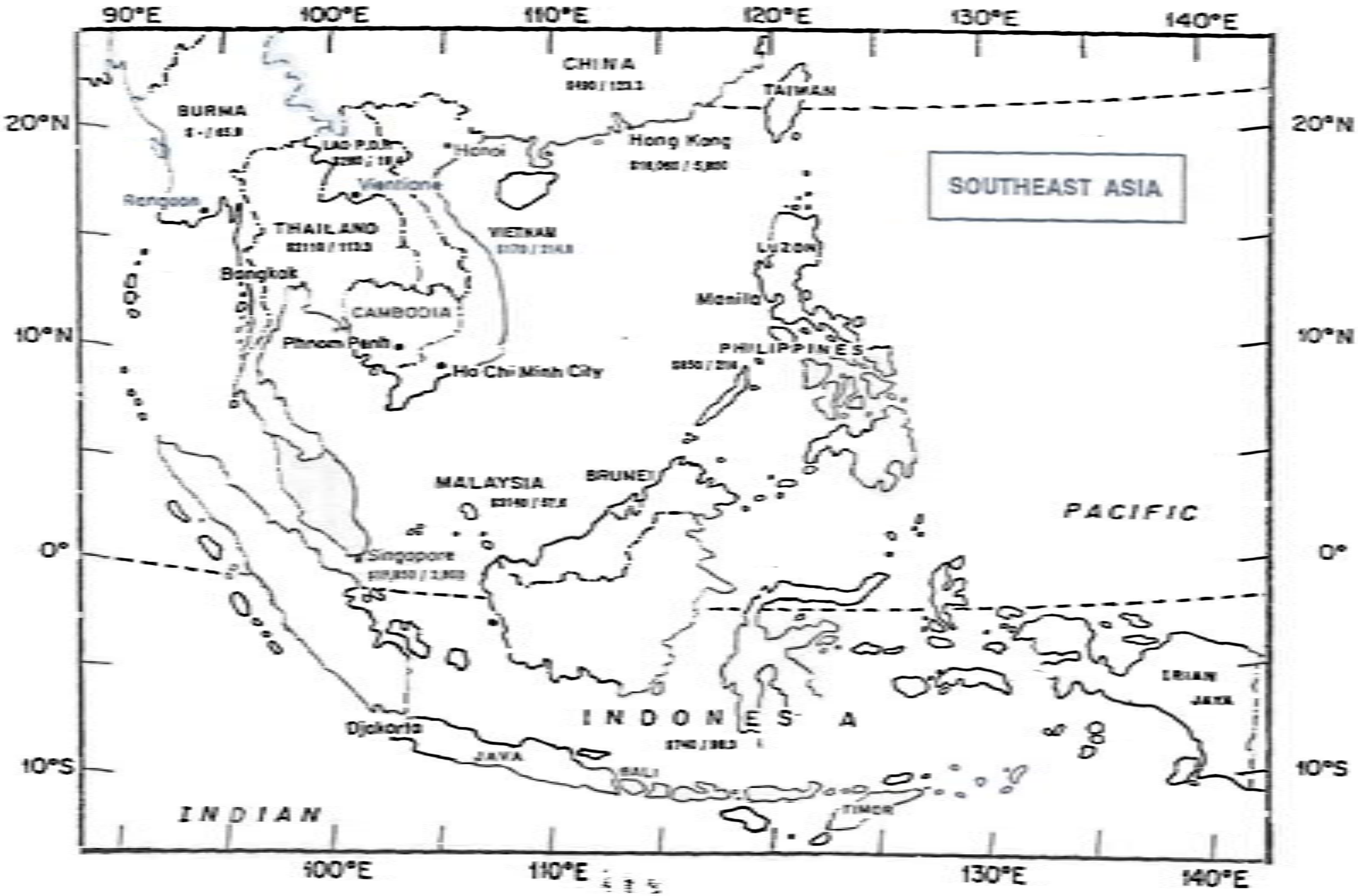
Comparison of Buying Power and Land-Use Pressures:
Key Variables Indicating Market and Supply Opportunities for Livestock Products

($ GNP per capita / People per sq. km.)



