Plenary Session I.

Interstitial Tree-Based Fallows

The Angami, Chakhesang and Konyak tribes in Nagaland, N.E. India carefully manage Alnus nepalensis in their jhums (swiddens).

Plenary Session I. Interstitial Tree-Based Fallows

Oral Presentations:

Alnus nepalensis-Based Agroforestry Systems in Yunnan, Southwest China

By Guo Huijun*, Xia Yongmei*, and Christine Padoch**

Swidden cultivation continues to be an important form of land management in southern Yunnan Province, China, although population growth, increased market activity, and changes in policy, have led to a shortage of land for swiddening. In response to these changes, the indigenous people of Yunnan have developed many types of agroforestry systems that have helped intensify management of land previously used for swiddening. Research in 8 prefectures of Yunnan identified 220 types within 82 forms of agroforestry systems (Guo and Padoch, 1996). Agroforestry systems based on the cultivation of alder (*Alnus nepalensis) trees* are some of the most important types found in Yunnan. This paper describes alder-based systems and traces their development in a diversity of locations and by farmers of several ethnic groups in Yunnan. The authors also discuss the prospects for maintaining and further developing alder-based agroforestry in the face of economic change, policy shifts and population growth. The paper concludes that *Alnus*-based agroforestry systems should continue to play an important role in preserving environmental quality, improving cash crop production, increasing fuel supply, and enhancing rural economies in Yunnan.

Keywords: *Alnus nepalensis,* agroforestry, Yunnan, China, swidden cultivation

* Chinese Academy of Science / Kunming, Huguo Road No.22, Kunming, Yunnan, 650021, P.R. China. Tel: 86 0871 3331789; Fax: 86 0871 3324834; Email: hjguo@ms.kmb.ac.cn

** Curator, New York Botanical Garden, Bronx, NY, USA 10458. Tel: 718-817-8975; Fax: 718-220-1029; E-mail: cpadoch@nybg.org

Shifting Forests in North-Eastern India: Management of Alnus nepalensis as an Improved Fallow in Nagaland

By Malcolm Cairns[*], Supong Keitzar[**] and Amenba Yaden[***]

The remote and mountainous topography of Nagaland is the ancestral homeland of an array of ethnic minority groups known collectively as Nagas. The state's rugged terrain permits limited opportunities to carve bunded terraces in the steep slopes and much of the rural population continues to rely on variations of shifting cultivation (known locally as *jhum* cultivation) to meet livelihood needs.

Nagaland was historically a volatile region, characterized by intertribal warfare, head-hunting, and slave-taking. This paper presents a thesis that despite relatively sparce population densities, security concerns motivated several Naga tribes to develop an improved fallow system that enabled an intensification of land use close to the relative security of their villages. Farmers widely recognize that crops growing nearby *Alnus nepalensis* perform better; this observation provided the impetus for jhum cultivators to begin experimenting with cropping patterns to exploit the agronomic properties of alder on a more systematic basis.

Anecdotal evidence suggests that through centuries of trial and error, Naga farmers gradually evolved their contemporary system of maintaining *Alnus* stumps scattered throughout their jhum fields. The antiquity of the system is evident in farmers' estimates that individual trees are up to 150 years old, their careful management passed from generation to generation, almost as family heirlooms. During the fallow period, rapid coppice growth from these interstitial stumps forms a closed canopy and shades out light-demanding weeds. Significant N fixation and copious litterfall rejuvenates soil chemical and physical properties. Fallows are reopened by careful pollarding of the coppices flush with the main trunk. Harvested coppices are used for poles and firewood and the remaining slash is burned in the tightly controlled fires. Jhum crops, generally upland rice, maize, sorghum, millets and an array of secondary cultigens are then dibbled directly. This innovative manipulation of *Alnus* has permitted Naga farmers to intensify swiddening into a 2 years cropping - 2 years fallow cycle (total cycle length of 4 years), a relatively intense 1:1 ratio of cropping to fallow periods. Other than manure deposited by livestock grazing crop residues, no external inputs are applied in this system and crop yields are reported to be as high today as any time within memory.

This paper characterizes Naga management of *Alnus* as an improved fallow species imparting both economic and ecological benefits, and identifies emerging issues warranting further empirical research. It concludes that this system could provide an interesting prototype for swidden intensification, both in the Himalayan foothills where *Alnus nepalensis* is endemic, and more broadly across tropical highlands where other species of the *Alnus* genus may be similarly managed.

[*] ICRAF Southeast Asia Programme, Jl. Gunung Batu No. 5, P.O. Box 161, Bogor 16001, Indonesia. Tel: 62-251-315234, Fax: 62-251-315567, Email: ICRAF-INDONESIA@cgnet.com, icrafind@indo.net.id

[**] Joint Director (Research), State Agricultural Research Station, Post Box no.23, Mokokchung – 798601, Nagaland – India. Tel: (91-369) 23-537 (O)

[***] ACF Forest, NEPED POU, c/o Mr. R. Kevichusa, MH-14, Old Minister's Hill, Kohima 797 001 Nagaland, INDIA. Tel: 0370-22004; Fax: 0370-22572

Management of Fallow Species Composition with Tree Planting in Papua New Guinea

By R. Michael Bourke*

In response to increasing population pressure and demand for food to feed pig herds, villagers are intensifying land use in Papua New Guinea (PNG). Managing the species composition of fallow vegetation is one intensification technique used. The most important species used is *Casuarina oligodon*. Minor species include *Parasponia rigida*, *Schleinitzia novo-guineensis*, *Albizia* spp. *and Piper aduncum*. Casuarina is a multi-purpose species grown throughout the highlands that provides timber for fencing, firewood and house construction. In four regions of the highlands, villagers transplant self-sown seedlings into food gardens towards the end of the cropping phase to enhance soil fertility. These grow to form dense stands of trees which dominant the fallows.

