

Current and future opportunities for introduced forages in smallholder farming systems of south-east Asia

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Abstract

Livestock in south-east Asia are used for a wide variety of purposes. In many regions, there is an increasing demand for animal protein but, at the same time, increasing population pressure is pushing livestock on to more marginal lands. These marginal lands are generally uplands where soils are acid and infertile.

These upland regions are variously under plantations, shifting cultivation or natural or induced grasslands. There are also limited areas of intensive cropping. Adapted and productive forages have been identified for each of these agro-ecological systems, and these are listed.

In south-east Asia generally, there has been only a very limited uptake of improved forages by smallholders. This is considered to be due to lack of available information and lack of involvement of smallholders in the selection process. Examples are provided where selection criteria of scientists are very different from those of smallholders. The Forages for Smallholders Project, active in 7 countries in south-east Asia, is using farmer-participatory methodologies in promoting the adoption of adapted forages in the region.

Introduction

Livestock production in south-east Asia continues to be an activity dominated by smallholder farmers. They utilise a virtually free and otherwise untapped resource (the communal feed

resources of the community) to provide significant but secondary benefits to cropping, including manure for fertiliser and fuel, draught power, financial security and fulfillment of social obligations. Frequently, meat production for sale is of secondary importance. In intensive cropping areas of central Vietnam, for example, small cattle herds provide more income from manure (which is sold to coffee farmers) than from sale of calves. In Indonesia, small ruminants are kept primarily for the financial security they provide.

Feeding systems used by smallholders vary greatly between regions, depending largely on the availability of the feed resource and labour. They include combinations of total or partial pen-feeding, tethering, free grazing and shepherding. Until recently, planting of forages has seldom been practised because of limited land area; the perception that already available forage resources are adequate; the perception that forages cannot or need not be planted and managed; and the lack of access to capital and appropriate technologies. A further negative factor is land tenure arrangements, which commonly treat grazing land as communal, excluding any chance of using planted forages while livestock remain uncontrolled.

This low demand for planted forages is, however, beginning to change. In recent years, demand for livestock products (including manure) has outstripped production. Predictions of a decline in self sufficiency in meat production in south-east Asia from 94% in 1975 to 62% in 2000 are being fulfilled (Remenyi and McWilliam 1986). Despite sustained recent economic growth in many countries of greater than 5% and corresponding increases in demand for meat products, increases in livestock numbers have lagged behind.

The demand for higher crop output in the region is resulting in ever-greater intensification and expansion of lowland agriculture. This trend has forced livestock production on to more

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marginal uplands. Other forms of land use are also expanding on to traditional grazing areas. In parts of Indonesia, grazing lands are being replaced with extensive oil palm and forestry plantations. In other areas, smallholder farming systems are intensifying around tree cropping in former grazing land, such as in central Vietnam with coffee and rubber and in north Vietnam with fruit trees.

Upland farming systems — what scope is there for improved forage resources?

The expanding opportunities for forage development are in the upland areas, as an integral part of existing and developing agricultural activities. In south-east Asia, upland areas (defined as those areas of sloping land from slightly above sea level to about 1000m) occupy more than 60% of the total land area (Howeler 1994). These upland areas are typified by acid soils (mainly ultisols), which have become progressively more infertile following deforestation and successive cycles of burning, cultivation and erosion.

There are many productive forage legumes and grasses that have adaptive mechanisms making them suitable for these acid, infertile soils (Rao *et al.* 1992). There are four main kinds of upland farming systems where forages have potential (Fujisaka 1994):

- Plantations (especially coconut in Indonesia and Philippines);
- Intensive cropping (as in Java and the Philippines);
- Grasslands (such as the induced grasslands of Kalimantan, Laos and Vietnam); and
- Shifting cultivation (especially in Laos, Thailand, Philippines and Vietnam).

The potential of forages for each of these systems is outlined below.

