Forestry for Development - Proceedings of the Annual Forestry Symposium 1995, Sri Lanka, 15-16 December 1995. (Eds. Amarasekera, H S and Banyard, S G). Published by Department of Forestry and Environmental Science, University of Sri Jayewardenepura, Sri Lanka (1996)

POTENTIAL OF LIVESTOCK PRODUCTION IN FORESTRY SYSTEMS: FOCUS ON THE GOAT IN SRI LANKA

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ABSTRACT

Forest systems, both natural and cultivated, have a very high potential for livestock production. The fodder for feed could be obtained from forestry systems. This biomass can easily be converted to cash generating products through animals. The GOAT is an ideal livestock species, well suited to these systems.

In the Dry Zone under natural browsing in scrub jungles, live-weight gains up to 50 - 75 grams per day have been achieved. The rumen ammonia levels were higher (400 mg $N\ l^{-1}$ SRF) than those where grazing was in pure Brachiria pastures. The blood urea levels were satisfactory (10.3 m $moll^{-1}$).

In cultivated forests such as *Eucalyptus* and *Pinus*, similar potentials exist. Under pine forests in the Mid-Country of Sri Lanka, goats on natural pastures gained 45 grams per day and with *Gliricidia* this increased to 55 grams per day.

Goats are also efficient "Biological Weeders". Removal of weeds reduce weeding costs, competition and minimize fire risk. A single goat will remove nearly 0.5 metric tonnes of weed dry matter per year and convert this to 25 kg of meat. Five goats can keep a hectare of moderately weedy land clean (2,500 kg dry matter per hectare per year), while returning 28 kg N, 18 kg P_2O_5 and 11 kg K_2O as nutrients to the system. Livestock fit well into agroforestry systems, where tree/ shrub species are grown as hedgerow and more biomass is produced than is needed. It is concluded that the *'SALT-2'* system is well suited to improve the family budget and sustain the soil productivity for mid-country farmers.

INTRODUCTION

Traditionally, forests were given a high priority for their potential to supply high quality timber and other wood products. However, in the recent past much attention has focused on non-timber and non-wood forest products from forestry systems, their efficient utilization and their sustainability. Throughout the history of mankind, there has been a heavy dependence on forests for shelter and food before people resorted to tilling the soil. Forests also provided people with quality fodder to satisfy the feeding

needs of their domesticated livestock. It is clear that the use of fodder from natural resources such as forestry systems is not a new concept to be associated with modern livestock production. Of course, in nature wild animals sustain themselves by acquiring their food from the same systems.

Today, as well as natural forests, there are many other man made forestry systems. These include forest plantation systems using for example pine and eucalyptus, monoculture plantations (for example rubber and coconut) and forestry based agricultural systems (Agroforestry). Any of these systems can be utilized to upgrade the living standards of the resource-poor smallholders (poor owners of small farms) while maintaining sustainability. At present, however, the potential of these systems is very poorly exploited.

WHY SHOULD RUMINANT LIVESTOCK BE GIVEN A HIGH PRIORITY?

Ruminants are species of animal (cattle, buffalo, goat and sheep), which carry three extra pouches, called "fore-stomachs", before their actual stomach and they also re-masticate the ingested food by the process called "rumination". All plant based feed (grasses and fodder) are called roughage. This is mainly composed of cell wall materials (cellulose) made up of glucose units. No other higher animals can digest this glucose based feed due to the absence of the enzyme "cellulase". Ruminants harbour micro organisms in their fore-stomachs, which produce cellulase enzyme to facilitate the digestion of cellulose. Thus, only ruminants can utilize the vast quantity of glucose trapped as cellulose.

WHICH RUMINANT IS BEST FOR FORESTRY SYSTEMS?