Some 1.3 million people plant some casuarina trees and about one fifth of these manage fallow species composition with casuarina. The technique is most commonly used over an latitudinal range of 1400-2100 m; on steep land (over 20°); where the landform is hills or mountains; the lithology is sedimentary; vegetation is grasslands; and the annual rainfall is relatively low (2000-3000 mm). Land use intensity in these locations is very low to low. Limited soil analysis indicates that casuarina increases levels of nitrogen and carbon in the soil.

In two of the four regions where casuarina is used most intensively, the practice has been adopted since the 1920s. In another, it has increased greatly since the 1930s. Pollen evidence indicates that casuarina planting increased from about 500 AD in parts of the highlands. It is suggested that this represented limited planting but not widespread fallow management. It is hypothesized that the management of fallows by casuarina planting has been adopted more recently, probably over the past 150 years. It is concluded that there is potential for adoption of the technique in other locations in the PNG highlands. Many aspects of the tree and its use are poorly understood and deserve further systematic study.

Keywords: *Casuarina*, fallow, food, indigenous knowledge, swidden, tropical

* Dep't of Human Geography, Research School of Pacific and Asian Studies, The Australian National University, Canberra ACT 0200, Australia. Tel: 61-6-249-4345; Fax: 61-6-249-4896; email: rmbourke@coombs.anu.edu.au

Intensification of Indigenous Fallow Rotation Using Leucaena leucocephala

By Fahmuddin Agus*

Fallow rotation using *Leucaena leucocephala* has been traditionally practiced by farmers in Lilirilau sub district, Soppeng district, South Sulawesi province of Indonesia. Soil is planted to both annual and perennial crops, but annual crops including onion, corn, and tobacco occupy more than 50 % of land. Without or with limited chemical fertilizer inputs, soil productivity steadily declines and reaches an unacceptable level after 3 to 5 years under annual crop production. *Leucaena* plants then sprout from left over stumps that remained intact during the annual crop growing periods. *Leucaena* grows for about 3 to 5 years during which time the densely (30 to 50 cm irregular plant spacing) grown plant attains a height of 3 to 8 m. The *Leucaena* is then cut; the woody plant parts are used as firewood while the green parts are used as mulch. The soil (very fine, mixed, isohyperthermic Vertic Ustropepts) is naturally prone to rill and gully erosion due to the massive structure in the *B*-horizon. However, there is almost no sign of rill erosion under the *Leucaena* trees. This phenomenon is believed to be a result of increased soil infiltration capacity due to root channels penetrating layers of low permeability *B*-horizon and the effect of humus coverage which protects the soil from being eroded. With the traditional system, however, it requires 3 to 5 years of fallow to support the growth of annual crops for about the same length of time. In addition, at a catchment scale, the system is unable to protect the land from erosion due to discontinuity of the *Leucaena* forests. We believe that modification of the current system into continuous and permanent strips of *Leucaena* along the contour lines would improve the system in terms of erosion reduction. This modification requires only minimal adjustments from the indigenous practice, but the question is how to unite farmers to collaborate in the formation of these continuous strips.

Keywords: contour hedgerow, continuous strips, gully erosion, mulch, *Leucaena leucocephala*

* Center for Soil and Agroclimatic Research, Jl. Ir. H. Juanda 98, Bogor 16123, Indonesia. Tel: 62-251-621-987; Fax: 62-251-311-256 or 621-987. Email: f.agus@wasantara.net.id

The Role of Leucaena in Village Cropping and Livestock Production in Nusa Tenggara Timur, Indonesia

By Colin M. Piggin*

The islands of Nusa Tenggara Timur province in eastern Indonesia lie in the rain shadow of Australia, and have a semi-arid climate with a short wet season from December to March, and a long, hot dry season. Natural erosion can be quite severe when heavy rains at the start of the wet season fall on vegetation which has lost much of its leaf over the long period without rain. Increasing human populations and introduction and increase of swidden cropping, extensive wildfires, domestic livestock and weeds in the late 1800s and 1900s have accelerated losses of natural vegetation and lead to extensive land degradation over much of the province.

Between 1930s and the 1960s, villagers, Government institutions and non-government organizations recognized that more sustainable fallow systems were needed, and developed and promoted the use of leucaena [*L. leucocephala*] in the Province. Contrasting systems have developed and endured in the Amarasi and Sikka areas, and provide excellent examples of village adoption and use of shrub legumes in village farming systems.

The Amarasi system was developed in the 1930s, and is based around the use of leucaena forest as a fallow rotation for corn, and as a food source for tethered cattle and goats. The Sikka system was developed in the 1960s, and is based around the use of contour rows of *leucaena* to prevent erosion and allow the development of indirect terraces; crops such as corn, peanut and mung bean are grown on the terraces and mulched with leucaena clippings. These extensive systems both cover some 50.000 ha (70 and 30% of the Amarasi and Sikka areas) and have contributed substantially to farm production, wood supply and stabilization of the resource base.

The systems were placed under severe pressure and were in decline for several years after 1986 when the psyllid (*Heteropsylla cubana*) spread, multiplied and devastated *leucaena* over wide areas. This lead to increased use of other tree legumes in the systems, and the search and promotion of *leucaena* species tolerant to the psyllid. However, over time, the influence of the psyllid has waned and leucaena production and utilization have returned to pre-1986 levels.

This paper describes these contrasting systems, and draws conclusions about reasons for their success. They are examples of successful and robust cropping and livestock systems which have been developed and widely adopted by farmers. Lessons from these systems are valuable in considering the promotion and adoption of similar systems in other areas.