Data extracted from The World Bank, 1995, pp 162-163

Figure 7

Table 2. *Challenges to Animal Husbandry in the Uplands of S.E. Asia*

Technical:
✓ Insufficient feed resources / inadequate nutrition; ✓ Unimproved pastures; ✓ Poor management of existing improved pastures - resulting in soil compaction (rainy season) / over-grazing (dry season); ✓ Grazing area available for free-roaming animals is diminishing; ✓ Access to drinking water; ✓ Monogastric livestock may compete with humans for food resources, e.g., cassava and grains; ✓ Prevalence of diseases and parasites reduces productivity and inflicts high mortality; ✓ Sporadic or unavailable administration of vaccinations; ✓ Lack of reliable cold chain reduces vaccine quality; ✓ Increased stocking rates may induce rapid transmission of infectious diseases, decimating entire livestock populations within a village; ✓ Judicious use of exotic breeds through cross-breeding to introduce heterosis but maintain hardiness of native breeds; ✓ Free-range management not conducive to systematic vaccinations, controlled breeding, supplemental feeding or other improved husbandry techniques; ✓ Tensions between trying to increase livestock numbers and cropping intensification; ✓ Livestock necessitate labor expenditures in fence construction; ✓ Predation by wildlife; and ✓ Inefficient manure management.
Socio-Economic:
✓ Credit access; ✓ Serious labor constraints of most swidden cultivators; ✓ Potential to exacerbate social tensions within villages, particularly if non-owners of livestock must absorb the costs of fence construction; possible stratification into livestock owners and herders; ✓ Social conflict between livestock owners and neighbors suffering property damage; ✓ Unacceptably high risk / learning costs if improper management leads to the death of expensive animals; ✓ Slaughter for religious / cultural obligations slows buildup of livestock capital; and ✓ Possible hygiene / health issues if livestock kept in close proximity to residence, e.g., transmission of Japanese encephalitis is associated with presence of pigs.
Institutional:
✓ Village regulations need to place increasing responsibility with the livestock owner for property damage and fencing costs; ✓ Potential degradation of common property resources as forests and grasslands are grazed more heavily, raising issue of equitable distribution of benefits, e.g., Bhutan, Nepal; ✓ Potential for communal efforts to disburse (e.g., livestock banks) and manage (e.g., communal pastures) livestock; ✓ Rudimentary or no livestock extension services to isolated uplands; ✓ Inability to monitor / control livestock movements and implement effective quarantine procedures; and ✓ Need to formulate sharply focussed policy instruments aimed at encouraging expansion of livestock sector.
Marketing:
✓ Distance to markets; ✓ Access to market information; ✓ Vulnerability to unfair trading practices by middlemen buyers; ✓ Disease problems hinder access to export markets; and ✓ Protectionist tariffs of neighboring countries.

This is obviously a dynamic process with both spatial and temporal variability. Although all the constraints listed in Table 2 are potential points of intervention to upgrade the livestock sector in Laos, the challenge will be to elucidate under what circumstances they are appropriate.[12] This section of the paper highlights fallow management, fodder resources, and fencing as three key issues in the integration of livestock into swidden environments. Each will be discussed in the context of S.E. Asia's intensifying swidden systems.

A. Fallows: Pressures to Manage Swidden Fallows More Productively

After active cultivation of swidden fields stops and they are left to fallow, farmers usually continue to extract a number of useful products from the regenerating vegetation. Cassava and other crop vestigials that have escaped the attention of wild pigs may be salvaged. Women search for mushrooms, bamboo shoots and a wide variety of other wild food plants to supplement household diets or sell in the market (Scoones et. al., 1992; Burgers, 1997; Mertz, 1997; Tangan, 1997). Broomgrass (*Thesolina agrotis* L.) is collected for sale to middlemen buyers. Free-ranging livestock graze crop residues and native grasses appearing in the succession vegetation. *Imperata cylindrica* and other thatch grasses are harvested for roof construction. As herbs and grasses give way to pioneering shrubs and trees, the poles may be extracted for firewood or construction materials. Fallows of all ages may be productive hunting and trapping sites. This type of opportunistic harvest of fallow products is widespread in Laos and elsewhere in S.E. Asia's uplands - and constitutes fallow management in its most fundamental form.[13]

i) Proposing Typologies of Indigenous Fallow Management (IFM) as a Basis for Analysis