Of all the domesticated ruminants in Sri Lanka, the "ideal" species is the GOAT. This species has many advantages over others including:

i low requirement of skilled labour (easily handled by any member of a farming family)
ii efficient convertors of non-edible biomass to valuable animal proteins (milk and meat)
iii highly prolific and high survival rate
iv high resistance to parasites and diseases
v prefers wide variety of feeds which are not acceptance to other livestock
vi easy to exchange for cash
vii no religious or ethical barrier for meat
viii high nutritional value and non allergenic properties of milk
ix high market value for products.

POTENTIAL FOR THE DEVELOPMENT OF GOATS AS A SOURCE OF INCOME.

Many countries have reported the success of raising goats under different forestry systems - both natural and man-made. One of the major examples is raising goats under rubber and oil palm plantations in Malaysia - to control weeds, to reduce the cost of production and to generate additional income with very low inputs. The common example in Sri Lanka is the system of raising sheep and goats in the Northern peninsula, where they depend completely on crop residues and natural vegetation in scrub lands.

POPULATION AND DISTRIBUTION OF GOATS IN SRI LANKA.

The total population of goats in Sri Lanka has been estimated to be 0.5 million of which 65% is found in the dry and dry intermediate zones. These are the high potential areas available for livestock production using the existing natural resources. The dry and dry intermediate zones contain a large extent of waste and scrub land with an abundance of high quality natural fodder. About 25% of the goat population in Sri Lanka is confined to the wet zone, where man made forestry systems such as pine plantations, plantation agriculture and agroforestry systems are present. Goats in all agro-ecological zones are distributed in smallholdings and the owners are generally resource poor farmers. These animals are predominantly indigenous (and their crosses) and are mainly raised for meat. Milking is not very popular at present due to marketing limitations but a very high potential exists.

POTENTIAL IN SCRUB JUNGLE AREAS.

In the dry and intermediate zone of Sri Lanka, scrub jungle has become the major browsing source for goats. They thrive very well under these conditions due to the presence of the variety of fodder which satisfies their nutritional requirements of energy, protein and minerals. Goats prefer these feeds as they are the type of vegetation which favours their feeding pattern (browsing). They also have a wide choice and select the best using their feeding behaviour, which is nipping from a bi-pedal stance.

In scrub jungle, 20 goats can easily be stocked on 1 hectare of land for 6 months and achieve the marketable weight of 22 kg per animal (Perera, 1995 unpublished). This would yield 896 kg of live weight per year. Generally in these regions, marketing is done through a middle man, and at present the farm gate price per kg of live weight is Rs.40. At this stocking rate one could earn Rs. 44,800 per year or Rs. 3,733 per month by selling the goats for meat. The fertilizer value of dung has not been taken into account (Perera, 1995., unpublished).

Comparing the performance of goats browsing on scrub jungles and monoculture grass such as signal grass (*Brachiria brizantha*) revealed a higher average live

weight gain under browsing in scrub jungle. This is understandable because of the diversity in the feed which supplies all nutritional requirements.

POTENTIAL IN PINE PLANTATIONS.

Pine is a fast growing tree species which was introduced as a monoculture forestry system, especially in the wet and wet intermediate zones. Plantations have established well in the wetter regions in highly denuded and acidic soils. It was selected as the most suitable species for the region because of its ability to withstand low soil fertility, periodic fire and soil acidity together with its fast growth rate. In the recent past this species has been the subject of many controversies among botanists, ecologists and hydrologists regarding its narrow biodiversity and its impact on the hydrological cycle. However, the undergrowth of these plantations is a treasure to the adjacent livestock smallholders as their major source of fodder comes from these plantations (Perera *et.al.*, 1994). The undergrowth is rich in the variety of natural grasses and broadleaved herbs which are highly digestible and palatable. In some areas, the undergrowth is limited or completely absent due to heavy shading and the presence of a dense accumulation of un-decomposed pine needles. However, periodic pruning would result in high light penetration and encourage a better quality understorey (Hawke, *et.al.*, 1993).

