

## Sustainable management of grassland resources for ruminant livestock production in Sri Lanka

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### ABSTRACT

In Sri Lanka, approximately 12,000 km<sup>2</sup> out of the total land area of 65,000 km<sup>2</sup> are under grasslands. The use of grassland resources for livestock has a long tradition. In climatic and vegetation contrast, these grasslands are much more diverse. They are likely to play an economically vital role in livestock farming sector in Sri Lanka. With the increase of human population, these ecosystems have been acutely restricted due to various reasons associated with development activities. Therefore, a continuing need should be to maintain a broad spectrum of production and conservation, for sustainable management of the grassland resource for the future.

This paper reviews the current background of the grassland resource with a purpose of livestock perspective through experiences of local studies carried out by many workers including authors. The constraints and opportunities, and policymaking and research and, development priorities for long term sustainable management are also discussed.

**Keywords:** Grassland management, ruminant livestock, sustainability of grasslands

### INTRODUCTION

In botanical perspective, grassland is a plant community in which the grasses (species of family Poaceae) play a major part in its floristic composition and, woody species do not exceed 40% of the total land cover. Ecologically, natural grassland is a combination of climate, soil, topography, fire and many biotic factors (Moore, 1964). Nearly 20% of the landscape of the earth is covered by grass-dominated vegetation, which includes numerous communities (Pemadasa, 1990).

In Sri Lanka, nearly 12,000 km<sup>2</sup> of the total land area of 65,000 km<sup>2</sup> is under grass-cover (Pemadasa, 1990). The history of using this grassland resource for livestock rearing through traditional means goes back several centuries. The cohesiveness of traditional societies and social groups in livestock rearing led to holistic approaches that resulted in appropriate, environmentally sound and sustainable technologies. Nevertheless, as in many other countries, grassland of Sri Lanka, also have led to deterioration due to mismanagement under the existing socio-economic position in the country. However, there is no doubt of continuing importance of natural grasslands for livestock with environment stability. Therefore, a continuing need should be to maintain a broad spectrum of production and conservation interests in order to ensure the effective

and sustainable management of the grassland resource for the future.

This paper reviews the general background of the grassland resource of Sri Lanka in a livestock farming perspective through the experiences of local studies carried out by many workers including authors. The paper also discusses the constraints and opportunities, research and development priorities and, areas of focus in policy making for long-term sustainable management of the grassland resource of the country.

### Grassland resources of Sri Lanka

#### General background

Grasslands of Sri Lanka have been categorized in many ways based on their origin and evolution, geographical distribution and floristic composition. However, natural grassland communities in Sri Lanka can be recognized as plant communities in which dominant species are perennial grass and, very few or no shrubs and trees (Moor, 1964). However, stability of grasslands often depends on the direct or indirect influences of man (Moor, 1964). Pemadasa (1983) has carried out a comprehensive account on natural grassland resource in the country and Table 1 lists the major and, sub grassland types based on this survey.

**Table 1. Grassland types of Sri Lanka.**

Main Type	Main-Sub Type	Sub-Type
Montane (Patana)	Dry	Humid zone dry Patana Summer zone dry Patana
	Intermediate	Intermediate Patana
	Wet	Lower wet Patana Upper wet Patana
Savanna	-	Upland savanna
	-	Lowland savanna
Lowland	Wet zone pastures	Inland grasslands Maritime grasslands
	Dry zone pastures	Damana grasslands Thalawa grasslands Villu grasslands Tank bed grasslands
	Intermediate zone pastures	Coconut grazing grounds
	Arid zone pastures	Dry pastures Humid pastures Mixed pastures

Source: Extracted and arranged from Pemadasa (1983).

Sri Lankan grasslands are likely to play an economically vital role because they have a potential as feeding grounds for livestock. However, their exploitation has been rather unsystematic due to increasing biotic interference by haphazard clearing for short-term cultivation, illegal burning, and extensive removal of herbages for fodder and over grazing. These activities have caused considerable floristic and habitat changes and severe erosion of many types of grassland with near complete destruction of some areas (Pemadasa, 1981).

In climatic and vegetation contrast, grassland of Sri Lanka can be divided into three general categories; Patana, Savanna and Lowland grasslands. Further, they are sub divided into several forms (Table 1). Important characteristics of some grassland types, which have a potential for livestock farming, are summarized in Table 2.