Land-use pressures are pushing farmers to adapt swidden systems into more intensive models, however. A recent regional survey has shown that shifting cultivators have been remarkably innovative in responding with a wide spectrum of strategies to modify fallow vegetation, thereby enhancing its economic and ecological functions (Cairns, 1997b). These farmer-generated fallow management technologies may generally be classified as innovations to achieve :

- more 'effective' fallows - wherein the biological efficiency of fallow functions is improved, and the same or greater benefits can be achieved in a shorter time frame;

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[12] An apt analogy may be drawn with S.E. Asia's experience in promoting Sloping Agricultural Land Technology (SALT). Although the technology package is sound, it did not take sufficient account of farmer circumstances, particularly labor constraints. Despite its wide promotion, farmer rejection of SALT stemmed from its demand for an intensity of land management (and labor input) beyond what was warranted under contemporary land use pressures. In that respect, it could be considered a technology ahead of its time.

The need for a phased, incremental approach to improvements is equally valid for livestock development. Although corralled cattle fed from improved fodder banks in a cut-and-carry system may be appropriate in the more densely populated Vientiane Prefecture, it may be less acceptable to a swiddenist in Attopeu Province, where land remains relatively abundant and returns to agricultural labor is the key concern. Despite its lower productivity, free range grazing in forests and fallowed land may be the most rationale management approach in conditions of land abundance and labor scarcity. It may be equally impractical to promote the need for livestock vaccinations and veterinary care in villages whose isolation and poverty denies even rudimentary health services to their human populations (SUAN et. al., 1991, pp. 125-127).

[13] Careful inventorization of the diversity of fallow products harvested by shifting cultivators suggests that conventional perceptions of swidden fallows as idle and unproductive need to be rethought.

more 'productive' fallows - in which fallow lengths stay the same or actually lengthen as the farmer adds value to the fallow by introducing perennial economic species; or

combinations of the two trends, where a degree of both biophysical and economic benefits may be accrued (see Figure 8).

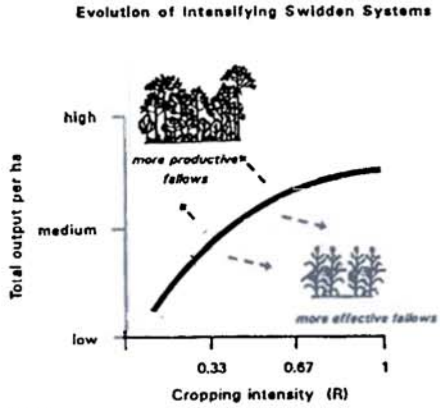


Figure 8.

More effective or accelerated fallows often provide an intermediate step in a transition to permanent cultivation of annual crops. Alternatively, in more productive fallows, the phase of reopening and cultivation of annuals may eventually be foregone altogether as the farmer chooses to protect perennial vegetation, allowing it to develop into semi / permanent agroforests. These two major pathways towards fallow management strongly influence opportunities for integration of livestock. The categorization of indigenous fallow management practices suggested in Figure 9 will provide a framework for examining these in some detail.

ii) Fodder vs. Fertility Conundrum?