* Upland Rice Program Leader, International Rice Research Institute, PO Box 933, 1099 Manila, Philippines. Tel: 63-2-845 0563; Fax: 63-2-845 0606; Email: c.piggin@cgnet.com

Poster Presentations:

Pruned-Tree Hedgerow Fallow Systems

By Peter Suson* and Dennis Garrity**

Alley cropping was originally conceived as a sustainable replacement for fallow rotation, but many Asian farmers that installed pruned-tree hedgerow systems have been observed to fallow them after a period of time. Hedgerow systems may extend the cropping cycle beyond that possible with natural fallows, but do not eliminate fallowing without fertilizer application. Our survey of farmers that adopted contour hedgerows in Claveria, Mindanao, Philippines, elucidated two dominant reasons why they eventually fallowed their hedgerow systems: Inadequate farm labor to maintain the pruning regime on the hedgerows, or the crop productivity was observed to decline in the hedgerowed fields. The sample of farmers interviewed had tree fallows that ranged from 0.5 to 10 years.

We conducted studies to characterize the hedgerow fallow system and its prospective sustainability. Experimental findings from fields with fallowed hedgerows of *Senna spectabilis* (formerly Cassia spectabilis) that were reopened for maize cropping indicate that crop productivity and overall profitability was increased compared to cropping in adjacent plots with natural fallows of *Chromolaena odorata* or grass. We observed a major shift in fallow vegetation in the alleyways as a consequence of hedgerow fallowing. After three years the alleys were intensely shaded and dominated by broad-leaved species, suggesting that *Imperata cylindrica* is effectively suppressed.

We hypothesize that the extrapolation domain for pruned-tree hedgerow fallowing is most likely to be areas where farmers practice slash-and-burn cultivation in *Imperata* grasslands with manual cultivation without access to fertilizer inputs, where grassland fires can be controlled. Farmers in these environments may benefit from higher yields and reduced labor in opening the land from *Imperata*, although this is partially offset by the added labor to cut the tree biomass prior to cropping. The system is less likely to be acceptable to farmers with access to animal power. In such situations control of *Imperata* is manageable with draft power. Farmers with draft power are less likely to invest their labor in hedgerow pruning than farmers that cultivate manually. Hedgerow fallow systems have received little research attention thus far. Further comprehensive systems analyses of this alternative fallow-rotation concept are needed.

* S.E. Asian Reg'l Research Programme, ICRAF - Philippines, Claveria Research Site, c/o MOSCAT Campus, 9004 Claveria Misamis Oriental, Philippines. Tel: 63-0912-710-0798; Fax: (63-912) 7105324, Email: icrafphi@irri.cgnet.com

** Regional Coordinator ICRAF Southeast Asia Programme, Jl. Gunung Batu No. 5, P.O. Box 161, Bogor 16001, Indonesia. Tel: 62-251-315234, Fax: 62-251-315567, Email: ICRAF-INDONESIA@cgnet.com, icrafind@indo.net.id

The Use of Sesbania grandiflora (L) Pior, as a Farmers' Answer to Declining Soil Fertility in Swidden Agriculture in North Central Timor

By Johan Kieft*

Swidden agriculture in north central Timor has undergone major changes during the post war period. From a system based upon mainly subsistence agriculture in a feudal framework towards a market oriented system of agriculture. These changes combined with an increased population pressure and virtual disappearance of natural vegetation have forced the Timorese farmer to look for more intensive land use.

Two major development have initiated the use of *Sesbania grandiflora*. Firstly, the increased pressure on land and forest resources had led to short fallow periods in which natural vegetation was not able to maintain soil fertility by the early 70's. Secondly, the introduction of Bali cattle and an increase in market possibility for Bali cattle led to the introduction of new animal husbandry system. *Sesbania grandiflora* was able to fulfill both the need to sustain soil fertility within about fallow periods and the production of high quality fodder. Next to these *Sesbania grandiflora* has good initial growth compared with other fallow crops. This enables the farmers to leave the fallow unfenced after the crops (mainly rice, cassava, and maize) and harvested which is impossible with others.

The farmers have developed a system of maintaining an optimal number of plants during the fallow period by thinning and cutting trees. They try to find an optimum between wood production, fodder production for their cattle and maintaining a soil fertility for staple food production. The wood is needed for burning before planting and also for fencing the gardens. The fodder is fed to the bulls which are kept in a cut and carry system. Litter fall maintains soil fertility.

The case of *Sesbania grandiflora* in north central Timor gives good insight in how farmers try to develop strategies to cope with an increasing pressure on land and with an increasing incorporation in markets. It enabled them to bring the fallow period back for 8 years to 3 years, intensifying livestock production and sustaining the production of staples.

The use and management of *Sesbania grandiflora* is indigenous although the crop itself might have come from outside. Farmers have developed different strategies in using the crop depending upon their circumstances, both agro-ecological and socio-economical. What can be learnt from this case is the ability of farmers to intensify their land use to fulfill their needs. This ability and rationality of farmers which has lead to development of these strategies are of crucial importance for further development of agriculture. The neglect of these two factors has lead and still is leading to low adaptation rates of newly introduced technologies on Timor.

* Agricultural Advisor, Yayasan Timor Membangun, P.O. Box 46, Kefamenanu 85601, Nusa Tenggara Timur, Indonesia. Tel: 62-388-31355 / 31364; Fax: 62-388-31111

Initial Results in SALT Model Application and Some Recommended Solutions to Reduce Shifting Cultivation for Ethnic Minority Farmers in Daklak Province, Vietnam

By Phan Quoc Sung* and Pham Van Hien**

"Shifting cultivation and settlement" in the highlands under the pressure of natural and mechanical (new arrivers) population growth has become unstable and increasingly harmful to environment. This mode of agriculture typically consists of deforestation for new cropland devoted to monoculture, and by no mean resorts to fertilizers on traction forces, this gradually depleting the nutrients in the soil and making life harder to the people.

In this context, a research focused on finding a highland crop pattern which may prove stable and economically efficient is obviously of great necessity.

Ea Tam village, Ban Me Thuoc town, Daklak province has been chosen as a pilot point as it holds features typical of the natural, socio-economical conditions of the whole province.

