Some natural and induced grasslands of the Lao PDR

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The raising of livestock is a major industry in the Lao PDR. Livestock is not only a major source of livelihood security for rural families but also livestock exports contribute approximately 15% to gross domestic product. The Lao Department of Livestock and Fisheries is therefore interested in supporting and promoting this industry, particularly ruminants (Sihanath 1995). Currently, all of the ruminant livestock (cattle, buffalo, and goats) of Laos are raised by farmers in rural communities. The AusAID-funded Forages for Smallholders Project (FSP) is contributing to the improvement of ruminant production through the introduction, development, and distribution of high-yielding, adapted forage species and promoting their adoption by smallholders through participatory techniques (Stür et al. 1995, Hacker and Kerridge 1997).

Although the adoption of high yielding, adapted forages should make a substantial impact on livestock productivity, most production will continue to be dependent on traditional feed sources, including natural and induced grasslands and savannas. There is therefore an interest in the production potential of these grasslands and savannas, the extent to which they have been degraded, and the relative abundance of the more productive and palatable species. This led to a request to the FSP to assemble botanical information on the grasses of Lao PDR, with particular emphasis on pek savannas (dominated by the dwarf bamboo known as 'pek') and the grasslands of Xieng Khouang Province. The results of surveys covering these two regions have been published (Hacker et al. 1997, 1998), and the present paper provides an overview of findings.

Why are there grasslands in tropical Lao PDR?

Southeast Asia is more typically a region of forests than of grasslands and savannas. The presence of these vegetation types is likely to be due to environmental constraints, or previous management, that has prevented a forest cover from developing. In Lao PDR, environmental constraints include a long dry season and low soil fertility. Management effects include burning, cultivation, and fire. The presence of natural grasslands does not necessarily indicate a rich grazing resource, but may indicate that the soils are too poor to support a forest cover. This is apparently the case on the Plain of Jars, Xieng Khouang, where poor calving percentages and extremely low animal production are attributable to low soil fertility, with very low phosphorus (P) percentages (Gibson 1997), rather a grass flora comprising species which are intrinsically low in quality.

Pek savannas

Pek savannas occur in Lao PDR south of about latitude 17^{o} N, and at altitudes up to about 500 m. They have an understorey which is dominated by two species of dwarf bamboo, previously known as *Arundinaria ciliata* and *A. pusilla* and since 1990 known as *Vietnamosasa ciliata* and *V. pusilla*. This new genus includes a third species, *V. darlacensis*, restricted to southern Vietnam (Nguyen To Quyen 1990). *Vietnamosasa pusilla* is known as pek in Thailand and Lao and grows in dry dipterocarp forest from the

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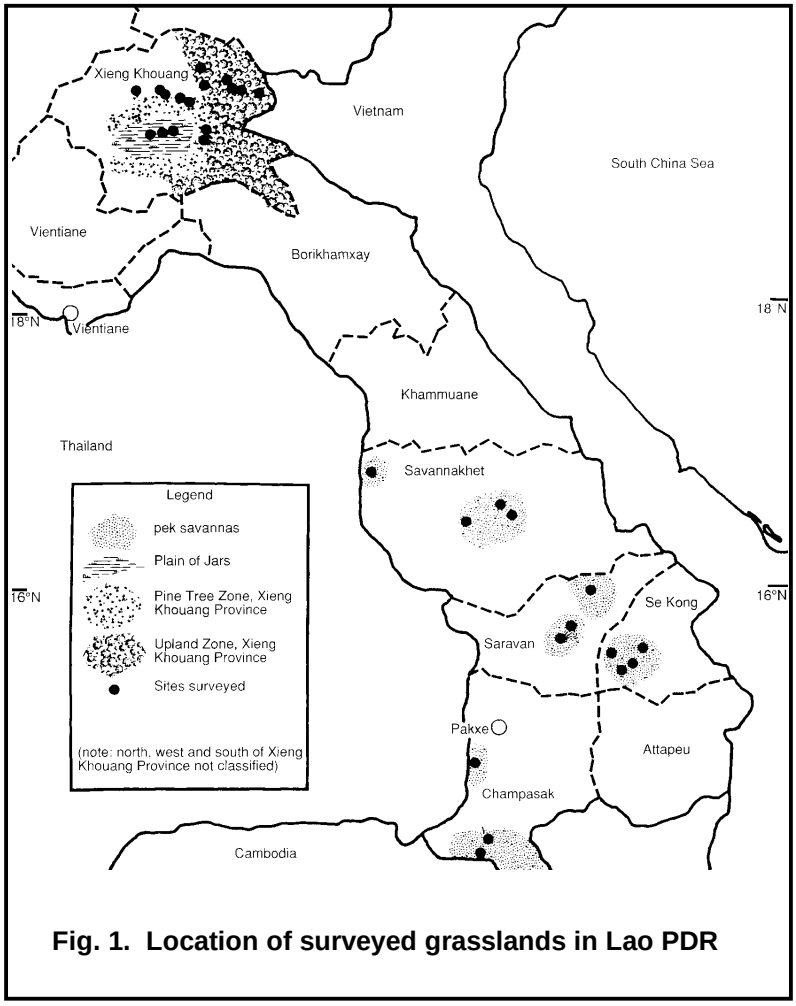