Fire is common in pine plantations in the mid-country during February and March. During this period of the year the undergrowth (mainly *Panicum spp.* "guinea grass" and *Cymbopogum* "wild citronella") is mature and dry, and therefore highly flammable. If grazing is practised, the periodic removal keeps the undergrowth low and lush and minimizes the risk of fire. This will not only prevent pollution and erosion, but will also save many trees in the plantation as well as the forest wild life (Perera, 1994).

Pine plantations are floristically superior to non-forested scrub jungles or grasslands (Bandarathilake, 1988). Therefore, this system provides a more balanced diet for the animals grazing the undergrowth than grazing in a monoculture grassland. Perera and Perera (1994), reported that goats grazing under pine alone gave an average daily live weight gain of 44 grams. When grazing was supplemented, using either *Gliricidia* or coconut oil meal, the daily average weight gains were 54 and 57 grams respectively. There was no significant difference in weight gain between gliricidia and coconut oil meal. Therefore, feeding gliricidia can replace the expensive coconut oil meal. This can be grown on the boundaries of the plantations or between pine rows provided there is sufficient light. Gliricidia is also a common plant which grows in abundance in pine growing regions and thus, finding sufficient quantities of *Glirieidia* to feed livestock as a supplement is not a problem.

Premalal and Perera (1994), reported the successful establishment of improved pastures under pine. They established *Paspalum plicatulam* and *Chloris gayana* under pine and were able to produce an annual dry matter yield of 9,500 and 10,000

kg per ha. respectively. The dry matter was further increased to 12,000 kg by introducing a pasture legume (*Centrosima pubescence*) to the improved grass. This could maintain a stocking rate of 45 goats per year, and provide an income of Rs. 50,625 per year or Rs. 4,220 per month.

POTENTIAL IN PLANTATION CROPS.

The two major plantation crops that can easily be integrated with livestock are rubber and coconut. These two major plantation crops are grown as monoculture crops in the wet and wet intermediate zones. Due to the large planting spacing there is a large extent of land below the canopies which is often under-utilized.

The integration of livestock with rubber is dependent on the available edible biomass in the understorey and is determined by the age of the plantation. It is not possible to incorporate livestock for free grazing under plantations that are less than 5 years of age or are being used for tapping. Young rubber trees can be damaged by goats and when tapping is under way, the latex collection can be disrupted or the animals suffer injuries due to ingestion of latex. Therefore, if integration is to be adopted under rubber, the best system of management would be zero grazing (the cut and carry system). The undergrowth of rubber plantations provides a mixture of good quality mixed green biomass in large quantities and can accommodate high stocking rates. The quantity and the quality of the biomass is even better when the under growth consist of "Peuro" (*Peuraria phasioloids*) which is a common cover crop under rubber.

Many attempts have been made in the past to establish improved pastures under rubber. Waidyanatha *et.al.*, (1984), reported that pasture species such as *Brachiria, Paspalum* and *Panicum* produced dry matter yields of 1.2 to 3.5 metric tonnes per hectare per year under mature plantations (0 - 25% light) and 8.4 - 9.5 metric tonnes under young plantations (50 - 75% light). These data reveal the existence of a high potential for integrating livestock into rubber plantations.

Coconut is another monoculture plantation crop which covers a land area of 0.4 million hectares. As for rubber, the wide spacing at planting leaves vast areas of unused land available for other production systems (Perera, 1994). However, less than 20% of this unused land area is being utilized. These lands are generally occupied by weeds which interrupt inter-cultivation activities and involve a high cost for control. These weeds are mixed in composition and provide a nutritionally balanced diet for grazing livestock. Under grazing, goats are efficient "Biological weeders", as they keep the weeds at a low level and even completely eradicate certain noxious weeds (Perera, 1992). Introducing goats will also recycle trapped plant nutrients in the weeds. These will be far more efficiently and more readily available after passing through the goat's digestive system when compared with waiting for natural decomposition. In addition, these weeds can be converted to valuable animal proteins with minimum cost.

