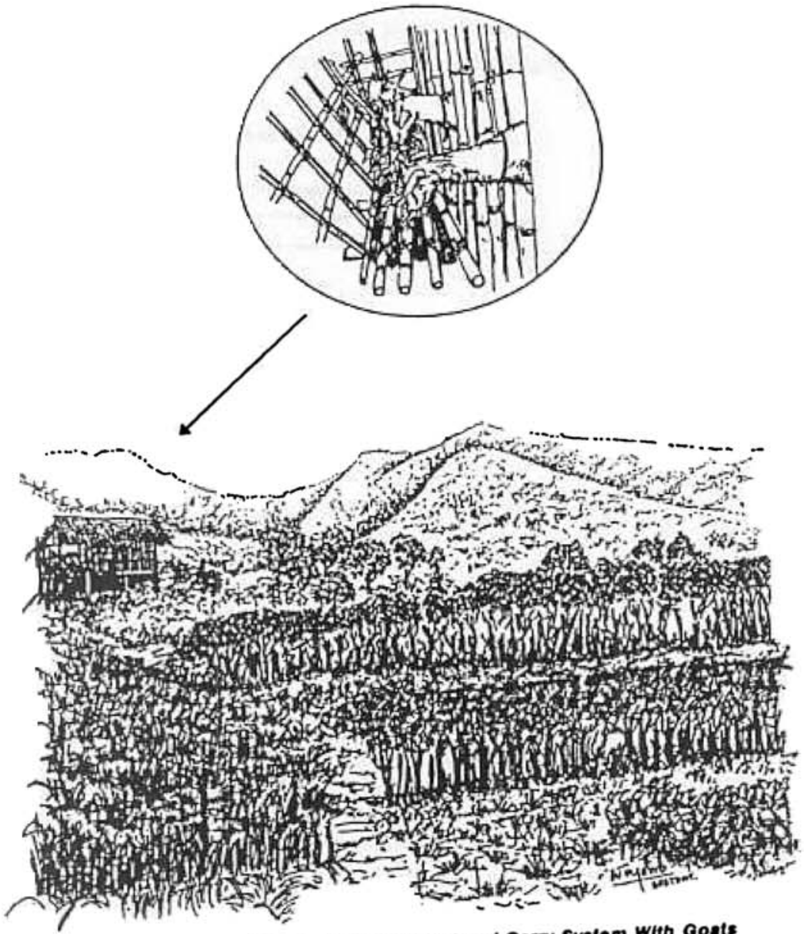

Tithonia diversifolia Hedgerows In Cut-and-Carry System With Goats

Figure 11

iii) *Tithonia diversifolia*: Prospects for Livestock, Talapia and Honey

Tithonia diversifolia is a noteworthy exception in that it combines efficient fallow functions and compatibility with some livestock sectors. Although cattle and buffalo usually ignore it, sheep and goats are often seen browsing *T. diversifolia* fallows. Its abundance and ease of propagation by stem cuttings has made it a favorite contour hedgerow species in Mindanao, the Philippines. Instead of applying loppings directly to the soil, some farmers instead feed them to confined goats in a cut-and-carry system, and then return the manure to the alleyways (Figure 11). This promising system combines benefits of livestock production, efficient nutrient cycling and soil conservation. *Tithonia* is commonly protected in northern Luzon as an important nectar source for apiculture. Farmers there also describe broadcasting its leaves in ponds for talapia to browse (author's field notes; Voss, pers. com.) Studies conducted in China (Wai, ----) and Latin America (Geilfus, 1994; Rios, 1994; Rios and Salazar, 1995) confirm *T. diversifolia*'s fodder potential for sheep, goats, rabbits and even swine, as well as its utility in honey production. Further feeding trials in Indonesia (Susana and Tangendjaja, 1988) and the Philippines (Capundag, 1989) showed promising results from incorporating *T. diversifolia* leaf meal as a component in poultry rations.