Fig. 1. Location of surveyed grasslands in Lao PDR

Korat Plateau in Thailand to Vietnam. *Vietnamosasa ciliata*, known as 'chote' in Thailand, 'chawd' in Lao, is larger than 'pek', and grows wild in any open place in dipterocarp forest throughout the same range (Sujatmi Dransfield, pers. comm. to J. Veldkamp).

Twenty sites where pek was a significant component of the herbaceous vegetation were examined during the survey (November 1995). These ranged from relatively small areas of several hectares to extensive areas of many square kilometres. In general, areas which were more remote from habitation, and hence from grazing, had an understorey which was close to 100% dominated by *Vietnamosasa pusilla*, growing to heights of 1.6 m tall. Few other species of grass could tolerate this level of competition, together with the shade from the trees. These species were all growing to heights of 2 m or more. In areas which had evidently been subjected to heavier grazing, low shrubs tended to dominate the understorey, together with a few lower growing grasses (Table 1). In tracks and pathways, grasses were annuals or weakly perennials (checks), producing large numbers of seed, thus ensuring success at reestablishment.

Table 1. Some grasses characteristic of pek savannas (Species tabulated are those considered to be of more value to livestock – after Phengvichith and Hacker 1997).

Competition from pek		Tracks and bare areas	Glades
Strong	**Moderate**		
Heteropogon triticeus[a]	*Andropogon chinensis*[a]	*Aristida cumingiana*	*Chrysopogon aciculatus*[b]
Schizachyrium sanguineum[a]	*Heteropogon contortus*[a]	*Gymnopogon delicatulus*	*Germainia capitata*
Themeda arundinacea[a]	*Isachne globosa* [a]	*Eragrostis brownii*	*Germainia ?khasyana*
Sorghum nitidum[a]	*Diectomis fastigiata*[a]	*Eragrostis tremula*	*Paspalum scrobiculatum*
Chionachne ?koenigii	*Eulalia trispicata* [a]	*Schizachyrium brevifolium*	

[a] Generally considered a useful species for livestock.
[b] In areas subjected to heavy grazing.

Xieng Khouang

A very diverse province, much of Xieng Khouang is not readily accessible. Hacker et al. (1998) recognised four agro-ecological zones: the Plain of Jars, the Pine Tree Zone, the Upland Zone, and the Valley Zone. The latter zone, being of more significance to cropping than to livestock, was not surveyed.

The Plain of Jars

As defined by Hacker et al. (1998), the Plain of Jars is a plain 1,100 m above sea level and is probably an old lakebed. It is a natural grassland, devoid of trees. Soils are acidic, with a high aluminium saturation, and are low in nitrogen and phosphorus (Table 2). Areas close to the provincial capital of Phonsavanh were too heavily grazed for botanical analysis. In other areas, the flora was dominated by *Themeda triandra*, which comprised 70-90% of the vegetation, with other grasses as minor components of the vegetation (Table 2). Small valleys and other areas protected from grazing commonly include tall-growing species such as *Themeda intermedia* and *Sorghum nitidum*.