The method of bottom-up approach through PRA (Participatory Rural Appraisal) has been applied in this research. The research proceeded in the following steps:

1. Defining the area and the point of focus.
2. Describing and diagnosing problems.
3. Designing the new pattern.
4. Experimenting technical components.
5. Running test crops, assessing the results.
6. Spreading the model to a larger scale.

Preliminary diagnosis showed the following major problems:

- Topographic complexity with 3 grades of slope.
- Low productivity of the highland rice, unsuitability, degeneration of the variety.
- Heavy erosion of the soils which become nutrient-depleted.
- Overwhelming prevalence of monoculture.

Results obtained from the 3 crop patterns experimented on the grades of slope:

- *Crop pattern for grade I slope (< 5°):* Highland rice alternated with strips of fertilizer plants (*Terphosia cadida*). The strips of fertilizer plants act as obstacles against down slope run-off, this keeping down soil erosion. The plant biomass when returned to soil considerably restored its nutrient composition. Soil analysis showed increase in total N% and organic component as compared to reference.

- *Crop patterns for grade II slope (5 - 15°):* Alternation between highland rice, red bean-corn raised in rows, cassia-trees arranged in strips parallel to elevation contours. As a result, nutrient wash out and soil erosion have been kept down, productivity of rice, read bean and corn together is higher than reference.

- *Crops pattern for grade III slope (> 15°):* SALT (Sloping Agriculture Land Technique): Combination of agriculture and forestry consisting of: cashew tree, fruit trees, coffee grown in rows parapet to elevation contours, as for highland

* Director, Tay Nguyen University, Daklak, Buon Ma Thuot, Vietnam. Tel: 84-50-852290; Fax: 84-50-855572
** Farming Systems Department, Agroforestry Faculty, Tay Nguyen University 3, Road No. 14, Km 4, Buon Ma Thuot City, Daklak Province, Vietnam. Tel: 84-50-852290; Fax: 84-50-855572; Email: endavn@netnam2.org.vn

rice it was grown alternately during the place of basic construction. The whole system yielded high productivity and the soil reclaimed considerably. SALT model therefore fields high economical and biological efficiency and reliable soil stability.

A rough conclusion after 3 years of research is that the bottom-up approach applied to the development of the Vietnamese agricultural system, as well as the application of crop patterns adequately designed to suit each particular case of slope and peasant resources, field high efficiency, insure good soil reclamation and gradually raise people's life standard.

The Naalad Improved Fallow System and Its Implications to Global Warming

By Rodel D. Lasco*

The main objectives of the paper are to provide an overview of the Naalad improved fallow system and to assess the contributions of the system to global warming.

The Naalad system is a *Leucaena leucocephala*-based improved fallow system. It was developed by farmers in the island of Cebu more than 100 years ago. There are two basic modifications from traditional shifting cultivation system. First, leucaena is deliberately planted in the fallow fields. This shortens the fallow period to only 5-6 years. Second, fascine-like structures called "balabag" which are made of leucaena branches are placed along contour lines in the cultivated fields to minimize soil erosion.

The fallow fields are able to sequester 40 t C/ha at the end of fallow. The mean annual C storage is 16 t C/ha. While the mean annual C accumulation is about 5 t C/ha. These figures are generally within limits of the reported C storage of agroforestry systems. The main advantage of the Naalad system is that no burning is done. However, the use of leucaena branches as fuelwood and the burning of tobacco leaf as cigarette also release C.

* Associate Dean, College of Forestry, UPLB College of Forestry, 4031 Laguna, Philippines. Tel: 63-94-536-2342; Fax: 63-94-536-3206; Email: rdl@mudspring.uplb.edu.ph

Plenary Session II.

Shrub-Based Accelerated Fallows

Artist: Wiyono, ORSTOM

An Igorot transmigrant in Bukidnon, the Philippines, slashes a young Tithonia diversifolia fallow.

Plenary Session II: Shrub-Based Accelerated Fallows

Oral Presentations:

Farmer-Improved Short-Term Fallows Using a Spiny Legume Benet (Mimosa Invisa Mart.), in Western Leyte, Philippines

By Edwin Balbarino*, David M. Bates**, Z. De la Rosa***, and Julito Itumay****

Fallows following upland crop production in western Leyte, Philippines are usually dominated by *Calopogonium mucunoides* Desvaux, locally known as nipay-nipay. This legume and other weed species are foraged by domestic animals, thus reducing their biomass and potential to improve soil fertility. Benet (*Mimosa invisa* C. Martius ex Colla), a weedy legume introduced to the area in the 1960's, joined nipay-nipay and other species as spontaneous invaders in corn fallows. Farmers recognize benet's value in maintaining soil structure and restoring soil fertility after harvesting corn. They observed that corn yield is greater following benet-based fallows than in nipay-nipay dominated fields. The spinyness of benet discourages grazing, hence, soil compaction is less and only two plowings, rather than three, are needed before planting corn. The benet-based, crop-fallow system provides compost, green manure, mulch and cover crops to the soil, restores soil fertility, and protects soil from compaction and erosion, thereby efficiently increasing the productivity of corn and other crops.