### Productivity of grasslands

The economic viability of grasslands as grazing grounds depends partly on their productivity and quality of constituent forage species (Pemadasa, 1990). Further, grassland productivity depends on many factors, including annual rainfall and its seasonal variations, soil fertility, species composition, stocking rates and, anthropogenic and other biotic pressures (Murphy, 1975). Although little is known of the productivity of the grasslands of Sri Lanka, the general view is that most of the

grasslands are of low productivity. This is supposed to be a reflection of deficiency of nutrients, particularly nitrogen, phosphorus and potassium (Pemadasa, 1981). The low population density of legumes, loss of nutrients by leaching and erosion and, slow rate of microbial activity are some of the possible causes (Mueller-Dombois and Perera, 1971). Amarasinghe and Pemadasa (1983), estimated the annual productivity of some regions of dry Patana grasslands to be around 68,000 to 111,000 kg/ha, which is much less than the value of around 3810,000 kg/ha recorded by Ambst *et al.* (1972) for some Indian grasslands. However, information on current studies under Sri Lankan conditions is lacking on this matter.

### Traditional livestock production in natural grasslands

There was a strong tradition among the pastoralists based on the natural grasslands in Sri Lanka. When considering the history of community oriented systems, the sustainable production pattern, protection of grassland resource and, protection and appreciation of wild life were the positive key factors. These strong traditions gave environment stability to large part of the country together with other agricultural practices. Under this age-old tradition, different pastoral systems were found in various regions in the country.

Further, these livestock holders represent centuries of accumulated experience and skills for locally available resources of the grassland. Indigenous knowledge has been brought down from generation to generation and functioned as a part of the information base in the society. The pastoralists had a wide knowledge of the ecosystem in which they survive and ensured the use of natural resources in a sustainable manner (Vaheesan, 2002). However, in the past, due to availability of land and free from various outside threats, farmers were able to have many more animals and therefore livestock farming was a first-class business.

### Present situation of grassland based livestock production

With an increase of human population, the traditional feeding, breeding and surviving habitats for livestock (including wildlife) have been acutely restricted due to large-scale development activities (E.g. irrigation schemes, agricultural settlements, urbanization etc.) pertaining to human life. Nowadays, farmers have developed a complex culture, including a wide variety of on- and off-farm

Table 2. Grassland types of Sri Lanka for livestock farming.

Grassland type	Rainfall (annual), climatic zone and elevation	Distributed locations	Dominant forage species found*	Potential for livestock rearing**	Important remarks
Dry Patana	♦ 1750-2250 mm ♦ upcountry intermediate ♦ 500-2000m	Uva Basin	<i>Arundinella</i> spp. <i>Pollinia</i> spp. <i>Ischaemum</i> spp. <i>Themeda tremula</i> . <i>Andropogon</i> spp.	Moderate	The burning of grass just before the rain results in the soil being exposed and consequently getting eroded. This probably accounts for the absence of any trees.
Wet Patana	♦ 2500-4000 mm ♦ upcountry wet ♦ >2000 m	Horton Plains, Elk Plain, Moon Plain, Bopaththalawa	<i>Chrysopogon zeylanicum</i>	Poor	Grasses are tufted, coarse and wiry. Scattered trees are prominent.
Lowland Savanna	♦ 1450-1750 mm ♦ low country intermediate ♦ 300-400 m	Bibile, Monaragala	<i>Panicum</i> spp. <i>Themeda tremula</i> <i>Desmodium</i> spp. <i>Themeda triandra</i>	High	The grass cover is much taller. Fire-tolerant species are rather sporadic.
Upland Savanna	♦ 1500-2000 mm ♦ mid country wet ♦ 400-500 m	Wellawaya Pethyagoda	<i>Panicum</i> spp. <i>Themeda tremula</i> <i>Heteropogon triticeus</i> <i>Desmodium</i> spp. <i>Mimosa pudica</i>	Moderate	The grass cover is much taller. Soil is eroded and denuded as a result of frequent destruction of vegetation.
Villu	♦ 1500-2000 mm ♦ low country dry ♦ 0-200 m	Polonnaruwa Manampitiya Thamankaduwa Maduru Oya	<i>Cynodon dactylon</i> <i>Stenotaphrum secundatum</i> <i>Bothriocloa glabra</i>	High	Wet grasslands found in the flood plains of the rivers in the dry zone. Grasses are more succulent. Soil is rich in nutrients.
Damana	♦ 1250-1750 mm ♦ low country dry ♦ 0-100 m	Damana Ampara Inginiyagala	<i>Imperata cylindrica</i>	High	Origin seems to be the results of forest clearing followed by repeated fire.
Talawa	♦ 2000-2500 mm ♦ low country wet ♦ 0-200 m	Kalutara Galle Matara	<i>Cynodon dactylon</i>	High	Arise as results of forest felling and chena cultivation in wet zone.