The Pine Tree Zone

The Pine Tree Zone is a hilly area to the west, south and east of the Plain of Jars. It includes forested areas dominated by conifers *Pinus merkusii* and *P. kesiya* and areas where trees are occasional or absent, which are presumed to have been cleared of forest. Soils are similar to those of the Plain of Jars (Table 2) and, where cleared, support a generally similar grass flora, dominated by *Themeda triandra* (Table 3). In the one forested area surveyed, *Eulalia phaeothrix* was the dominant grass, with a range of herbaceous legumes which were absent in nearby cleared areas.

Table 2. Soils (0-10 cm) of the Plain of Jars, Pine Tree Zone, and Upland Zone of Xieng Khouang (Hacker et al. 1998).

	Plain of Jars	Pine Tree Zone	Upland Zone
pH (1:5 water)	4.9 (4.8-5.0)	4.9 (4.7-5.2)	5.4 (4.7-7.7)
NO_3 (mg/kg)	0.6 (0.2-1.3)	3.0 (0.4-10.8)	14.9 (0.4-58.5)
P (Colwell) (mg/kg)	2 (2-3)	2 (1-2)	7 (3-15)
Al saturation (%)	77 (74-79)	62 (43-81)	34 (0-79)

Table 3. Some grasses characteristic of the Plain of Jars and open grasslands in the Pine Tree Zone.

Dominant species	Minor species		
	Palatable	Palatable when young	Unpalatable
Themeda triandra	*Eulalia spp.*	*Hyparrhenia diplandra*	*Arundinella nepalensis*
		Hyparrhenia newtonii	*Arundinella setosa*
		Sorghum nitidum	*Cymbopogon nardus*

The Upland Zone

The Upland Zone is extremely variable in topography, geology, and soils (Table 2), with some soils as infertile as those on the Plain of Jars and others alkaline and fertile. Altitude is up to 2,450 m; the sites surveyed were restricted to 1,000-1,450 m, owing to difficulty of access to higher altitudes.

The only true grasslands seen in the Upland Zone apparently resulted from previous management. These were either grasslands comprising almost pure stands of *Imperata cylindrica* or small areas of heavily grazed grass in the vicinity of villages. A high proportion of the Upland Zone is subject to slash-and-burn farming for the production of upland rice, maize and other crops.

Table 4. Some grasses characteristic of the Upland Zone.

Often growing in full sun			Shaded (palatable)
Palatable	**Palatable when young**	**Unpalatable**	
Leersia hexandra[a]	*Imperata cylindrica*	*Miscanthus floridulus*[b]	*Centotheca latifolia*
Thysanolaena latifolia	*Neyraudia arundinacea*		*Cyrtococcum accrescens*
	Saccharum spontaneum		*Microstegium spp.*
	Themeda arundinacea		*Panicum spp.*

[a] swamps
[b] in Xieng Khouang, considered to be palatable when young.

While not being actively farmed, this land has varying proportions of native grasses, shrubs, and trees, with shrubby weeds *Chromolaena odorata*, *Tithonia diversifolia*, and *Artemisia* sp. frequently being dominant components of the vegetation. In these situations (and also in *Imperata grasslands*), large tussocks of the robust grasses *Neyraudia arundinacea*, *Thysanolaena latifolia*, *Miscanthus floridulus*, and *Saccharum spontaneum* are significant features of the vegetation. Other frequently encountered grasses are listed in Table 4. Some Upland Zone grasses only occur in moderately shaded conditions; these include palatable grasses such as *Panicum* and *Isachne* spp., and grasses of forest margins which scramble over vegetation in order to access better lit situations, such as *Microstegium* spp. and *Panicum sarmentosum*. Most grasses under shaded conditions are reputedly palatable to livestock, although most do not yield a high biomass.

Heavily grazed areas in the Upland Zone tend to be dominated by stoloniferous grasses or low-growing tussock grasses (Table 5). A high proportion of the unpalatable *Sporobolus indicus* is indicative of serious overgrazing and reduced productivity. Similar grasslands almost certainly occur at lower altitudes, as all the species listed in Table 5 are widespread.

Table 5. Some grasses of heavily grazed areas in the Upland Zone.