Shifting cultivators universally attach value to individual fallow succession species, according to their palatability for grazing livestock, soil-building properties, or potential for direct use. Ideally, preferred fallow species may provide a combination of these benefits - but there are often conflicting tensions between fertility management and fodder availability. This tradeoff is most prevalent in the case of *Asteraceae*[14] spp. that were introduced from the Neotropics and have since become widely naturalized across S.E. Asia. *Chromolaena odorata*[15] (Dove, 1986; Agbim, 1987; de Foresta and Schwartz, 1991; Field, 1991; de Foresta, 1993; Slaats, 1993; Baxter, 1995; Roder et. al., 1995; 1997), *Austroeupatorium inulifolium*[16] (Stoutjesdijk, 1935; Cairns, 1994b; 1997c), and *Tithonia diversifolia* (van de Goor, 1953; Verliere, 1966; Nagarajah and Nizar, 1982; Pandosen, 1986; Adchak, 1993; Derpsch, 1993; Baxter, 1995b) are all aggressive pioneering shrubs valued by swiddenists for their efficiency in performing fallow functions. Evidence suggests that they share an ability to scavenge labile soil nutrients that might otherwise be lost from young fallows through runoff or leaching, and store them in the rapidly accumulating biomass[17]. They form dense, almost

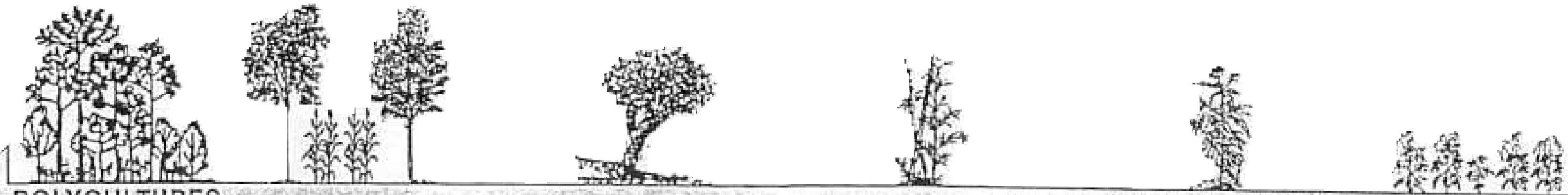
[14] Renamed from previous *Compositae* designation.

[15] Formerly named *Eupatorium odoratum*.

[16] Previously known as *Eupatorium inulifolium*, and prior to that, as *Eupatorium pallescens*.

[17] *Ageratum conyzoides* L. (see Figure 10) is another *Asteraceae* that is widely appreciated by shifting cultivators as a soil fertility indicator and rapidly establishing cover crop, protecting vulnerable soils after harvest of swidden crops (author's field notes; Oyen, 1995; Pandeya, 1995). It is reported to act as an intermediate host for rice blast however, and thus may be problematic in areas where upland rice is grown as the staple food (Fahrney, pers. com.).

Work in Northeast India shows that *Mikania micrantha*, yet another *Asteraceae*, is also an important component of early fallow successions and plays a similar role in nutrient sequestration, particularly K (Ramakrishnan, 1993, p. 260). *Mikania* spp. are aggressive creepers however, and a major weed problem when farmers attempt enrichment planting of economic trees into swidden fallows. Even trees several meters tall can be pulled to the ground and smothered by climbing *Mikania*.



POLYCULTURES
GOAL: Harvest of tree products.

CONTINUUM

MONOCULTURES
GOAL: Rehabilitate soil properties after cropping period.

AGROFORESTS

LATEX-BASED:
- *Havea brasiliensis*
  - widespread

RESIN-BASED:
- *Shorea javanica*
  - Krui, Sumatra, Ind.
- *Toxicodendrom vernicifera* /
- *Pinus yunnanensis*
  - west Yunnan, China
- *Styrax tonkinensis* /
- *S. benzoides*
  - northern Laos
- *Styrax benzoin* /
- *S. paralleloneurus*
  - North Sumatra

FRUIT/NUT-BASED:
- *Durio zibethinus*
  - Kalimantan, Ind.
- coconut palm
  - Menado, Sulawesi, Ind.
- commercial fruit orchards
  - widespread

OTHERS:
- *Amomum compactum*
  - northern Laos
- *Amomum subulatum*
  - Himilayan foothills
- *Piper nigrum* (pepper)
  - widespread in Ind.
- *Camellia sinensis*
  - S. China / N. Thailand
- *Coffea spp.*
  - widespread
- *Zanthoxylum limonella*
  - northern Thailand
- *Borassus sundaicus*
  - Roti & Savu Islands, Ind.