Plantations

There are over 20 M ha of coconuts, rubber and oil palm plantations in south-east Asia, mostly on rolling upland areas (Stür *et al.* 1994). In conventional rubber and oil palm plantations (450–500 trees/ha), the period when forages can be grown under the trees is limited to 3–5 years during tree establishment, after which shading seriously restricts pasture growth. Good long-term opportunities exist for the integration of forages under the more frequent tall varieties of coconut.

Naturally occurring forages in these plantations can be grazed by ruminants with no detrimental effect on coconut production (and sometimes a positive effect) (Reynolds 1995). However, over time, grazing leads to invasion by unpalatable species, particularly woody plants, and eventually to loss of crop production. On unimproved pastures, stocking rates and live-weight gains are generally low, with cattle often being tethered. Owing to the favourable light environment in these plantations, introduced forages can more than double cattle production under coconuts with minimum inputs. Income from the cattle component can sometimes exceed that of copra production (Stür *et al.* 1994). Promising grass species for this situation include *Brachiaria decumbens*, *B. humidicola*, *B. brizantha* and *Stenotaphrum secundatum* grown in mixtures with the legumes *Arachis pintoi*, *A. glabrata*, *A. repens* and *Desmodium heterophyllum*. However, in plantations of dwarf palm varieties, with planting densities of up to 400 trees/ha, the prospects for improved forages are not as high (Reynolds 1995).

Intensive cropping systems

Intensive, upland cropping systems occur on more fertile soils and consist mainly of rainfed cropping and home gardens. The most widely adopted planted forage in these systems has been *Pennisetum purpureum* and its hybrids. However, often it has failed in smallholder situations when it is planted in areas unsuitable for cropping, where there is inadequate soil fertility and soil moisture. Hardy and persistent grasses such as *Brachiaria brizantha*, *Brachiaria decumbens* and *Paspalum atratum* may be more successful in these situations.

There is potential in some areas to grow herbaceous legumes such as *Desmanthus virgatus* (more alkaline soils) or *Stylosanthes guianensis* in fodder banks. Forage trees and shrubs can also be used for this purpose. Commonly used tree species include *Leucaena leucocephala* (only moderate acid tolerance), *Calliandra calothyrsus* and *Gliricidia sepium*. In many areas, there is existing or potential use of tree and shrub legumes in fencelines (such as with *Gliricidia sepium* in Bali).

Some forage species, when planted in hedgerows, have great potential to cover the soil, minimise runoff and erosion as well as provide

feed for ruminants. In an example from Hainan, China, soil erosion on 15% and 25% slopes planted with cassava was severe, especially with intensive land preparation (Howeler 1994). Reducing tillage and creating hedgerows of *Stylosanthes guianensis* or *Brachiaria decumbens* greatly reduced soil loss (although it was still very high).

For species to have potential uses in hedgerows, they need to be effective in reducing runoff and erosion, productive (especially in the dry season) and require little time to control during the growing season (to minimise competition with crops). Potentially useful species include bunch-type grasses such as *Panicum maximum*, *Pennisetum purpureum*, *Brachiaria brizantha* and *Paspalum atratum*, erect herbaceous and shrub legumes such as *Desmanthus virgatus*, *Desmodium rensonii*, *Flemingia macrophylla* and *Stylosanthes guianensis* CIAT 184, and tree legumes such as *Leucaena leucocephala*, *Calliandra calothyrsus* and *Gliricidia sepium*.

Grasslands

In south-east Asia there are only relatively small areas of natural grasslands. Induced (mainly *Imperata*) grasslands occupy about 20 M ha, mostly in Kalimantan and South Sumatra. Often, these grasslands are used for cattle breeding only, with very low stocking rates.

Although forage opportunities are limited by long dry seasons and lack of control over grazing animals, there are some possibilities for improvement. On grasslands in Timor, Indonesia, *Leucaena leucocephala* and other tree legumes have been planted to provide leaves that are fed with banana stems to fatten cattle (Barlow *et al.* 1990). In some small areas of Kalimantan, farmers are cultivating and planting forages such as *Stylosanthes guianensis* CIAT 184, *Brachiaria decumbens*, *Andropogon gayanus* and *Brachiaria humidicola* to reclaim small areas of *Imperata* grassland.