Source: Modified from Pemadasa, 1983, \* Forage species are hesitant and recent studies are a requisite, \*\* Authors observations

activities in order to deal with an unfavorable economic and social environment (Zemmelink *et al.* 1999).

Available information on socio-economic background of the livestock farmers of grassland surroundings and their production systems, forage species and their botanical composition, and soil and animal status are limited. However, preliminary studies on farmers socio-economic background and production systems, investigations on available forage species and their botanical composition, and, some chemical properties of soils in selected grassland types and locations have been recently carried out by the authors. The important findings of these studies are summarized in Table 3.

Preliminary investigations carried out by the authors revealed that the so called tradition of pastoralism is not further economically sound, basically due to land limitation and other unsettling reasons (Premalal and Premaratne, unpublished).

This paper does not discuss the matters pertaining to number of classifications in livestock production systems previously made by number of workers of the country.

### Burning issues and development programs in grassland development

According to the experiences of other countries, development and demonstration of a sustainable grassland management and livestock improvement strategy is not merely a technical matter. Further, it has very little to do with basic principles such as, stocking rates, grazing patterns and systems. Issues such as water, extension and education, and health are rated much higher in many instances. It was also realized that the capacity of local community based structures where they existed to address their own problems in an organized manner was very limited. On the other hand, it has been revealed that most of

the farmer communities had a very clear picture of a prosperous future, but very few of them had the capacity to get their own, or had thought of soliciting the right support to get there (Reynolds *et al.* 1999). The authors of this paper have also noticed the same chain of issues as a core problem pertaining to development of local grasslands. However, many positive results are available in other instances with a clear mandate of developing and demonstrating grassland management for livestock production through a participatory and multi-disciplinary manner (Reynolds *et al.* 1999 and Miller, 2001).

The authors have observed that the current livestock management systems are incompatible

with the area and, are not sustainable because of the following reasons:

Rapidly growing population has failed to adjust their management system of which farmer and their livestock depend,

The lack of land tenure system that permits free access to communal resources,

The absence of long-term development policies, plans and strategies for particular region and community,

Uncoordinated and poor governmental and institutional support,

Making present livestock breeding policies

**Table 3. Some basic information pertaining to present grassland based livestock production systems in Sri Lanka.**

Information category	Description
Grassland types and locations studied	<ul style="list-style-type: none"> <li>◆ Dry Patana grasslands/Knuckles range</li> <li>◆ Tank bed grasslands/ Tabbowa and Ingimitiya</li> <li>◆ Lowland Savanna/ Bibile and Monaragala</li> <li>◆ Open grasslands/ Wasgomuwa</li> </ul>
Forage resource	<p>Grassland is the main source for forages.</p> <ul style="list-style-type: none"> <li>◆ high in seasonal variability</li> <li>◆ low in productivity</li> <li>◆ herds are moved on availability of forages</li> </ul>
Tribulations	<ul style="list-style-type: none"> <li>◆ loss of animals due to drought and cattle raiding</li> <li>◆ threats from illegal cultivation and activities</li> </ul>
Grazing behavior	<p>Mostly free grazing. Animals are not gathered at night or grazing for 8-10 hrs from early morning to late afternoon and housed at night</p>
Facilitates and supports lag behind	<ul style="list-style-type: none"> <li>◆ reliable markets</li> <li>◆ appropriate veterinary and extension facilities</li> <li>◆ government and other organizational supports</li> <li>◆ income diversification opportunities</li> <li>◆ water resources in dry season</li> </ul>
Degree of crop-livestock intensification and diversification of income sources	<p>very low, but increasing in some areas where cropping is possible</p>
Livestock species	<p>mainly traditional breeds of cattle, buffaloes and goats</p>
Services provided by livestock	<ul style="list-style-type: none"> <li>◆ meat, milk and draught power</li> <li>◆ Some time hoofs and hides</li> <li>◆ collection of manure is rare</li> <li>◆ milk production ranges from 200-400 liters per animal during a lactation</li> </ul>
Degree of economic stability	<ul style="list-style-type: none"> <li>◆ low, systems are predominantly lack of inputs</li> <li>◆ With increasing population the system tend to evolve into mixed system</li> </ul>
Environmental concerns	<ul style="list-style-type: none"> <li>◆ overgrazing, soil erosion, weed invasion and burning</li> <li>◆ adverse changes in floristic composition</li> <li>◆ competition with wildlife and recreation</li> </ul>

Source: Information of preliminary studies carried out by authors (unpublished)

particularly on the climatic zone, but not for particular grassland community

Inadequate information base and extension service, and Inadequate marketing opportunities and support.