Keywords: farmer-improved fallows, short-term fallows, *Mimosa invisa*, Philippines

* Assistant Professor/Program Leader, FARMI, VISCA, Baybay, Leyte 6521-A, Philippines. Tel: 63-53-521-2027; Fax: 63-2-588-692 or 63-912-500-1898 (Baybay); Email: V+VISCA@sat.vitanet.org
** Professor of Botany, Cornell University, Ithaca 14583, New York
*** Study Leader, FARMI, VISCA, Baybay, Leyte
**** Research Assistant, FARMI, VISCA, Baybay, Leyte

Fallow Improvement in Upland Rice Systems with Chromolaena odorata

By Walter Roder*, Soulasith Maniphone**, Boonthanh Keoboulapha**, and Keith Fahrney**

In the absence of other opportunities farmers in the hills of northern Laos have to continue rice production in slash-and-burn systems spite declining labor productivity and economic benefits. Labor required for weeding is the single most important constraint to rice production. *Chromolaena odorata* is the most abundant weed and fallow species. After 1 year fallow *C. odorata contributed* 48% to the fallow vegetation and contained 54, 62, 67, and 54% of the above ground biomass N, P, K, and Ca, respectively. With progressing fallow period *C. odorata* is gradually replace by tree and bamboo species. *Chromolaena odorata*, although not palatable, does have many attributes of an improved fallow species specially: fast expansion after crop harvest, high biomass production, accumulation of plant nutrients, and fast decomposition rate. With repeated rice cultivation *Chromolaena odorata* was partly replaced by *Ageratum conyzoides* and the nematode (*Meloidogyne graminicola*) density increased from <10 to 740 nos. g^{-1} root. Nematode and *A. conyzoides* density was negatively correlated to rice yield. *Chromolaena odorata* may not only reduce *A. conyzoides*, but also nematode density. The majority of farmers interviewed acknowledge the positive effect of *C. odorata* fallow on a succeeding rice and felt that fallow periods can be shortened thanks to *C. odorata* presence. Yet they had limited confidence in its weed suppression, most would not like to have more *C. odorata* in the fallow vegetation. Only 11% reported to make some efforts to increase its presence. The species effects on nematodes, allphatic effects, efficiency in nutrient mobilization and its effect on biological, chemical and physical properties need further evaluation.

* Renewable Natural Resources Research Ctr, Min. of Agriculture, P.O. Jakar, Bumthang, Bhutan. Tel: 975-3-31194; Fax: 975-3-31218
** Upland Agronomist, Luang Prabang Agricultural & Forestry Service, P.O. Box 600,Luang Prabang, Lao PDR. Tel/Fax: (856-71) 212-310; Email: keithf@ksc15.th.com

Spontaneous Adoption and Management of Tecoma stans Fallows by Local Farmers in a Semi-Arid Region of East Nusa Tenggara

By Tonny Djogo[*], Muhamad Juhan[**], Aholiab Aoetpah[**] and C. Nalle

A research to investigate a system of fallow generated by local farmers was conducted at three villages, i.e, Bello, Fatukoa, and Tunfeu, Kecamatan Maulafa, Kotamadya Kupang, East Nusa Tenggara. People living on agriculture is about 80 percent of the population and their income from food crops, animal husbandry, fire wood, and selling stone. The study area consists of harsh biophysical environment with long dry season, cropping systems, cultural groups and influences shaping the current agricultural production systems.

Simplified Agroecosystem Analysis with Rapid Rural Appraisal (RRA), Survey and observation as well as dialogue were employed for collecting data. Data ware analyzed using agroecosystem analysis approach.

Soil samples were taken by digging the topsoil down to the depth of 40 cm consist of two layers , 0-20 cm and 20-40 cm respectively. Soil physical characteristics were visually analyzed including the use of Munsel Soil Color Chart. Selected soil samples were sent to Bogor Soils Research Institute for routine chemical analysis.

The area covers coral type landscape with Mediterranean type of rocky soils with several characteristics such as : the average solum depth is 20-70 cm, yellowish-red soil colour and silty. The topography is hilly with 20-30% slope on the altitude of 300-350 above sea level.

Tecoma stans locally called 'hau sufmolo' or 'bunga kuning' (yellow flower) is used during fallow period. This plant can grow amongst the coral rocks in the dry season on marginal soils. Its rapid regeneration allows farmers to utilized for fallow fire wood production and in certain condition can be used as forage over the dry season.

The number of farmers adopted the fallow system is about 70% of the total population with various period of fallow system between 1 to 10 years between farmers to farmers. One of the indicator used by farmers for making decision on the duration of fallow period is the plant canopy and organic matter accumulated on the soil surface.

The main crop planted is ground-nut (*Arachis hypogea*), either as monoculture or multiple cropping with cassava (*Manihot utilissima*), pigeon pea (*Cajanus cajan*), and pumpkin (*Cucurbita argyrosperma*).

Some socio-economic aspects, biophysical condition, physical infrastructure briefly identified and analyzed.

[*] Nusa Tenggara Upland Development Consortium, Politeknik Pertanian, Universitas Nusa Cendana, PO Box 1152, Kupang, Nusa Tenggara Timur 85011, Indonesia. Tel: 62-391-22836; 32292; Fax: 62-391-22836; 26865; Email: djogo@rad.net.id

[**] Lecturer, Agricultural Polytechnical College, Politani UNDANA, P.O. Box 1152, Kupang 85011, NTT, Indonesia. Tel: 0380-26876; Fax: 0380-26865

Poster Presentations:

Management of Austroeupatorium inulifolium-Based Fallows by Minangkabau Farmers in Sumatra, Indonesia

By Malcolm Cairns*

Shifting cultivators widely associate some naturally-occurring fallow species with accelerated soil rejuvenation and deliberately intervene to promote their dominance in succession communities. This minimalist approach to fallow management allows labor-short farmers to improve the biological efficiency of the fallow phase. Key fallow functions of soil rehabilitation and weed suppression are accomplished more quickly - allowing a shortening of the fallow period and intensification of the swidden cycle.

Although prolific seeding, rapid establishment, and aggressive competition for available soil nutrients earns these pioneer species the reputation of noxious weeds in more permanent farming systems, paradoxically these same properties are effectively harnessed swiddenists in managing them as spontaneous cover crops or green manures.

Past research on candidate species for improved fallows has focused almost exclusively on N-fixing species. A growing body of literature indicates that it may be equally important to consider species that can play a nutrient conservation role - by efficient scavenging from labile nutrient pools that might otherwise be lost through leaching and run-off during the early fallow period - and immobilizing them in the vegetation biomass. These conserved nutrients can them be directed to crop production when the fallow is reopened for cropping.