MIXED SYSTEMS:
- Kenyah / Iban fallow enrichment
  - Kalimantan, Ind.
- Ifugao woodlots
  - Ifugao, Phil.

PERENNIAL-ANNUAL CROP ROTATIONS
(cyclical taungya system)

TIMBER-BASED:
- *Cunninghamia lanceolata*
  - southern China
- *Paraserianthes falcataria*
  - Mindanao, Phil.
- *Melia sp.*
  - N.W. Vietnam
- *Tectona grandis*
  - Laos
  - N.E. India
- *Gmelina arborea*
  - widespread
- *Eucalyptus spp.*
  - widespread
- *Pinus wallichiana*
  - Bhutan
- *Santalum sp.*
  - central Laos
- cedar
  - Kwangtung, China
- *Alnus nepalensis*
  - S./S.W. Yunnan, China

NON-TIMBER:
- *Cinnamomum burmanii*
  - Sumatra, Ind.
- *Aquilaria sp.*
  - central Laos
- *Broussonetia papyrifera*
  - northern Laos
- *Giganthochloa levis*
  - Mindoro, Phil.
- other bamboo spp.
  - Timor, Ind.
  - southern China
  - northern Vietnam
- *Calamus caesius*
  - Kalimantan, Ind.
- *Calamus sp.* /
- *Plectocomia himalayana*
  - southern China
- 'Talun kebun' (mixed)
  - West Java, Ind.

INTERSTITIAL TREE-BASED IMPROVED FALLOW

SIMULTANEOUS:
- *Alnus nepalensis*
  - Nagaland, India
  - S./S.W. China
- *Leucaena glauca* / *Gliricidia sepium*
  - Naalad, Cebu, Phil.
- *Leucaena leucocephala*
  - Amarasi, Timor, Ind
  - Sikka, NTT, Ind.
  - South Sulawesi, Ind.
  - Mindoro, Phil.
- *Sesbania grandiflora* / *Leucaena leucocephala*
  - Sumba/Flores/Timor, Ind.
- *Erythrina sp.* / *Desmodium sp.* / *Hybiscus sp.*
  - Flores, Ind.
- *Albizzia chinensis*
  - Sumba, Ind.
- *Acacia villosa*
  - Timor, Ind.
- *Ficus spp.* (fodder)
  - eastern Bhutan
- *Pinus kesiya*
  - northern India

SUCCESSIVE:
- *Tephrosia purpurea*
  - north Vietnam
- *Sesbania spp.*
  - Isabela/Cagayan, Phil.
  - Yap, S. Pacific
- *Alnus nepalensis*
  - southwest China
- *Casuarina oligodan*
  - New Guinea
- *Alnus japonica*
  - N. Luzon, Phil.
- *Parasponia rugosa* /
- *Schleinitzia novo-guineensis*
  - Papua New Guinea
- *Hibiscus tiliaceous*
  - Yap, S. Pacific

RETENTION / PROMOTION OF PREFERRED VOLUNTEER SPP.

ECONOMIC UTILITY:

Food
- bamboo shoots
- native vegetables & other wild food plants

Fiber
- construction materials, e.g., planting *Corypha ulan* Lan. & other palm spp. before abandoning swidden to provide roofing materials for field hut construction in next cropping phase
- harvest of poles useful for house or hut construction
- *Imperata cylindrica* & other spp. of thatch-grass for roof construction

Fodder
- *Imperata cylindrica* & other native forages
- Fuel
- Medicinal Herbs

Stimulants
- *Nicotiana tabacum* (tobacco)
- *Piper beetle* (beetle leaf)
- + spp. providing shade, pleasant smells, nectar for honey production, attracting wildlife for hunting, etc.
  - all widespread in subsistence swidden communities

