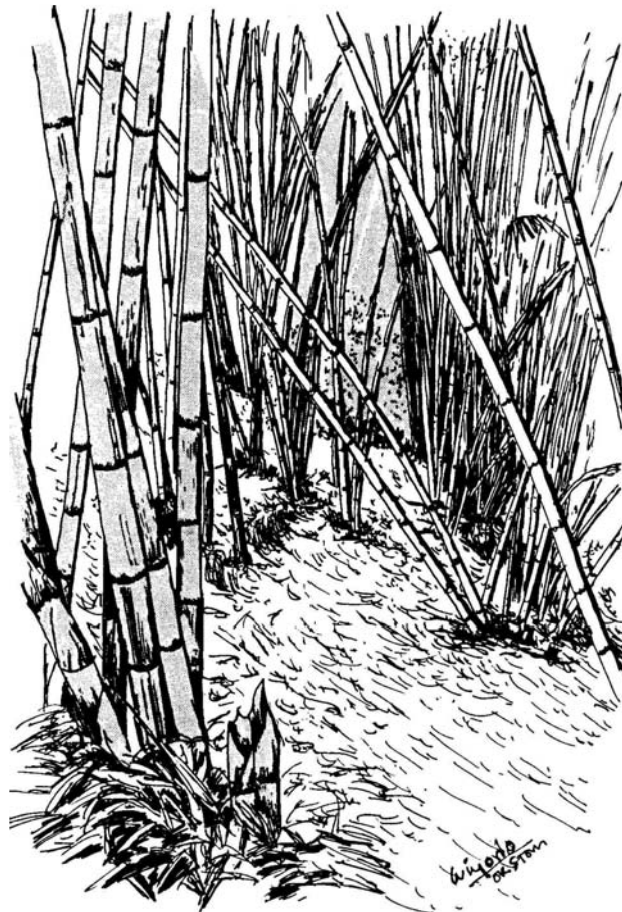
Despite the fact that land pressure in the area is now so high that farmers are virtually unable to fallow any of their fields, the village has continued to maintain the community forest as an integral part of Akha culture and livelihood. Given their uncertain legal status as dwellers in a protected watershed area, the desire to obtain land rights and Thai citizenship has provided an additional motivation for villagers to demonstrate their capacity to sustainably manage upland resources. The steepest fields have been taken out of production and followed for forest regeneration, while villagers look for methods to intensify crop production on their remaining farmland or migrate in search of work. Increased government recognition and support as well as the granting of legal security would assist the Thai hill peoples in their ongoing efforts to sustainably manage Thailand's watershed forests, including the regeneration of forests from fallow land.

Keywords: Akha, community forest, fire prevention, *Imperata cylindrica*, natural forest regeneration, reforestation

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Plenary Session V.

Perennial Annual Rotations



Sundanese farmers in Ciwidey, West Java, practice an intensive 'talun-kebun' fallow system-based primarily on marketable bamboo species. This practice, to be visited during the field trip, is remarkable for its adaptability to Java's high population densities..

Plenary Session V. Perennial Annual Rotations

Oral Presentations:

Forestry Management Strategies Among Hmong and Other Upland Cultivators of the Southwest China Borderlands: The Case of *Cunninghamia lanceolata*

By Nicholas Tapp^{*} and Nicholas Menzies^{**}

This paper, based on historical evidence as well as recent research in China, shows how forms of upland dry and shifting cultivation have been successfully combined with the management of plantation forest through examining the cultivation of *Cunninghamia lanceolata* (Chinese fir) pioneered by ethnic minorities in southwest China. The commercial values of *Cunninghamia* timber led to farmers perceiving timber as a crop in its own right rather than a by-product of clearing the land or a secondary crop grown for household needs. Agricultural intercropping with a wide range of cereal, cash, medicinal and oil-bearing crops formed a central feature of the traditional management system for *Cunninghamia*. Often the ecological practices of ethnic minorities have contrasted favorably with those of their Han Chinese neighbors. Evidence indicates that intercropping, long rotations, and patch cutting or leaving stands after felling (all traditional ethnic minority practices) contribute to sustainable *Cunninghamia* systems. Monoculture, short rotations, and extensive clear felling, of the type practiced today on China's state forest farms, appear to be components of non-sustainable systems. Such traditional systems demonstrate a possible trajectory of evolution from swidden systems in which land clearance for agriculture is the primary objective, to integrated 'composite swiddening agroecosystems' in which crops, livestock and trees all contribute in different ways to rural livelihoods.