B. Fodder: Conversion of Natural Fallow Successions into Managed Fodder Banks

The above-discussed examples of farmer manipulation of preferred fallow species constitute a minimalist approach to fallow management, adoptable by even the most labor-constrained households. However, in an environment of continued land-use pressures; declining yields from swidden crops; government proscription of 'unscientific' forms of land management involving elements of fallow and fire; and increased engagement in markets, it gradually becomes more profitable for farmers to shift to increasingly intensive fallow management systems (Figure 12). Rising opportunity costs of fallowed land warrant labor expenditures towards increasing its productivity.

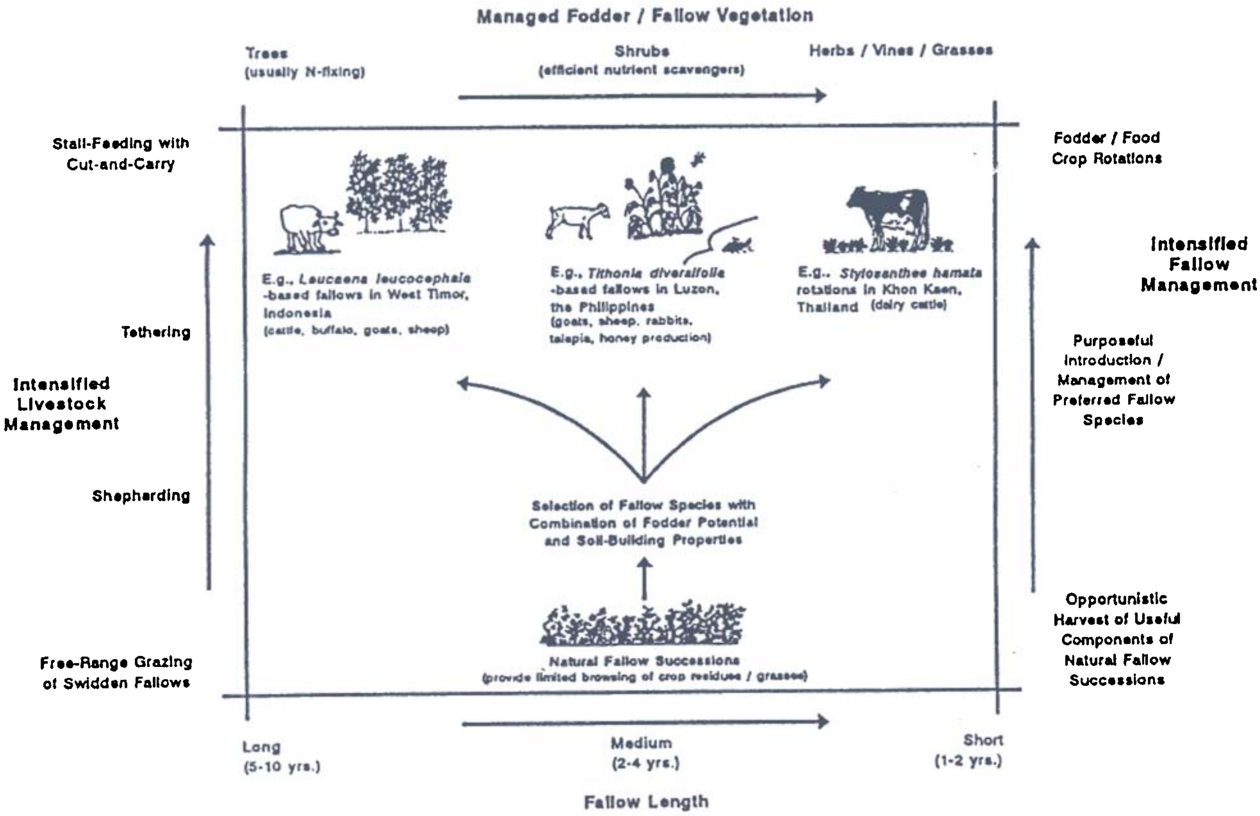

Figure 12 *Farmer Practices to Combine Objectives of Soil Rejuvination and Fodder Production*