In facing the ever more complex challenge to sustainable grassland resource management, authors recognize the importance of fundamental social and socio-economic issues into the design and implementation of related interventions through participatory and multidisciplinary manner.

#### **Constraints improvement of national grasslands**

Management of grasslands for sustainable development remains one of the major challenges faced by researchers, policy makers and development agencies of the world. Sri Lanka is not exceptional to this challenge. The livestock sub-sector together with larger agricultural sector of the country has now faced with common enormous limitations. Further climatic, biotic and edaphic factors are coupled with these common limitations when development activities are implemented. Such major limitations are listed below:

Inadequacy of grassland management policies coupled with other functional policies such as economic, socio-economic, land use and wildlife management

Inadequate funding and many other complex issues in the national research system

Difficulty in management of researches due to dispersion of agricultural research under several ministries of the government

Poor infrastructure in many grassland associated areas. e.g. market outlets and veterinary facilities

Inherent low productivity of grasslands due to seasonal variation of rainfall, poor nutritional status of soils, weed invasion, unpalatability and low quality of existing forages.

Lack of current research information on productivity, soil properties, existing forage species and their nutritional quality and, persistence of improved forage species under particular grassland ecosystem.

Unavailability of functional sources of planting materials for improved forage species under local conditions

Main focus of current livestock policy towards agro climatic issues but not towards the actual background of the grassland ecosystem

Lack of collective agreement, poor-cooperation and disorganization by the pastoralists.

Poor participation of governmental and private organizations in participatory approach

#### **Opportunities for development of grassland resources**

Despite the discussion made pertaining to constraints, for a sustainable goal, every grassland-resourced country should have its own opportunities for development of this resource in a sustainable manner for reducing poverty and meeting the future food needs. Sri Lanka is also not exceptional of these opportunities.

The ministry of Agriculture and Livestock of the Government of Sri Lanka has now launched its revised Agriculture and Livestock Policy. This generates a line of attack towards a new approach in traditional livestock production. Now the ministry has started to allocate the funds for communal grassland development activities. In the mean time, the research sector especially the state and universities have made efforts to identify the relevant institutional structure, existing resources of grasslands, socio-economic background of the associated farmers in selected grassland ecosystems. Structure of milk marketing system and consumption of liquid milk seem to be increased gradually in the country and farmers now take interest in investing more money on dairy farming. Under this situation, natural grasslands have to be played a key role in providing feeding grounds for dairy cattle and buffaloes.

Council for Agricultural Research Policy (CARP) now funds for demand driven research and development activities to ensure sustainability in agriculture and livestock sector without irreversible degradation of environment resources. Under this objective, the Government has also increased the fund allocation to the CARP for implementing such research for reducing poverty and meeting the future food needs

The universities and relevant state sector institutions have access to highly qualified, well-trained human resources with laboratory and field equipment and this is a big boost for grassland research activities in the country. A keen and enthusiastic group of researchers will be formed in near future to implement the development of grassland resources.

#### **Conclusions and Suggestions**

There is a considerable "hidden harvest" from grassland resources of Sri Lanka. Further, the grasslands divers their volume from livestock,

wildlife use and other domestic uses, each of which generates marketed and non-marketed outputs. Researchers and policy makers should pay much more attention to extract these uses and outputs, integrating the fundamental, social and socio-economic issues into the design and implementation of development interventions through a multidisciplinary manner. The key policy question in this regard is how to increase total land productivity in a sustainable way through minimizing degradation.

Contrasting the above mentioned core issue, following suggestions are also made to a sustainable development of grassland resource of the country for the future.

Models together with agricultural and livestock must be developed as base of communal grassland management.

Research must be continued and more case studies are required to deepen the understanding of the locally appropriate solutions.

Logical statistical data bank must compiled and revised accordingly for regular planning development activities.

A strong extension service with effective veterinary background needs to be strengthened.

Planning must take account of the potential effects of climatic changes. E.g. effect of drought on herbage productivity, and soil and water resources.

A national level review and mapping the status of present grassland cover of the country are urgently needed.

Ongoing monitoring of various aspects of land deterioration is essential

Participation of pastoralists must be encouraged during interventions of strategies.

Pastoralism in wildlife protected areas must be gradually proscribed and encourage to form communal grasslands in adjoining public localities.

Issues such as development of water resources, extension and education must be considered as higher attentions than basic grassland principles.

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