Dominant/subdominant		Occasional
Palatable species	**Unpalatable species**	
Axonopus compressus	*Sporobolus indicus*	*Cynodon dactylon*
Chrysopogon aciculatus		
Paspalum conjugatum		

A comparison between the grass floras of pek savannas and Xieng Khouang

Although not geographically widely separated, the grass floras of the Plain of Jars (together with the Pine Tree Zone), the Upland Zone, and the pek savannas were radically different. As the surveys were of short duration, some species present in the three regions would not have been collected. However, although 66 grass species were collected in Xieng Khouang and 41 species (excluding bamboos) in the pek savannas, only 14 species were common to the two regions. The most notable variations were the complete absence of *Heteropogon* spp. from Xieng Khouang and of *Miscanthus*, *Neyraudia* and *Saccharum* spp. from the pek savannas. These differences reflect variation in climatic and edaphic adaptation of the species, differences which are also likely to occur with introduced forage species.

Some general principles

It is frequently possible to obtain information about the environmental conditions of a site and its management history from the species present, and their abundance. Several examples come from the present studies:

- Some grass species are indicative of degraded, infertile soils and overgrazing. These include *Schizachyrium brevifolium* and *Aristida cumingiana*.
- A high proportion of unpalatable grasses, such as *Sporobolus indicus*, in a pasture is likely to be associated with overgrazing.
- A high proportion of low shrubs in pek savannas is likely to be indicative of long periods of heavy grazing. However, *Vietnamosasa ciliata* appears not to be susceptible to heavy grazing pressure over periods of up to 4 years (Gutteridge 1985).
- In Xieng Khouang, dominance of *Themeda triandra* in grasslands is indicative of extreme infertility (this is not necessarily the case in other regions).

Opportunities for improving production from Lao grasslands

Opportunities for improving pek savannas without total replacement of the native vegetation appear to be limited. In northern Thailand, *Vietnamosasa ciliata* provides reasonable forage in the early wet season and after fire, but quality rapidly declines. Attempts to introduce exotic legumes into pek savannas (following tree removal and slashing) were unsuccessful, the legumes failing to persist for more than 2-4 years (Gutteridge 1985). The slashing treatment also failed to result in a long-term increase in the proportion of native grasses other than bamboos. The best opportunity for improving production from pek savannas in Lao PDR is probably to maintain undisturbed areas of pek savanna as a sustainable resource, while fully improving smaller areas around villages with introduced grasses and legumes such as *Brachiaria decumbens* and *Stylosanthes* spp. In northern Thailand, liveweight gain per hectare was four times higher from improved pasture than from pek grasslands, whether or not any attempt had been made to improve the pek grasslands (Gutteridge et al. 1983). Also in Thailand, supplementation of cattle grazing pek grasslands with salt doubled liveweight gain, this being an inexpensive treatment which could be recommended in Lao PDR.

On the Plain of Jars and in the Pine Tree Zone, the dominant grass is *Themeda triandra*, a species which is widely accepted as being a high-quality and productive grass for grazing (Bogdan 1977), although not always persistent in grazed pastures (Mannetje and Jones 1992). As the soils are so P-deficient, any improvement will necessitate P input into the system. Improvement in ruminant production will be limited by the low P status of the soils, rather than the intrinsic quality of the grass. Management will need to avoid fertility transfer (through corralling cattle and using manure for cropping), and hence further reduction in soil fertility. However, the tendency in some countries for *T. triandra* not to persist with moderate to heavy grazing is a matter of concern.

In the Upland Zone, many native grasses are used by smallholders as cut-and-carry feeds. Many are locally and widely known to be palatable species. However, these are growing naturally, often at some distance from smallholder farmsteads. For cut-and-carry systems, adequate areas of planted forage close to homesteads would reduce the time and effort required for a smallholder to feed his stock. One farmer was already doing this, of his own initiative, with the annual *Coix lacrima-jobi*. Productive and leafy exotic forages could be used, but there could also be opportunities for planting local species of grass. The species selected for this purpose should be those which are high-yielding and retain a high percentage of leaf throughout growth. The late-flowering *Thysanolaena latifolia* is a species which could be considered for this purpose.

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