i) Herbaceous Legumes as Short-Term Fallows

Although research has often verified the potential of fallow enrichment with leguminous cover crops as a promising point of intervention in degrading swiddens, these technologies have attracted little farmer adoption. There are isolated reports of indigenous practices to plant short-term fallows with: *Phaseolus calcaratus, Dolichos lablab* and *Vigna sinensis* in northern Thailand (Ongprasert and Prinz, 1997); *Phaseolus calcaratus* (Hao et. al., 1997) and *Pachyrhizos tuberosis* in northern Vietnam; *Amphicarpaea linearis* in Hainan Island, P.R. China (Weifu et. al., 1997); and *Flemingia vestita* in Northeast India (Ramakrishnan, 1997) - but these have not stimulated widespread diffusion. To date, there is not a S.E. Asian analogy to the *Mucuna*-based models that have swept across West Africa and Latin America in recent years (Figure 13). The exact reasons for this have yet to be clearly defined.[22]

[22] Hairiah (1996, p. 5) suggests that the *Mucuna* cover crop systems practiced in Benin and other parts of West Africa might not be transferrable to Indonesia due to the latter's: 1) smaller farm size (i.e., Java); 2) smaller livestock population and hence reduced demand for fodder; 3) continued subsidization of inorganic fertilizers; and 4) unavailability of seed.

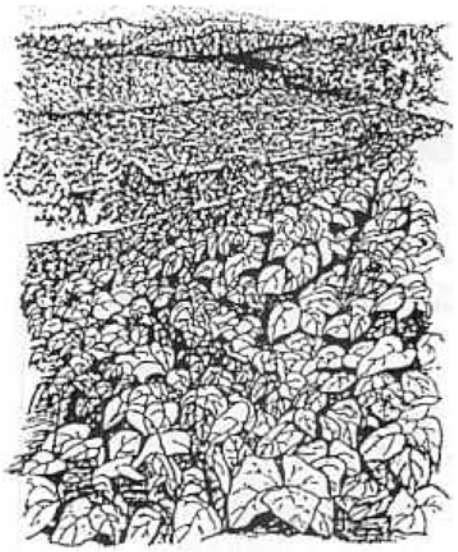

Figure 13 *Mucuna Fallows in Southern Brazil*

Some evidence suggests that incorporating legume green manures / cover crops into fallows has not earned wider acceptance by swiddenists because they do not receive immediate and tangible returns to increased labor inputs (Boonwat, 1994, p. 228). This deterrent could conceivably be overcome by selecting legumes with fodder value[23], and introducing grazing animals to take advantage of the feed and recycle nutrients back to the soil through the dung. Conversion of the swidden fallow into an economic leguminous pasture phase with return of the animal manure thus broadens farmer incentives from longer-term fertility goals to more immediate benefits of forage production and livestock sales (Figure 14).

A case study illustrative of these potentials was a ley-farming project implemented out of Khon Kaen University, northeast Thailand, in the late 1980s. The project was designed to introduce corrective interventions to plummeting cassava yields on soils exhausted from continuous cultivation. Cooperating farmers were assisted to establish soil-building *Stylosanthes hamata* pastures grown in rotation with the cassava cash crop. Dairy cows were then introduced on favorable credit terms to graze the stylo, return manure to the soil and supplement income with milk sales. Although test plot indicated dramatically improved cassava yields after the leguminous pasture phase, participating farmers confounded the project implementers by electing not to plough down their pastures - but instead focus on expanded dairy husbandry. This experience underlines that farmers are not necessarily stagnant or traditional in their farming practices - but can swiftly embrace livestock / fodder production technologies in the presence of market incentives (Simaraks, pers. com.).

ii) Tree Fallows with Fodder Potential

Of course integration of fodder trees into fallowed land is another pathway to support higher livestock populations in swidden environments, plus generate numerous other products. Much ligneous fallow regrowth does have browse potential for ruminants - and farmers often intervene to protect and promote the most palatable species. A typical example of this can be found on the slopes of Mongar in eastern Bhutan, where *Ficus* spp. are widely maintained on swidden (*tseri*) land (Figure 15). This type of opportunistic management of native species fits well under conditions of scarce labor and abundant land - but the concept also holds promise for incremental intensification as conditions warrant. The need for fodder for Bali cattle was a central catalyst in the adoption of more highly managed *Leucaena leucocephala* (Metzner, 1983; Surata, 1993; Piggin, 1997; Poffenberger and Suryanata, ----) and *Sesbania grandiflora*-based fallows (Kieft, 1997) in Timor, Indonesia.[24]

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[23] Legumes warranting testing in field trials could include *Centrosema pubescens*, *Pueraria phaseoloides*, *Calopogonium mucunoides*, *Pubescens stylosanthes* and *Mucuna* spp.

