Management of Trees for Animal and Wood Production in Upland Farming Systems

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Abstract

Existing information suggests that for considerable areas of the wet-dry tropics it would be possible to create an agroforestry system in which production of quality timber was combined with increased animal production. The essential feature of this system is the use of particular tree species at wide spacings in open grassland. These trees provide feed by (1) the dry-season fall of edible leaf, flower, or pod, and (2) by the tree canopy causing an increase in grass production and quality. Further animal production benefits would come from the moderation of seasonal extremes and the option of lopping part of the green canopy for drought feeding. Managing open-grown trees to obtain clear wood would require more management than for forage alone, but need not reduce forage production. Returns from wood production would depend on on-farm processing, the technology for which is increasingly available. Possible species for the Lao DPR include siris (Albizia lebbeck), white siris (Albizia procera), yemane (Gmelina arborea), and raintree (Samanea saman). A number of other species are also of interest and may well be found in the local flora.

There has been much consideration of the role of multi-purpose trees in the tropics. Usually this means rees for fodder with a number of other benefits such as fuel wood, fertiliser, or soil conservation. The practical application is best seen in the mixed garden system of West Java. However, there is a system that appears biologically feasible for Imperata dominated or degraded grasslands, yet is relatively untried. This involves tree species that have the potential to be grown at wide spacing for wood production while at the same time promoting animal production and restoring soil fertility.

Animal Production from Dual-Purpose Trees

This depends on considerably widening the concept of fodder trees, overcoming the assumption that trees can contribute feed only when animals browse green leaf, or it is cut and carried.

Deciduous leaf fall

The species of interest are obligately deciduous in the dry season, or else facultatively deciduous under prolonged dry conditions. In either case, the entire standing leaf crop becomes accessible to the grazing animal.

The suggestion that fallen tree leaf could make a useful contribution to grazing-animal nutrition is novel, as it has been assumed to have low feed value. However, in the tropics one must take account of the dry-season loss of feed quality in the grasses. When the rumen digestibility of fallen leaf from 27 native deciduous trees was compared with dry-season grasses in North Queensland (Lowry 1995) it was found in general to be more digestible than the grasses. However the fallen leaf has quite different nutritional characteristics (Kennedy and Lowry 1996). There is thus the contradiction of low digestibility and high intake, as was found for fallen leaf of Albizia lebbeck (Lowry 1989). Overall, it seems likely that utilisation of fallen leaf by grazing ruminants occurs to a considerable extent in tropical rangelands. The paucity of published accounts and research is simply because it is not a conspicuous behaviour and no one has paid much attention to it.

Flowers and fruit

Depending on the species, annual production of flower or fruit biomass may be negligible or up to 20 kg/tree. It may have high feed value or none at all. It may be shed at a time of year for it to be of little use, or at a time when it has high strategic nutritional value.

Promotion of pasture in the wet-dry tropics by tree canopy

It is generally assumed that because trees compete for water with grasses, they will have an adverse effect on pasture. However, in northern Australia, it is very easy to observe that large isolated trees of Albizia lebbeck sometimes have a zone of enhanced pasture growth below the tree canopy. This is not an optical illusion. In
North Queensland early wet season yields of grass dry matter were 82% higher under the canopy in grazed areas and 127% higher in an ungrazed area (Lowry et al. 1988). Apart from the question of relative overall dry-matter production, it was noted that grass below the canopy remained green and continued growing for up to two months after that in the open had died off, and that, at the end of the dry season, there was a more rapid response to rain from grass below the canopy. In addition, it has been found that grass associated with the canopy in North Queensland had digestibility 5-10 units higher than that in the open, and maintained quality for 6-8 weeks longer at the onset of the dry season (Llano 1990).

A fuller discussion of this aspect, and the mechanism by which it happens, can be found in the report by Lowry and Seebeck (1996). However, key references on the ecophysiology of grass enhancement by tree canopies in the African savanna are Belsky (1992-1994), and in Australia, on the effect of shade alone, showing that some grasses can be more productive under 50% shade, is Wilson (1996).

Overall, these results suggest that it is possible to devise agroforestry regimes for the seasonal tropics in which the trees will not only increase total pasture production but also prolong the period of higher pasture quality. It is also possible to indicate the conditions under which positive effects can be obtained: strongly seasonal climate, medium dense tree canopy (40%-60% transmission), medium to low fertility soils, and preferably but not necessarily a nitrogen-fixing tree species. Naturally, a major long-term effect will be improvement of soil condition in the sub-canopy area, so this system is also a strategy for rehabilitating degraded Grasslands.