Chromolaena odorata, *Tithonia diversifolia*, *Austroeupatorium inulifolium* and other *Asteraceae* shrubs have similar beneficial agronomic properties that make them promising fallow species. All are endemic to the Neotropics and appear to have been introduced into Southeast Asia only within the last century. Their rapid spread in the region may, in part, be attributed to a lack of natural enemies in their new environment.

This paper presents an illustrative case study of Minangkabau management of *Austroeupatorium inulifolium* as an improved fallow species in the uplands of West Sumatra, Indonesia. This pioneer shrub, known locally as '*rinju*' was introduced to the study site by the Dutch near the turn of the century. Its intended purpose was to act as a smother crop in shading out ubigtous *Imperata cylindrica* in rubber plantations. A 1935 report documented that as *A. inulifolium* became naturalized in the area, it quickly assumed dominance in fallow successions. Its performance of fallow functions was reported to be so efficient that shifting cultivators reduced under their fallow periods by 50% - from 6-8 years for secondary forest vegetation to 3-4 years under *A. inulifolium* fallows. Farmers' appreciation for the species was evident in their collections of stems cuttings from neighboring communities to transplant into their own swidden fallows. In this manner, some farmers used it as a biological tool to smoother out *Imperata* swards and bring the land back into productive cultivation. This virtual doubling of land use intensify in turn translated into reduced agricultural pressure on forest margins.

Sixty years after the initial Dutch report, the author returned to the site to conduct an anthropological study of farmers' current perceptions and practices to exploit the agronomic properties of *A. inulifolium* to enhance the fallow's biological efficiency and permit an

* Associate Scientist, ICRAF Southeast Asia Programme, Jl. Gunung Batu No. 5, P.O. Box 161, Bogor 16001, Indonesia. Tel: 62-251-315234, Fax: 315567, Email: ICRAF-INDONESIA@cgnet.com, icrafind@indo.net.id

intensification of land use. To try to quantify the benefits described by farmers, soil and biomass samples were analyzed and compared between managed *A. inulifolium* fallows (treatment) and alternative *Imperata* and *Pteridophyta spp.* (fern) fallows (control) over the span of a two year fallow period.

The data confirms much higher biomass and nutrient accumulation in aerial biomass of *A. inulifolium* fallows and verifies the rationality of indigenous practices to encourage its domination on fallow land.

The paper concludes that by providing the biological basis for abbreviated fallow periods, *A. inulifolium* is playing a valuable bridging role in the transition phase between relatively longer fallow rotations of the past and today's more intensive forms of cultivation. Retention and refinement of indigenous practices in managing *Austroeupatorium inulifolium* and analogous pioneer species in swidden environments warrants closer research attention. Although the preferred species will change with location, this minimalist approach to fallow improvement has wide extrapolation potential in highly stressed swidden systems across S.E. Asia's uplands.

Keywords: nutrient scavenging, *Austroeupatorium inulifolium*, swidden intensification, *Asteraceae*, Sumatra

Use and Management of Mimosa diplotrica var, inermis as a Simultaneous Fallow in Orange Orchards and Upland Annual Crop Cultivation in Northern Thailand

By Klaus Prinz* and Somchai Ongprasert**

McKean Rehabilitation Center (MRC) in Chiang Mai, Northern Thailand carries out activities for the physical rehabilitation of disabled persons. Among other activities, the Center is involved with extension and development work on sustainable agriculture production. This study is based on observations and interviews at a local site as well as sources from research publications.

A practice of accelerated fallow is presented which is carried out in an upland area of northern Thailand. With the gradual intensification of agriculture production, farmers in Ban Den Village, Wang Chin District, Prae Province, were faced in particular with problems resulting from weed infestation in orange orchards as well as declining yields of upland crops. For several years, they have integrated spineless mimosa in their production system as it became obvious to them that this plant provided various other benefits that originally expected.

Through contacts with a neighboring villages, seeds of spineless mimosa were obtained and were obtained broadcasted in some orchards for purposes of weed suppression. Subsequently, the plant spread to crop areas and fallow lands partly by natural seeding and partly by sowing of collected seeds. The farmers developed means to manage plants and residues in various methods depending on the cultivated crops of upland rice, ground nut, cassava, or orchards.

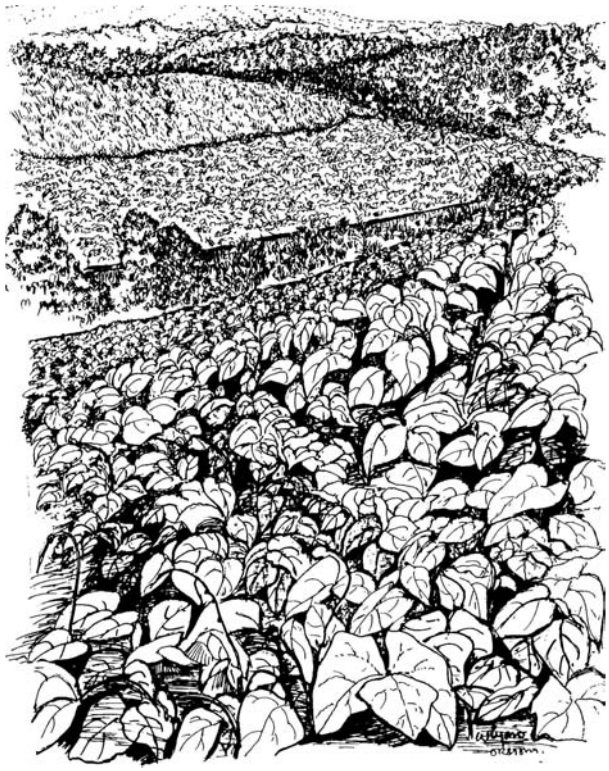
Keywords: *Mimosa diplotrica*, fallow, Thailand, live mulch, cover crop, orchard, cassava, upland rice

* McKean Rehabilitation Center, P.O.Box 53, Chiang Mai, ChiangMai 50000, Thailand. Tel: 66-53-817170; 817171; 277-049; Fax: 66-53-282-495; Email: Mckeanrc@chmai.loxinfo.co.th

** Dept. of Soils and Fertilizers, Mae Jo University, Mae Jo, Chiang Mai 50290, Thailand. Tel: 66-53-489164; Fax: 66-53-489164; Email: chai@maejo.mju.ac.th

Plenary Session III.