[24] In contrast, livestock is less important in analogous *Leucaena*-based systems in southern Suleweisi, Indonesia (Agus, 1997), and both Cebu (Lasco and Suson, 1997; Lasco, 1997) (see Figure 16) and Mindoro of the Philippines, where soil rehabilitation and firewood are the major objectives.

The history of fallow enrichment with *L. leucocephala* and its expansion in Amarasi Subdistrict, West Timor, also provides interesting insights on the potential long-reaching effects of policy interventions. As a response to frequent famines, the Dutch colonial government imported Bali cattle into Timor in 1912. *Lantana camara* became a weed problem however, dominating grasslands and reducing their carrying capacity for livestock. *L. leucocephala* (known locally as '*lamtoro*') was introduced in 1930 to alleviate the fodder shortage, and the local Raja declared that opening of new swiddens was prohibited until the old ones had been planted with lamtoro. Defying this decree would result in large monetary fines or jail sentences (Surata, 1993).

This precipitated several interesting spinoffs. Fences were required to separate grazing cattle from crops. Crop damage inflicted by straying cattle was the sole responsibility of the livestock owner, providing a strong self-interest to ensure that fences were well mended. This 'owner-pays' policy provided the impetus for a shift away from pasturing cattle to stall-fed, cut-and-carry systems. Until this point, Bali cattle were kept in large herds by elite groups who monopolized common property pasturages. The move towards more labor-demanding confinement systems was not conducive to large cattle herds, resulting in a more equitable redistribution of the cattle industry among smallholder farmers (Poffenberger and Suryanata, ----). Models such as the Amarasi system are of tremendous scientific interest in that they illustrate the under-reported potentials of managing multi-purpose leguminous species as a fallow crop - providing both biological and economic benefits.