The availability of natural biomass for livestock production has been estimated as 1,000 to 1,500 kg dry matter per ha per year (Perera, 1992). This quantity is sufficient to maintain 8 to 10 goats for fattening. This stocking rate can be increased to 25 to 30 provided an additional source of feed is made available and many attempts to do this have been have been successful. One is the establishment of leguminous shrub/tree species in boundaries and between coconut rows. In this regard *Gliricidia, Calliandra* and *Leucaena* has been tested and shown to be suitable. (Liyanage, 1995, personal communication). The other alternative is to establish grass and pasture legume species between coconut palms. Researchers at the Coconut Research Institute, have successfully developed methods to establish grasses under coconut in smallholdings (Santhirasegaram, 1967). The successful species are *Brachiria, Seteria, Paspalum* and even fodder types such as *Panicum*. However, when pastures are introduced it is important to ensure that the fertilizer circle is kept open and to fertilize both coconut and grass simultaneously using a suitable fertilizer mixture. As for the management system, the livestock can be either free grazing or tethered to coconut palms (with rotation of tethering). There can be no doubt that this increases the family budget of the resource-poor smallholder, while utilizing natural resources efficiently.

POTENTIAL IN AGROFORESTRY SYSTEMS.

In an attempt to upgrade soil fertility by building up soil organic matter and by reducing soil erosion, the "Sloping Agricultural Land Technology - **SALT**" system was introduced to the heavily weathered marginal lands of the mid-country in Sri Lanka. The total extent of this marginal land has been estimated as 60,000 hectares in the mid-country alone. Under the SALT system, promising shrub/ tree leguminous species such as *Gliricidia, Calliandra, Leucaena, Desmodium* (shrub type) and *Flemengia* and non-leguminous species such as *Tithonia* and *Morus alba* have been successfully established as linear hedgerows. Perera (1994), reported that a 10 metre linear row of *Gliricidia, Calliandra, Desmodium* and *Flamingia* could produce an edible biomass yield of 35, 17, 10 and 22 kg dry matter per year respectively, with a defoliation frequency of 16 weeks. The biomass produced by these hedges is often more than the requirement for mulching. The excess biomass is a valuable fodder for livestock. Chemical analysis revealed that the nutritive value of these fodders is far superior to any other roughage feed in use. Their feeding value will be higher and better utilized when they are fed as a mixture rather than by feeding them individually.

Combining these available fodder resources with the other physical resources available within the smallholdings, the Mindanao Baptist Rural Centre (Philippines) has developed a new SALT system by integrating a livestock component called "Simple Agro - Livestock Technology or **SALT-2**". This system can replace the present SALT system to raise the prosperity of the resource poor farmer.

Using the SALT-2 system, 8 to 10 goats can easily be maintained on 0.5 ha of land. Another advantage in the mid-country is the high demand for goat milk. The environmental conditions in this region are favourable for raising dairy goats, and this will bring income with minimum input when compared to keeping cows. Additionally, the dung is freely available for the home garden or for the fast growing domestic horticultural industry (nursery and cut flower industry).

The resources for livestock production under different forestry systems in many agro-ecological zones are available, but their utilization potential needs to be well understood. Given a few incentives such as breeding material, proper extension and training, low interest loans and marketing security by the state or NGOs, the resource poor smallholders will certainly be able to better utilize the available natural resources for livestock production. This system will produce enough animal protein to satisfy the requirements both locally and nationally, and will save the millions of rupees of foreign exchange which is currently being spent on importing meat and other animal products.

ACKNOWLEDGEMENT

The author wishes to thank the National Livestock Development Board and the Sri Lanka-German Upper Mahaweli Watershed Management Project for providing the facilities to carry out sections of this study. Thanks are also due for the support given by the technical staff of the Department of Animal Science.

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