ECOLOGICAL FUNCTIONS:
- - selective felling to retain 'mother trees' & accelerate recovery of secondary forest
- - protect existing coppices: limit cropping period, fire management & avoid tillage

SHRUB-BASED ACCELERATED FALLOW

NON-N FIXING:

Compositae spp. (*N-accumulating?*)
- *Austroeupatorium inulifolium*
  - West Sumatra, Ind.
- *Tithonia diversifolia*
  - Mindanao, Phil.
- *Chromolaena odorata*
  - Luang Prabang, Laos
  - Nusa Tenggara, Ind.
  - Kalimantan, Ind.
  - Yunnan, China
  - northern Thailand
  - widespread below 1000 m asl

Other
- *Mallotus barbatus*
  - northern Thailand
- *Ricinus communis*
  - Timor, Ind.
- *Tecoma stans*
  - Timor, Ind.

N-FIXING:
- *Mimosa invisa*
  - Leyte, Phil. (spiny)
  - northern Thailand (spineless)
- *Cajanus cajan*
  - Mindoro, Phil.

VINY LEGUMES AS SEASONAL FALLOWS

LEGUME ROTATIONS:
- *Phaseolus calcaratus*
  - northern Vietnam
  - northern Thailand
- *Amphicarpaea linearis*
  - Hainan Island, China
- *Flemingia vestita*
  - N.E. India
- *Dolichos lablab*
- *Vigna sinensis*
  - northern Thailand
- *Calopogonium mucunoides*
  - Leyte, Phil.
- *Pachyrhizos tuberosis*
  - northern Vietnam

- Increasing integration of legume components into cropping sequence + ruminant livestock

After Cairns, 1997, p. 7

monospecific thickets that quickly shade out *imperata* and other grasses with fodder potential. Although initial plant populations are high in very young fallows, they self-thin through competition, leaving intermittent clumps that can easily be cleared with the farmer's machete. Farmers point to copious quantities of litterfall as improving soil tilth sufficiently that seeds can be dibbled directly without need of any tillage operations. These combined properties may provide the biological basis for accelerating fallow functions and intensifying the swidden cycle without sliding into ecological decline.

Figure 10. *Ageratum conyzoides and other Asteraceae are valued fallow species (Oyen, 1995; Pandeya, 1995).*

A critical attraction of the *Asteraceae*-based fallows is that they are largely spontaneous and require minimal human intervention to manage. *C. odorata* and *A. inulifolium* produce large quantities of wind-dispersed seeds, enabling both species to rapidly colonize disturbed land. The fruit of *Tithonia diversifolia*, heavier and without a pappus, require birds, running water or other mechanical means to disperse. Farmers have been known to assist this process in the case of *A. inulifolium* (Stoutjesdijk, 1935) and *T. diversifolia* (author's field notes) by actively planting stem cuttings into *Imperata* swards. They are thus used as biological tools to rehabilitate degraded grasslands and bring the land back into productive cultivation.[18] After initial introduction of the germplasm, farmers have only to ensure that sufficient populations are preserved nearby to facilitate efficient seed dispersal on newly fallowed land.[19]

Farmers are vigilant of the floristic composition of fallow successions and may intervene to impede undesirable pioneer species and enhance the competitive edge of the *Asteraceae* in dominating the stand. For example, Banjarese shifting cultivators in Kalimantan apply spot applications of glyphosphate on *Imperata* clumps in new fallows, specifically to favor *Chromolaena odorata*'s expansion (Garrity, pers. com.). Lao swiddenists in Luang Prabang reportedly use grazing cattle for the same purpose - again to selectively target *Imperata* and encourage the expansion of *C. odorata* (Hansen, pers. com.). Yet in a seeming contradiction, further to the west in the rugged terrain of N.E. India, Naga swidden (*jhum*) cultivators condemn another high altitude *Asteraceae*, *Eupatorium adenophorum*, as a noxious weed that displaces *Imperata* and other native grasses valued for livestock fodder.