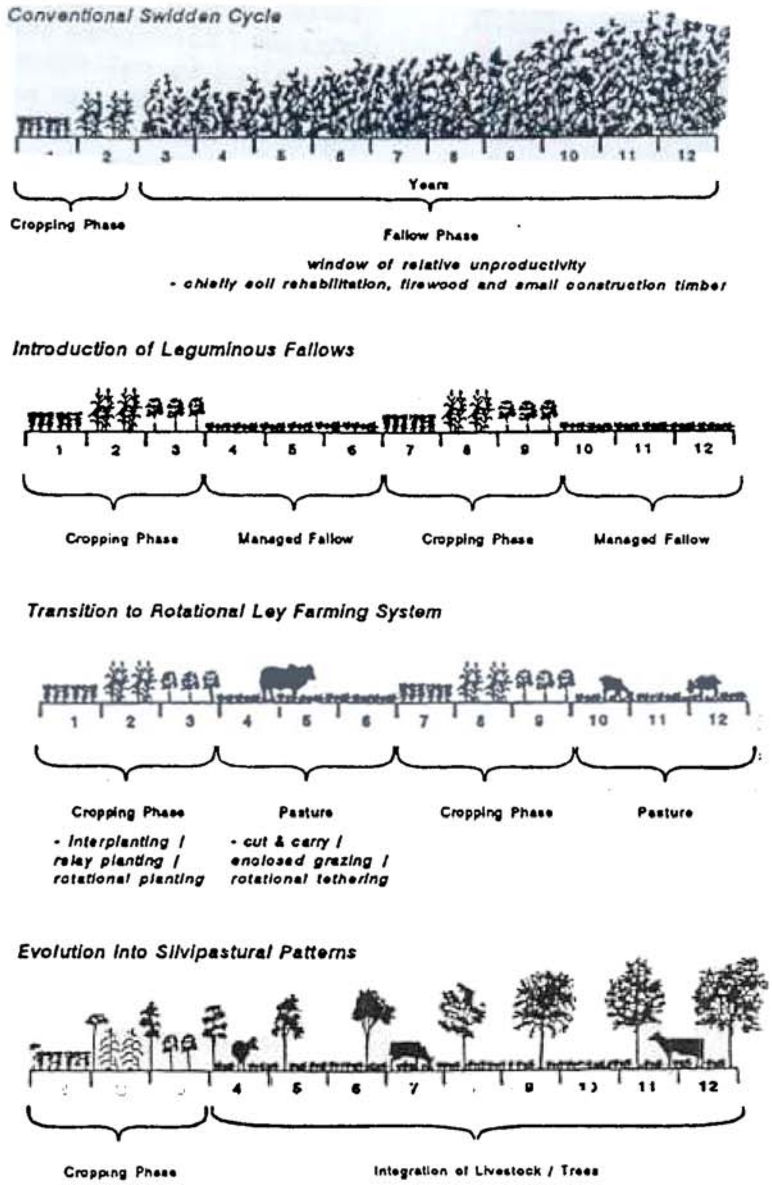

Figure 14. *Possible Pathways for Integrating Livestock into Swidden Systems*

iii) Silvopastoral Combinations

As mentioned earlier, smallholder timber production in swidden fallows is gaining increasing importance in Laos (Roder et. al., 1995; Hansen et. al., 1997) and elsewhere in S.E. Asia's uplands (Garrity and Mercado, 1993) as shifting cultivators respond to soaring timber prices and improved market access. Timber, like livestock, allows upland communities to exploit extensive land resources, enhance productivity of farm labor, and increase per capita incomes. The integration of livestock and trees into appropriate silvopastoral patterns is likely to earn wider adoption in the future.

Figure 15. *Ficus sp. maintained in Bhutanese swiddens for fodder value*

C. Fences: A Necessary Evil?

The history of project attempts to introduce managed fallows has not been encouraging due to the inability to control two key elements - wild fires and grazing livestock. Indeed, the two are often interlinked as livestock owners habitually burn grasslands to encourage new succulent regrowth of higher palatability and nutritional value. The imperative for constructing effective fencing to constrain wandering livestock is a serious handicap to labor-short swiddenists.

A survey of shifting cultivators in Luang Prabang and Oudomsay provinces consistently ranked domestic animals as a more serious constraint to upland rice production than wild animals (Roder et. al., 1993, p. 157). Others have cited livestock damage as a key disincentive to farmer adoption of alley cropping in Laos (Keomukda, 1993, p. 126). Clearly the fencing issue warrants strong attention in any plan to promote animal husbandry in the Lao uplands.

i) When Do Swiddens Need the Protection of Perimeter Fences?

Studies of crop predation and fencing requirements have paid inadequate attention to the dynamics of the problem as it relates to position on the landscape (Figure 17). In remote areas where swiddens are carved into forest margins, deer, wild boar, porcupines, monkeys, elephants and other wildlife necessitate fencing and vigilance to minimize crop damage. If tigers and other large carnivores are present, farmers will also be forced to monitor their livestock more closely and confine them at night to prevent losses.[25] The fact that there are fewer unaccompanied livestock wandering around should presumably translate into reduced incursions into swidden fields.

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[25] During field work in remote swidden communities in Bokeo province in 1993, the author witnessed several instances where pigs and calves straying too far were quickly preyed on by wild cats. Interestingly, in Sumatra, Indonesia, staff of the Directorate General of Protection and Nature Conservation (PHPA) reported a marked decrease in encroachment into the Kerinci Seblat National Park by shifting cultivators after reported-cases of human fatalities due to attack by Sumatran tiger (*Panthera tigris sumatrae*).