Shifting cultivation

Shifting cultivation, based on upland rice, is common in Laos, Thailand and Vietnam, on fragile, sloping lands. Livestock play an important role in these systems, sometimes providing more than 50% of farm income. Stability of traditional shifting cultivation systems depends

on sufficiently long fallow periods for organic matter to be returned to the soil before cropping (Chazee 1994). Shifting cultivation is frequently seen as unsustainable because of local population increases which lead to insufficiently long periods under fallow, soil erosion, soil nutrient depletion, forest clearing and weed problems (Fujisaka 1994). Strong efforts are being made in all countries either to eliminate shifting cultivation (replacing it with agroforestry, plantations or horticulture) or to stabilise it (by using improved fallows and contour hedges). Forages, in particular legumes, offer a means of minimising erosion on the fallow areas, improving soil fertility (through a build up of organic matter), controlling weed growth and providing feed for ruminants.

Ideally, leguminous forages for fallows would establish rapidly (usually undersown in rice), have high biomass production, effectively suppress weeds, be easily eliminated at the end of the fallow phase and not become weeds during the cropping phase (Roder *et al.* 1995). *Stylosanthes guianensis* is one such species and has been undersown successfully into upland rice crops in Laos (Roder and Maniphone 1995) and in the Philippines (Gabunada and Balbarino 1995). In Laos, Roder *et al.* (1995) compared many fallow management systems in terms of labour required for weed control in shifting cultivation areas. Herbicides were extremely effective but costly. The only other fallow treatments which substantially reduced labour requirement for weeding were grazed fallows (with the most promising species being *Stylosanthes guianensis* and *Brachiaria brizantha*) and tree legume fallows (especially leucaena and gliricidia). Other species with potential include *Stylosanthes hamata*, *Aeschynomene histrix*, *Flemingia macrophylla* and *Pueraria phaseoloides*.

Forage adoption — realising the potential of forages in each of these systems

Why is it that adapted forages are not widely grown by smallholders?

Despite the identification of robust forage species with potential in each of these upland systems, with only a few exceptions (such as contour hedgerows in the southern Philippines, high yielding grasses on dairy farms in Thailand, and *Gliricidia fencelines* in Bali), the potential has

not been even remotely fulfilled. This is partly due to a lack of access by development workers to information on the potential of each species and a lack of planting material. However, the most important reason is that forage development is usually planned, managed and analysed by researchers, with no farmer involvement, except as labourers for experiments and contributors to questionnaires and surveys.

The potential opportunities for forages in each upland system, as discussed above, are only technological options. The importance of this distinction is that it is not possible to identify appropriate forage species solely on the basis of adaptation to climate and soils and on researchers' perceptions of opportunities for forages in farming systems. Farmers commonly have different criteria for assessing forage species from the criteria that might be developed by a researcher (Horne 1996); several examples are listed below:

- In upland areas in Thailand, farmers recognise the severity of erosion problems but showed little interest in erosion-control measures unless they had other benefits, such as contour plantings of fruit or timber trees (Pahlman 1991, cited in Howeler 1994).
- It has been well demonstrated that green manures have significant potential to improve crop yields after fallows in upland areas, but there has been little farmer adoption.
- Improved liveweight gain and hence high forage yield are often considered by researchers to be an important way of improving smallholder livelihoods. Very often (but not always) the concern of smallholders is to minimise risk and labour constraints, not maximise production.
- Researchers commonly assume that forages are needed to feed ruminant livestock. In North Vietnam, an important criterion used by farmers for selecting forages is their suitability for feeding to pigs and fish.

In all these examples, technological opportunities and perceptions of researchers did not match farmers' needs. Often, where researchers see opportunities for increased productivity and profits, farmers may rightly see little more than higher risks and labour demand (Ørskov and Viglizzo 1994).

Increasing farmer participation

One approach to overcoming this problem is to involve farmers in all stages of research planning, implementation and analysis. By encouraging active farmer participation, their perceptions and needs in relation to new forage technologies will be clear from the beginning of a forage-evaluation program (Horne 1996). Involving farmers in the development of forages for their communities is the only way of dealing with this complexity and understanding how farmers perceive the role of planted forages in their systems.