Herbaceous Legume Fallows



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As the papers in this session indicate, gravitation towards herbaceous legume fallows has occurred in some localities in S.E. Asia; however, the adoption of Mucuna and other green manure / cover crop spp. In swidden environments that has gained wide popularity in Central / South America and West Africa does not have a parallel in the S.E. Asian context. The above sketch is a Mucuna fallow in Santa Catarina, Brazil.

Plenary Session III. Herbaceous Legume Fallows

Oral Presentations:

Flemingia vestita-Based Indigenous Fallow Management in North-East India

By P.S. Ramakrishnan*

The people of the north-eastern hill region predominantly practice slash and burn agriculture (locally called *'jhum'*), a multi-species complex agroecosystem which varies sharply depending upon ecological setting, and social, economic and cultural differences of the societies involved. This region also have a whole variety of wet valley rice cultivation and 'home gardens', differing under varied ecological, socio-economic and/or cultural settings.

Population pressure and depletion in natural resource base could result in rapid changes in cropping systems over short distances of a few kilometers, as observed by us in the north-eastern region, leading to declining shifting agricultural (jhum) cycles ending up in sedentary systems with emphasis on cash crops closer to the city centre market. With shortening of the cycle length from a more favourable 20-30 years to less than 10 years, often with an average 5 yr. cycle length, many communities of Nagaland emphasize upon Nepalese alder (*Alnus nepalensis*) as an introduction both during the cropping and fallow phases. Here and elsewhere in the region, this species is left undisturbed during the cropping and fallow phases since this species is culturally valued. Further reduction in the jhum cycle length would lead to rotational fallow and sedentary systems. Thus, along a 30 km. radius around the city centre of Shillong township one could see a 30 yr. cycle towards the periphery, declining to a 3-5 yr. cycle closer to the town. Further decline in jhum cycle under intense population pressure near the city leads to rotational fallow systems where the organic residues arising from the crop and the weed biomass are not burnt but ploughed into the plot once in every 2 or 3 years and with emphasis on vegetable and tuber crops. This system of cropping eventually ends up in sedentary agricultural systems where cultivation is done every year with recycling of organic residues being done on a regular basis.

One of the lesser known crops emphasized in all these systems is the legume, *Flemingia vestita* whose tuber is consumed by the traditional communities in the region, during the lean season when more traditional food items are in short supply. The emphasis on this nitrogen-fixing crop in the system increases with shortening of the jhum cycle and leading to the sedentary systems. Pure stands of *Flemingia* often forms part of the rotation of the crops both in the 'rotational fallow' and 'sedentary' cropping systems. The ecological implications of this traditional land use technologies are discussed here.

* School of Environmental Sciences, Jawaharlal Nehru University, New Delhi 110067, INDIA. Tel: 91-11-617-2438, 667-676 Ext.238; Fax: 91-11-616-5886. Email: psrama@jnuniv.ernet.in

Soil Improvement and Conservation Using Nho Nhe Bean (Phaseolus carcaratus. Roxb.) in Upland Areas of Northern Vietnam: Initial Results from a Case Study

By Nguyen Tuan Hao*, Ha Van Huy*, Huynh Duc Nhan*, and Nguyen Thi Thanh Thuy**

Nho nhe bean (*Phaseolus calcaratus* Roxb.) is one kind of indigenous leguminous crop. It is commonly grown in the northern upland area of Vietnam. Nho nhe bean grow very quickly and is an ideal cover crop. According to the farmer's practice, nho nhe bean is often grown intercropped with maize or cassava. The Nho nhe bean has a cultivation period of eight months and the maize of five months. In July the maize can be harvested leaving the stalks as a support for the bean to climb up and cover the ground during the rain season. At the end of October or November the Nho nhe beans is also harvested and residues of both crops are left on the field as a green manure for the next season.

The ripe fruits of Nho nhe bean are brown in color and is not chapped. Each fruit has 6-8 seeds. The seeds have dark brown color and plenty of nutrients. Local people used Nho nhe seeds for food. Total green matter of Nho Nhe bean about 20 ton/ha. The leaves of Nho nhe bean can be used for fodder.

Nho nhe bean can easily be grown. After harvesting fruits, the farmer ploughs up both Nho nhe and maize stalk. In the next year, the fallen Nho nhe seeds regrow naturally in that field, so do not need to be replanting. Nho nhe bean plant climbs very fast and forms a thick layer, that is good for soil cover during the rain season. The Nho nhe bean intercropped with maize has following benefits:

- More products and increases in crop yield from the same field
- Grows faster than maize providing a soil cover and acts as a living mulch
- Increased crop residue for improving the soil condition
- Nitrogen fixing ability increases available nitrogen in soil.

Another important function of Nho nhe is its use to eradicate imperata grass. This practice recovers the land for agricultural purposes. This initial study shows that Nho nhe bean has many advantages as a soil cover and soil conditioner.

Issues proposed for further research include:

- Integration of Nho nhe bean in to varied upland farming systems with aims to conserve, rehabilitate and improve soil fertility on sloping land for sustainable agriculture
- Growing techniques to develop Nho nhe bean in large scale
- Nho nhe bean in agroforestry system i.e. soil cover for orchards and plantations
- Nho nhe bean interaction with other major crops in different farming systems
- Application techniques for intensive Nho nhe bean
- Utilization in fallow land management and to eradicate weeds on cultivated land.