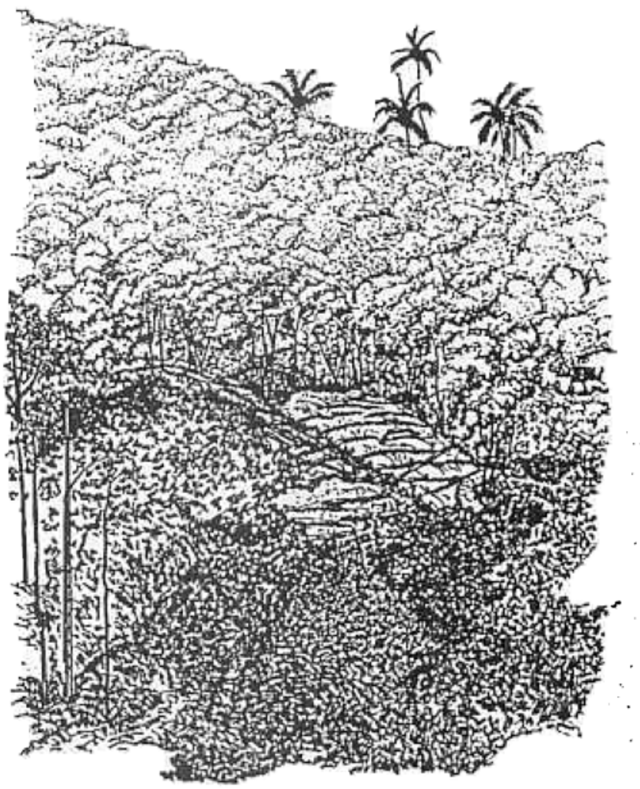

Figure 16. *Leucaena leucocephala-Based Fallows in Naalad, Cebu, the Philippines*

With increased anthropogenic modification of the landscape, the wild cats are generally among the first species to disappear from the system. Monkeys, wild boar and field rats prosper on swidden crops and are the main pest problems as forest margins recede and natural ecosystems are gradually transformed into agroecosystems. As human interventions intensify and convert more of the landscape into tightly controlled agricultural systems, the wildlife problem recedes - but is replaced by equally damaging depredations by buffalo, cattle, horses and goats.

We need to recognize that by its very nature, swidden agriculture often shares the same territory with rapacious wildlife[26] and fence construction is probably an inevitable burden necessary to slow their intrusion and reduce their claim of crop yields; in such a case, introduction of domestic animals may not add appreciably to fencing costs. In evaluating the potential of developing the livestock component of upland farming systems, we need to be cognizant if fence construction is already common practice - or if it will be an added expenditure which must be weighed against expected benefits.

ii) Whose Responsibility?

As human populations grow, domestic livestock soon oust wildlife as the main threat to swidden crops. Probably as an extension of their experience in fencing against feral pigs and deer, most swiddenists fall naturally into continuing this practice to exclude their neighbors' wandering cattle and buffalo. Although norms differ between upland communities,[27] the general convention is that land owners are obliged to fence out hungry livestock - rather than the livestock owners bearing responsibility for fencing them in and limiting their spoliation of others' crops. The rents are thus all captured by the livestock owners, while the fencing costs of labor, time and materials are shouldered by their neighbors. In view of the labor scarcity of most swidden households, this resource drain is a serious handicap; Ormeling (1955) for example, estimated that Timorese swidden cultivators were spending up to one-third of their labor on fence construction against straying livestock.[28] This problem may restrict the possibilities for dry season cropping or developing home gardens, as even individual trees around the houselot may need protective fencing.

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[26] As forest cover diminishes, it is not unexpected that swiddenists and wildlife may find themselves in increasing competition for survival on dwindling forest remnants.

[27] Villages in Lampung Province, South Sumatra, are illustrative of the sort of compromising policies that local institutions may enforce. Livestock damage inflicted on crops during the day is the responsibility of the field owner, apparently because the fence was not constructed sufficiently robust to keep livestock out. If the damage occurred during the night, then responsibility rests with the livestock owner since his animals should have been confined at night (van Noordwijk, pers. com.).

[28] Goats are probably the worst offenders. They breed quickly and provide good economic returns, but due to their propensity to devour all greenery within reach, aggravate tensions between livestock owners and non-owners.