The "Forages for Smallholders Project"

There are no set procedures for how to encourage farmer participation in research. Field workers need to be flexible and receptive to each community. The approach being taken by the AusAID-funded Forages for Smallholders Project is illustrated in Figure 1. In this example, farmer participation is central to all of the main stages of the research (planning, design, implementation and evaluation).

From the outset, on-station research can be important for screening a wide range of forage alternatives to identify a small group of adapted species (so long as the climatic and soil conditions on-station are similar to those of the target region). At the same time, field workers can be initiating problem-diagnosis with the local community. If, during the diagnosis, farmers and researchers identify problems which could be alleviated by planting forages, the next step can be to involve farmers in the planning, implementation and management of trials.

The Forages for Smallholders Project is using this process of participation in research with smallholder farmers to identify and develop forages that are both adapted to and appropriate in a number of different situations:

- Coconut plantations in Indonesia and the Philippines;
- Intensive upland cropping systems in the Philippines and Vietnam;
- *Imperata* grasslands in Indonesia and central Vietnam;
- Shifting cultivation areas in Laos and Vietnam; and
- Agroforestry areas in Laos and Vietnam.

Earlier work had highlighted 6 forages with broad adaptation through Indonesia, Malaysia, the Philippines and Thailand: *Andropogon gayanus* cv. Kent and CIAT 621; *Brachiaria*

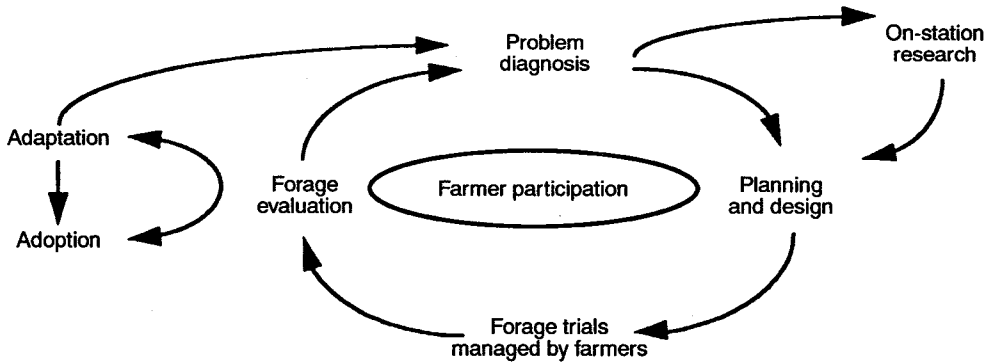


Figure 1. An approach to farmer participation in forage research (after FSP 1995).

brizantha CIAT 6780, *Brachiaria decumbens* cv. Basilisk, *Brachiaria humidicola* cv. Tully, CIAT 6369 and CIAT 6133; *Centrosema pubescens* CIAT 15160; and *Stylosanthes guianensis* CIAT 184 (Stür *et al.* 1995). These species are being evaluated currently by farmers in Indonesia, Laos, the Philippines and Vietnam. Evaluation of many other promising forages is in progress in these 4 countries, including accessions of promising species in the tree genera *Leucaena*, *Gliricidia* and *Calliandra*. By involving farmers in these evaluations, species will be selected that fit farmers' needs and will therefore have a much greater chance of subsequent wider adoption.