Wood Production from Dual-Purpose Trees

There are a number of tree species well recognised as fodder trees, that are, sometimes in a quite different context, also known as a source of quality timber. Normally, these uses would be somewhat exclusive. Fodder would be browsed or collected from wayside trees that would be of little use for timber. Quality timber would come from trees in forests or forest plantations that would provide little feed for livestock. It has been suggested that large isolated trees in grassland can promote animal production in the ways outlined above. The question is, can these trees be managed for quality timber? Trees growing in the open will tend to adopt a multi-branched spreading habit, and this is the aspect that requires active management. Pruning open-grown trees to obtain a good stem form is now a well-established practice in Australia and New Zealand, the number of species to which it has been applied is growing, and there seems no reason why any species of interest in the Lao DPR should not be managed similarly. The technology is simple, with labour costs less of a constraint. Developments in mobile mining technology mean that timber of precise dimensions can be cut from the log in situ (Lowry and Seebeck 1996). This avoids the use of heavy transport and allows the economic utilisation of small volumes of wood.

Notes on Particular Tree Species

The siris tree- Albizia lebbeek

Siris is a medium to large tree, found throughout much of Asia. It is of multi-stemmed widely spreading habit (to 30 m diameter, 20 m high) when grown in the open, but capable of good log form in plantation. The tree is fully deciduous in the dry season.

Large trees can boost animal production in all three ways noted here: as a feed, as a supplement, and by improving grass quality. Results of analyses and actual feeding experiments are reviewed in Lowry et al. (1994). The fallen leaf is of surprising value because of the high voluntary intakes shown by sheep. Fallen flower is an excellent feed. The value of siris as a supplement in extensive grazing systems would be that leaf, flower and pod drop sequentially during the dry season and can be utilised directly by grazing animals. In mature trees, leaf, flower and pod fall in comparable amounts (Lowry 1989) and can total 100 kg. The wood is of recognised value, and is exported to Europe as East Indian Walnut. A recent summary of timber properties is that of Keating and Bolza (1982).

White siris- Albizia procera

This species has a wide distribution through tropical Asia in savanna and deciduous forest habitats. It is regarded as a good fodder tree for all ruminants, the leaves being highly palatable and high in protein (Parrotta undated). However, there does not appear to be any published result from an actual feeding trial. Like siris, it is deciduous and the fallen leaf would be expected to have similar feed value. Leaf is the only feed supplied from the canopy. The biomass of the flowers is insignificant, while the pods are produced much more sparingly than siris. Isolated trees would be expected to have a promotional effect on pasture like that of siris and this appears to be happening with wayside trees but this has yet to be investigated. The wood has been described as follows: 'The timber is strong, elastic, tough and hard. Compared to teak it is 10% stronger in modulus of
elasticity, 25% more resistant iii compression parallel to the grain, and twice as hard ... The heartwood is moderately durable... Moderately hard work and saw by hand, but the wood planes to a smooth surface more readily than A. lebbeck due to the less oblique grain angle... Uses: furniture, and table and counter tops', (TRADA 1979).

Yemane—Gmelina arborea

This is a well-known timber tree of India and Burma. The suggestion that it could have a dual-purpose - agroforestry role is novel and arises from observations of its leaf phenology in Townsville. The trees were completely deciduous in the late dry season, the large membranous leaves forming a considerable carpet on the ground. This fallen leaf turned out to have a 24-hour intraruminal digestibility of 80%. This was quite improbably high, but his since been confirmed. A single publication from India reports a feeding trial (Majgaonkar et al. 1987) in which the leaf had a dry matter digestibility of 57%, a crude content of 11.5%, and the protein was 55% digestible. Animals showed a very high dry-matter intake of 2.6% body weight, indicating it was palatable as well as digestible. All these parameters indicate the leaf is an excellent feed. These results suggest that if yemane was grown at wide spacings in pasture in the wet-dry tropics, there would be a substantial dry-season leaf fall with a digestibility so high that it could be regarded as an energy supplement. The plantation-grown timber is described as: one of the best (and most reliable timber found in southern Asia.

Rain tree, monkey pod Samanea saman (Albizia saman)

This is an excellent shade tree in much of the tropics. The timber is best known for wooden handicrafts but has a range of uses. The rain tree has been already documented as a fodder tree (NAS 1979). This is mainly in relation to a high production of nutritious pods. However, the species is also deciduous in August-September and has quite large leaflets. When the fallen leaf was fed to sheep it had a very low digestibility but this was offset by a surprisingly high intake (Lowry 1995). The material would probably be utilised if falling into mature pasture. The rain tree is also one of the species that can unequivocally promote grass growth (Jagoe 1949).

White cedar-Melia azedarach

Clear wood from white cedar is of very high value. The tree is found over a very wide range of habitats, including semiarid areas. The leaf has an exceptionally high digestibility (Vercoe 1986) and is known as a fodder tree in India. In drier areas of Queensland, it has been said to be fed to dairy cows (Everist 1986). White cedar is conspicuously deciduous but the leaf drop occurs rather early in the dry season and this may detract from its feed value.

Leucaena-Leucaena leucocephala

Leucaena is usually hedged or otherwise managed for browse, and the question of sawn timber production does not arise. However, in the search for new lines, one of the most productive (‘Tarang’, K636) proves to be strongly arboreal (M. Shelton, pers. comm.). This opens the possibility of using it in a dual-purpose regime.

References


Thesis, James Cook University, Townsville.


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