Keywords: *Phaseolus calcaratus.* (Roxb.), nho nhe bean, intercropping, Vietnam, nitrogen fixation, corn (*Zea mays*)

* Forest Research Center, Bai Bang, Phong Chau, Phu Tho, Vietnam. Tel: (84-821) 829-241; Fax: (84-821) 829-275; Email: c/o karin@netnam.org.vn

** World Neighbors, Nha B_2 - Ngo 202 B, Doi Can St., Ba Dinh District, Hanoi, Vietnam. Tel: 84-4-8431463; Fax: 84-4-8327247

Growing Yazhuo Hyacinth Beans in Hainan Island in the Dry Season

By Lin Weifu*, Jiang Jusheng, Li Wuige, Xie Guishui and Wan Yuekun

In the mountainous area in Hainan island, Li and Miao minority people grow the hyacinth beans (*Amphicarpaea linearis chun & T.chen*) in some upland field in the dry season every year while the tillage in the other place in the island lies fallow for 5-7 months, in winter and spring. *Amphicarpaea linearis chun & T.chen* is one of the indigenous plant in the area. Its bean is nutrient green food and its stem is one kind of good fodder. The hyacinth beans' cultivation is much extensive. First, sew the seeds of the hyacinth bean on the ground of the fallow land just before the ending of the rain season (in October), and then plough the earth over to bury the seeds of the bean deeply, and without weeding and fertilizing and controlling of plant diseases and pests, harvest the plants when its beans are rap in the spring next year. It is popular that the mountaineers grow the hyacinth beans in mountainous area because it is so easy to manage, even its output is very low, 150 - 500 kg/ha. This shows that growing the hyacinth beans in dry season is one of the desirable ways to intensify the fallow in the mountainous area in Hainan Island.

Keywords: Hainan Island, hyacinth beans, mountainous area, green food, fodder

* Rubber Cultivation Institutes, Chinese Academy of Tropical Agricultural Sciences, Danzhou, Hainan 571737, P.R. China. Tel: (86-890) 330-0571; 330-0459; Fax: (86-890) 330-0315; Email: rcri@public.hk.ha.cn

Poster Presentations:

Use and Management of Viny Legumes as Accelerated Seasonal Fallows in Intensified Shifting Cultivation in Northern Thailand

By Somchai Ongprasert* and Klaus Prinz**

The results of the study on the innovation of a complex multiple cropping system of six crops which have evolved in a Lisu village at Huai Nam Rin, Chiang Mai, for 17 years are presented. The system consisted of relay growing of three viny legumes, i.e., cowpea, (*Vigna unguiculata*), rice bean (*Vigna umbellata*) and lablab bean (*Lablab purpureus*), after intercropping of corn and wax gourd (*Benincasa hispida*) or pumpkin (*Cucurbita moschata*). The relay-cropping of the three viny legumes could be considered as an accelerated seasonal fallow management in an intensified shifting cultivation. This research was conducted through participatory rural appraisal (PRA) exercises in Huai Nam Rin and group interview of farmers in its two surrounding villages. Dynamics of soils resulted from the practice were evaluated through physical and chemical analyses of soils.

Huai Nam Rin village which is located on a flat and fertile upland derived from limestone with relatively low altitude (450-500 m asl), was established in 1978 by Lisu immigrants who formerly were opium growers, in a nationally reserved forest. Since the altitude of the area was not suited for opium cultivation, the immigrants were compelled to practice other cash cropping systems. Intercropping and relay cropping were considered not new systems for shifting cultivators. Many vegetables and other crops were commonly grown simultaneously with upland rice and corn. Opium poppy plants were also cultivated about a month before corn harvesting. The practice of complex multiple cropping, therefore, could have evolved from indigenous experiences by the villagers as well as external recommendations.

Corn and wax gourd or pumpkin were simply intercropped by mixing their seeds at a 20-40:1 ratio and were then grown with zero-tillage, after burning of crop and weed residues. As it was done with opium, the three pulses were separately grown in intercropped fields about one month before corn harvest. Different cropping periods of the three pulses: 3, 4 and 6 months for cowpea, rice bean and lablab bean, respectively, helped in the distribution of labor requirement during harvest even though they were grown at the same time. Corn was harvested before cowpea, while wax guard and pumpkin were harvested between rice bean and lablab bean. Most of Huai Nam Rin farmers were satisfied with their present income status which was comparable to the cash earned from opium if they would have been allowed to produced it freely. Upland rice which was one of the villagers' ritual crops, was completely replaced by the innovative system more than ten years ago.

The following factors were considered contextual 'triggers' that contributed to the system's innovation: availability and accessibility of market for the products; high ability of the limestone-base soils in the village to sustain intensive cultivation for several years; land availability to generate acceptable income. The prohibition of using of farm tractors in legally national reserved forests forced the farmers to attempt other efficient weed control systems.

* Dept. of Soils and Fertilizers, Mae Jo University, Mae Jo, Chiang Mai 50290, Thailand. Tel: 66-53-489164; Fax: 66-53-489164; Email: chai@maejo.mju.ac.th

** McKean Rehabilitation Center, P.O.Box 53, Chiang Mai, ChiangMai 50000, Thailand. Tel: 66-53-817170; 817171; 277-049; Fax: 66-53-282-495; Email: Mckeanrc@chmai.loxinfo.co.th

While almost all 70 households in Huai Nam Rin village have practiced the system, the adopters of the system in the two neighboring villages varied from a quarter to a half of the village. Though relay cropping of pulses has been considered as excellent cover crops that helped control weeds and improve soil fertility, most of the farmers would only practice this system in smaller areas just enough for household consumption if their products could not be sold. This opinion indicated that market or economic returns was considered one of the adoption constraints of the system which also included transportation and availability of fertile land. Comments on the improvement of the system productivity are indicated.