Keywords: *Cunninghamia*, ethnic minorities, China, intercropping, sustainability

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Teak Production by Shifting Cultivators in Northern Lao P.D.R.

By Peter Hansen^{*}, Houmchisavath Sodarak^{**}, and Sianouvong Savathvong^{***}

Shifting cultivation is the most important farming system in Northern Laos, but population pressure and government regulations are increasingly undermining its productivity and sustainability. Identifying and promoting alternative production systems is a high priority of the Lao Government. However, farmers' adoption of new technologies is often hampered by the predominantly mountainous topography, the undeveloped infrastructure, the limited market demand, the relative poverty of the population, and by other factors. Teak (*Tectona grandis*) planting by shifting cultivators is one of the more promising possibilities, which has expanded rapidly since about 1988. Despite the high income potentials and ready adoption by farmers, the benefits of teak planting are limited by the inferior genetic material currently planted, by the inadequate management of farmers' teak plantations, by the competition with agriculture for the better land, and by the inability of farmers to hold on to plantations for 20-30 years. There are also concerns that plantations may be prone to serious pest attacks, excessive erosion, and soil depletion. Teak planting may provide an alternative or supplement to shifting cultivation, but is not likely to have a role in improved fallow systems.

Keywords: shifting cultivation, taungya, improved fallows, teak (*Tectona grandis*), Laos

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***Melia* spp. In Indigenous Fallow Management: An Experience from Northern Vietnam**

By Le Trong Cuc* and Tran Duc Vien**

Swidden cultivators in Northern Vietnam have developed and practice an fallow period management using *Melia* spp. The farmers using this multipurpose tree on their farms are from several minority ethnic groups, such as the Muong, Tay, Thai, Dzao and Cao Lan people, who have over many generations developed knowledge of tree husbandry in marginal areas. These practices are dynamic, responding to subtle socioeconomic pressures and to changing demands and opportunities.

Actually, *Melia* spp. is very relative with farmer not only in uplands but also in lowlands, and they are cultivated easily in every where in whole Vietnam. *Melia* is fast-growing and deep-rooted deciduous tree that occurs naturally in many forest stands. The leaves are considered to be a good source of green manure when applied to paddy rice, especially the summer crop. The leaves also used as a bio-pesticide to control of insects. *Melia* wood can be harvested 7-8 years after planting. The trunks are kept for some time deep under water, especially if covered by mud, then become high quality construction timber. Houses of *Melia* are popular in countryside. And, of course, the branches lopped when thinning or after harvesting are used as fuelwood.

There are several ways of using *Melia* in fallow management. The first is swiddeners sow *Melia* in the swidden seeds before burning, so that the heat encourages the seeds to germinate, and then they sowing rice seeds in the first swidden crop. They look after rice in the process tending the *Melia* nursery, too. After about 3 years when canopy of the trees has closed, local farmers stop cultivating rice, leaving the *Melia* strong enough to grow up on its own. Four or five years later, they return to cut the trees, then slash and burn for new period of swidden rice.

Because the *Melia* seed has the potential to survive in the earth for a long time (6-7 years), so when the farmer abandon swidden field for regeneration, the seeds spontaneously germinate and grow up. The Tay of Da Bac employ this method to establish the tree communities including some forest species, in which *Melia* dominates in fallow periods, and it call mixed-garden (vuon tap, A.T. Rambo 1995, field notes). The Dzao people in Yenbai Province also mix *Melia* with rattan, so that the *Melia* trunks become racks for rattan climbing.

We have not yet had the chance to do detailed studies on all of the mention systems, but it's clear that there are indigenous systems of fallow management in which *Melia* is the preferred spontaneous fallow species. We will offer interesting research focus in the near future.

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**Technical and Economic Innovations in Swidden-Based Rattan Cultivation
of Benuaq-Dayak People in the Middle Mahakam,
East Kalimantan, Indonesia**

By Hideyuki Sasaki*

This is a case study on Benuaq-Dayak's rattan cultivation combined with swidden agriculture (slash and burn agriculture, or shifting cultivation) in the Middle Mahakam, East Kalimantan, Indonesia. The case study concentrates on a species, *Calamus caesius*, locally called *sega*, which is the most popular species of the locally planted.