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[18] Although supportive quantitative data are still few, farmers interviewed in Bukidnon Province, the Philippines, contended that after planting stem cuttings into cogon (*Imperata cylindrica*), *T. diversifolia* shades out *Imperata* after the first year; by the end of the second year, they claim, the soil has rejuvenated sufficiently that the fallow can be reopened and a good crop grown without nutrient inputs. Others describe improved soil physical properties to such a degree that ploughing is no longer necessary and soil erosion is reduced.

[19] The most common strategy for preserving a convenient seed source is by simply leaving a belt of the desired *Asteraceae* around the perimeter of the swidden field. Others protect 'mother plants' growing in rock piles or other pockets of marginal land within or nearby the swiddens. Farmers using *Tithonia diversifolia* as an improved fallow species in Southern Honduras are reported to protect individual plants scattered sporadically across the field at the time of reopening the fallow (Derpsch, 1993).

The proliferation of these and other exotic *Asteraceae* spp. on S.E. Asia's landscape is significant to the livestock sector in that they are generally not palatable, but their expansion has been at the expense of *Imperata* and other native grasses that have traditionally provided the mainstay of ruminant diets. With increased attempts to control the annual burning that has perpetuated *Imperata* grasslands as a fire climax, we may see increasing conversion to *C. odorata*-dominated communities. In the Philippines where cattle ranches are more common, *C. odorata* is a pervasive weed that invades improved pastures and seriously erodes their carrying capacity. The threat is compounded in that if browsed, young regrowth of *C. odorata* (known widely as '*hagonoy*' in the Philippines) contains toxic nitrate levels and is attributed to significant levels of livestock mortality each year (Sajise et. al., ----).

The dichotomy of farmers' perceptions of *C. odorata* and other *Asteraceae* spp., as benevolent green manure crops to be managed during fallow periods - or as noxious weeds to be eradicated, is rational in the context of different land-use patterns and farmer objectives. The very properties of aggressive establishment, efficient nutrient capture, ability to smother out competing species, etc. that make *Asteraceae* ideal fallow crops - become liabilities in livestock pastures, tree crop plantations, and reforestation projects. It is more unexpected however, to find such dissimilar views within swidden environments, where one would expect similar farming systems to provide more solidarity of opinion.[20] That invasive *Asteraceae* are considered friends by Lao shifting cultivators in Luang Prabang and foes by their counterparts in Nagaland, may possibly be reconciled by the relative importance of the livestock component of their respective farming systems, and the scarcity of fodder resources.[21]

The 20 million ha. of *Imperata* grasslands of Southeast Asia are widely regarded as an underutilized use of scarce land resources. Substantial levels of research and development resources are allocated to rehabilitating these lands and bringing them into more productive uses. In situations of scarcity however, *Imperata* can quickly evolve from unwanted weed to economic plant highly sought after for thatching purposes. Aluminum sheets have replaced grass thatch only to a limited degree, and remain prohibitively expensive to many upland communities. Dwindling *Imperata* supplies thus provoke rapid market responses in the price of thatch. In this context, it becomes economically attractive for farmers to protect existing *Imperata* stocks, or even plant it as an improved fallow (Potter and Lee, 1997).

Finally, farmers' valuation of *Imperata* vis-a-vis *Asteraceae* or alternate succession species is influenced by the un/availability of animal draft power (van Noordwijk, pers. com.). Farmers owning draft animals not only exploit the fodder potential of *Imperata*, but also have the necessary traction to till the hardened soil and expose the *Imperata* roots. Fallow colonization by *Imperata* looms as a much bigger threat to swiddenists armed only with machete, hoe and fire.

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[20] For a detailed discussion of farmer vs. state perceptions of *Chromolaena odorata* and *Imperata cylindrica* in Indonesia, see Dove, 1986.

[21] *Eupatorium adenophorum* produces conspicuously less biomass and may also behave very differently than the other *Asteraceae* discussed here, contributing to its negative valuation by Naga swidden cultivators.