References

- BARLOW, C., GONDOWARSITO, R., BIROWO, A.T. and JAYASURIYA, S.K.W. (1990) Development in Eastern Indonesia: The Case of Nusa Tenggara Timur. *International Development Issues No. 13*. (AIDAB: Canberra). 110pp.
- CHAZEE, L. (1994) Shifting cultivation practices in Laos: present systems and their future. In: van Gansberghe, D. and Pals, R. (eds) *Shifting Cultivation Systems and Rural Development in Lao PDR*. pp. 66–97. (UNDP: Vientiane, Lao PDR).
- FSP (1995) *Participatory Research in Forages. A Training Manual*. (Forages for Smallholders Project: Vientiane, Lao PDR).
- FUJISAKA, S. (1994) Regional overview of upland agriculture in Southeast Asia. *Proceedings of the National Workshop "Sustainable Agriculture in the Uplands"*, Vientiane, Lao PDR, February 9–11, 1994. pp. 17–27. (Sustainable Agriculture Forum: Vientiane, Lao PDR).
- GABUNADA, F. Jr and BALBARINO, E. (1995) Experiences with on-farm research and extension of FSP forages in the Philippines. In: Stür, W.W., Cameron, A.G. and Hacker, J.B. (eds) *Forages for Smallholders. Proceedings of the 3rd Meeting of the Southeast Asian Regional Forage Seeds Project, Samarinda, Indonesia, 23–28 October 1994. CIAT Working Document No 143*. pp. 89–96. (CIAT: Colombia).
- HORNE, P.M. (1996) Partnership in research and technology transfer for livestock production through farmers' involvement. *Paper presented at the 18th Annual Conference of the Malaysian Society of Animal Production "New Perspectives in Animal Production"*, Kuching, 28–31 May, 1996.
- HOWELER, R. (1994) Integrated soil and crop management to prevent environmental degradation in cassava-based cropping systems in Asia. In: Bottema, J.W.T. and Stoltz, D. (eds) *Upland Agriculture in Asia*. pp. 195–224. (Regional Co-ordination Centre for Research and Development of Coarse Grains, Pulse, Roots and Tuber Crops in the Humid Tropics of Asia and the Pacific (CGPRT): Bogor, Indonesia).
- ØRSKOV, E.R. and VIGLIZZO, E.F. (1994). The role of animals in spreading risks and other non economic functions: a new paradigm for animal science. *Proceedings of the 7th AAAP Animal Science Congress, Bali, Indonesia, 11–16 July 1994*. Vol 1, 125–141.
- RAO, I.M., AYARZA, M.A., THOMAS, R.J., FISHER, M.J., SANZ, J.L., SPAIN, J.M. and LASCANO, C.E. (1992) Soil-plant factors and processes affecting productivity in ley farming. In: *Pastures for the Tropical Lowlands. CIAT's Contribution*. pp. 145–176. (CIAT: Colombia).
- REMENYI, J.V. and MCWILLIAM, J.R. (1986) Ruminant production trends in Southeast Asia and the South Pacific, and the need for forages. In: Blair, G.J., Ivory, D.A. and Evans, T.R. (eds) *Forages in Southeast Asian and South Pacific Agriculture. Proceedings of an International Workshop held at Cisarua, Indonesia, 19–23 August, 1985*. pp. 1–6.
- REYNOLDS, S. (1995) *Pasture-Cattle-Coconut Systems*. (FAO: Rome). 668pp.
- RODER, W. and MANIPHONE, S. (1995) Forage legume establishment in rice-slash-and-burn systems. *Tropical Grasslands*, 29, 81–87.
- RODER, W., PHENCHANH, S., MANIPHONE, S., SONGNHONGSUATHOR, K. and KEBOULAPHA, B. (1995) Weed management strategies aimed at reducing labour for upland rice production. *Proceedings of the International Rice Research Conference, IRRRI, Los Baños, Philippines, February 1995*.
- STÜR, W.W., CAMERON, A.G. and HACKER, J.B. (1995) (eds) *Forages for Smallholders. Proceedings of the 3rd Meeting of the Southeast Asian Regional Forage Seeds Project, Samarinda, Indonesia, 23–28 October 1994. CIAT Working Document No 143*. 149pp. (CIAT: Colombia).
- STÜR, W.W., REYNOLDS, S.G. and MACFARLANE, D.C. (1994) Cattle production under coconuts. In: Copland, J.W., Djajanegara, A. and Sabrani M. (eds) *Agroforestry and Animal Production for Human Welfare. Proceedings of an International Symposium held in Association with the 7th AAAP Animal Science Congress, Bali, Indonesia, 11–16 July 1994. ACIAR Proceedings No. 55*. pp. 106–114.