First, based on the data from my field work done in 1992 and 1996, this paper shows the following two characteristics of Benuaq-Dayak's rattan cultivation:

1. Benuaq-Dayak swidden farmers have traditionally developed rattan gardens by planting rattan seedlings on forest fallows of swidden agriculture. The rattan cultivation and swidden agriculture are well integrated in terms of ecology and economy of Benuaq-Dayak's livelihood. The swidden-based rattan cultivation has also transformed their practices of swidden agriculture itself and land tenure.
2. Having responded to increased market prices of rattan canes in the 1980's, the Benuaq-Dayak farmers have made efforts at expanding and intensifying rattan cultivation. They have changed ways of planting rattan and managing rattan gardens in order to increase both scale and productivity of rattan gardens. I argue that these changes can be called technical and economic innovations.

Second, based on the understanding of technically and economically innovated rattan cultivation, this paper examines how Indonesian government's policy of export ban of unprocessed rattan canes adversely affected Benuaq-Dayak's rattan cultivation and livelihood strategies.

This case study could provide not only an example of how important it is not to discourage people to continue their indigenous practices of agroforestry for rural economic development, but also an example of how easy it is for the government to ignore this importance for other reasons.

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Indigenous Management of Paper Mulberry (*Broussonetia papyrifera*) in Swidden Rice Fields and Fallows in Northern Laos

By Keith Fahmey^{*}, Onechanh Boonnaphol^{**}, Boonthanh Keoboualapha^{*},
and Soulasith Maniphone^{*}

Paper mulberry (*Broussonetia papyrifera*) is a shrubby tree which commonly appears as volunteers in swidden rice fields in northern Laos and regenerates in fallow vegetation. The inner bark of larger stems has long been harvested from bush fallows by villagers for local processing into a coarse-textured parchment. Recent development of a limited domestic processing industry and the opening of export market channels has encouraged farmers to retain paper mulberry volunteers in their rice swiddens and to begin experimenting with propagation and intercropping systems to intensify production of the cash crop in fallow fields.

Upland rice is currently grown on over 200,000 ha in Laos and accounts for 60-80% of annual rice production in several northern provinces. With increasing population pressures, fallow rotations in some areas have declined to as short as three years fallow, two years rice. Without application of modern agricultural inputs, productivity of the rice crop is low. Soil fertility and especially weed problems have become acute.

Lao government policy aims to stabilize upland rice cultivation and decrease the area under shifting cultivation. One possible strategy for stabilization is to increase the duration of fallows through enrichment with perennial species having cash market value. Longer-term maintenance of fallows is expected to provide weed suppression and soil fertility improvement benefits, as well as to provide cash for rice purchase and poverty alleviation.

A local paper mulberry bark wholesaler was interviewed to obtain information on the extent of regional trade in mulberry bark and the structure of local market channels and to assess future needs and market demands for the mulberry paper industry.

Province and district-level agriculture and forestry officers, farmer innovators, and households from 12 villages in Luang Prabang, Oudomxay, and Sayabouli provinces were interviewed in order to determine local knowledge of the botany, agronomy, and ecology of paper mulberry in swidden fallow progression and to determine what techniques are currently being employed to intensify paper mulberry production in upland rice and fallow fields.

The present range of interplanting systems and rotational practices is described. Knowledge gaps are identified and possible avenues for research aimed at intensifying upland rice production with enriched paper mulberry fallow systems are discussed.

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Poster Presentations:

Multipurpose Trees as Improved Fallows: An Economic Assessment

By Peter Grist^{*}, Ken Menz^{*} and Rohan Nelson

Traditional shifting cultivation in Southeast Asia appears to be economically and biologically unsustainable. Fallow lengths have shortened to a point where the objective of the fallow, to restore soil fertility, is not being met.

'Improved' fallows can hasten the process of soil fertility recovery, and provide alternative products for market. A bioeconomic analysis of one such improved fallow - namely a fallow involving a *Gliricidia* plantation on *Imperata* grassland is reported here. A *Gliricidia* fallow system is not commonly practiced by smallholders, but is modeled here to assess its potential as an alternative to traditional shifting cultivation systems. Regular pruning and mulching of the *Gliricidia* foliage improves soil fertility, and increases the yield of maize crops which follow the fallow. The analysis is undertaken using a computer model, which is an amalgamation of an existing biophysical, agroforestry model (SCUAF version 4), and an associated economic spreadsheet model.

The model predicted, that with a *Gliricidia* fallow, soil nutrient levels (carbon, nitrogen and phosphorus) can be improved and soil erosion reduced. This contrasts with the negative effects of an *Imperata* fallow. As well as enhancing maize production from higher soil fertility, *Gliricidia* can also provide firewood. The *Gliricidia* fallow system does require significantly more labour to operate, but this is compensated for by the higher level of productivity and new products. Overall, the *Gliricidia* system is more profitable, and more productive than an *Imperata* fallow.

Although this analysis has been undertaken as a case study, the aim of the work is^{*} to make a preliminary judgment about the potential suitability of *Gliricidia* fallow across broad areas of Southeast Asia. Consequently, the general trends and robustness of the analytical results are tested via sensitivity analysis.

Keywords: *Gliricidia*, *Imperata*, maize, smallholders, bioeconomic modeling

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A Cost-Benefit Analysis of *Gmelina* Hedgerow Fallow System in Claveria, Northern Mindanao, Philippines

By Damasa Macandog^{*} and Patrick M. Rocamora^{**}

Traditional shifting cultivation systems in the uplands requires a fallow period to rejuvenate soil productivity. Managing fallow areas by planting perennial trees like *Gmelina* is a possible alternative that can shorten fallow period due to faster improvement of the soil productivity fallow land. This study was conducted to compare the economic and ecological benefits of managing fallow lands by planting *Gmelina* trees along hedgerows.

A combination of research methodologies including farmer and sawmill operator interviews, secondary data collection and simulation of predicted maize yields using SCUAF was undertaken in this study. The research was done to assess the productivity of upland farms in Claveria, northern Mindanao, Philippines that plant maize for 3 years and fallow the land for 2 years compared with upland farms where *Gmelina* trees were planted along hedgerows during the fallow period. In the latter system, maize was planted along the alley areas in the first 2 years when *Gmelina* trees are still small and from the third year till harvest (seventh year), the alley areas will be under natural vegetation fallow. The natural vegetation is a source of animal feed.

Results revealed that the higher economic benefits gained from the *Gmelina* improved fallow system included revenues from maize yields, fuelwood from *Gmelina* prunings, *Gmelina* timber yield and animal related benefits such as draught power and liveweight gain. After 2 tree cycles, the cumulative net present value of the *Gmelina* hedgerow system is double that of the maize open field farming system. Farmers also reported environmental benefits including cooler air in the farm, more fertile soil due to leaf litter, erosion control, and provision of windbreaks in the farm.

Keywords: *Gmelina arborea*, improved fallow, cost-benefit analysis, maize farming system, timber production

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The Utilization of Dryland Through Bamboo Vegetation as a Fallow Crop in Timor Island, Nusa Tenggara Timur, Indonesia

By Abdullah Bamualiem^{*}, J. Triastono^{*}, E. Hosang^{*}, T. Basuki^{*}, S.P. Field^{**}

Bamboo plants (*Bamboosa sp.*) are generally adapted to semi-arid region in Timor Island, East Nusa Tenggara, Indonesia. There are few different species of bamboo found in Timor. A rapid rural appraisal (RRA) conducted in four villages in Timor Tengah Selatan (TTS) and Kupang districts indicated that there are four different species of bamboo in these areas. The Bambu Duri or thorny bamboo (*Bamboosa blumeana*) is dominated in hilly dryland areas, whereas the other three species, i.e., Bambu Licin or gleamy bamboo (unidentified Latin name), Bambu Ende or Ende bamboo (unidentified Latin name), and Bambu Petung (*Dendrocalamus asper*) are concentrated in wetter areas, either in flatted or undulated areas. The farmers on dryland areas have traditionally utilized Bambu Duri vegetation in their shifting cultivation system. The farmers prefer to choose the area, where bamboo are grown naturally, for shifting cultivation as the soil is considered to be fertile. The food crops generally planted in the area are maize, peanut, pumpkin and cassava. Perennial crops such as coconut and mangoes are also planted on the sites. The production of food crops is generally higher during the first year, then decreased significantly after three years. The farmers would then considered to leave the sites or to keep cultivate the land by exercising tillage in order to improve crop production of the area. The bamboo vegetation is also used for constructing fences, animal pens and housings. On the other hand, farmers on wetter regions are planted bamboo in limited areas on their yards for commercial purpose. The bamboo species in these areas are morphologically higher and bigger than on the dryland areas. The farmers received higher prices from selling bamboo (Rp. 7,500 - 12,500 per stick vs. Rp. 50 - 200 per stick for Bambu Duri produced in dryland). In general, the farmers in dryland areas tended to utilize bamboo vegetation as a fallow crop to improve soil texture and for other multiple purposes. In contrast, bamboo in wetter regions is primarily planted to gain more income for the farmers.

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