



Management of rangelands

Use of natural grazing resources in Southern Province, Zambia



Evaristo C. Chileshe
Aichi Kitalyi



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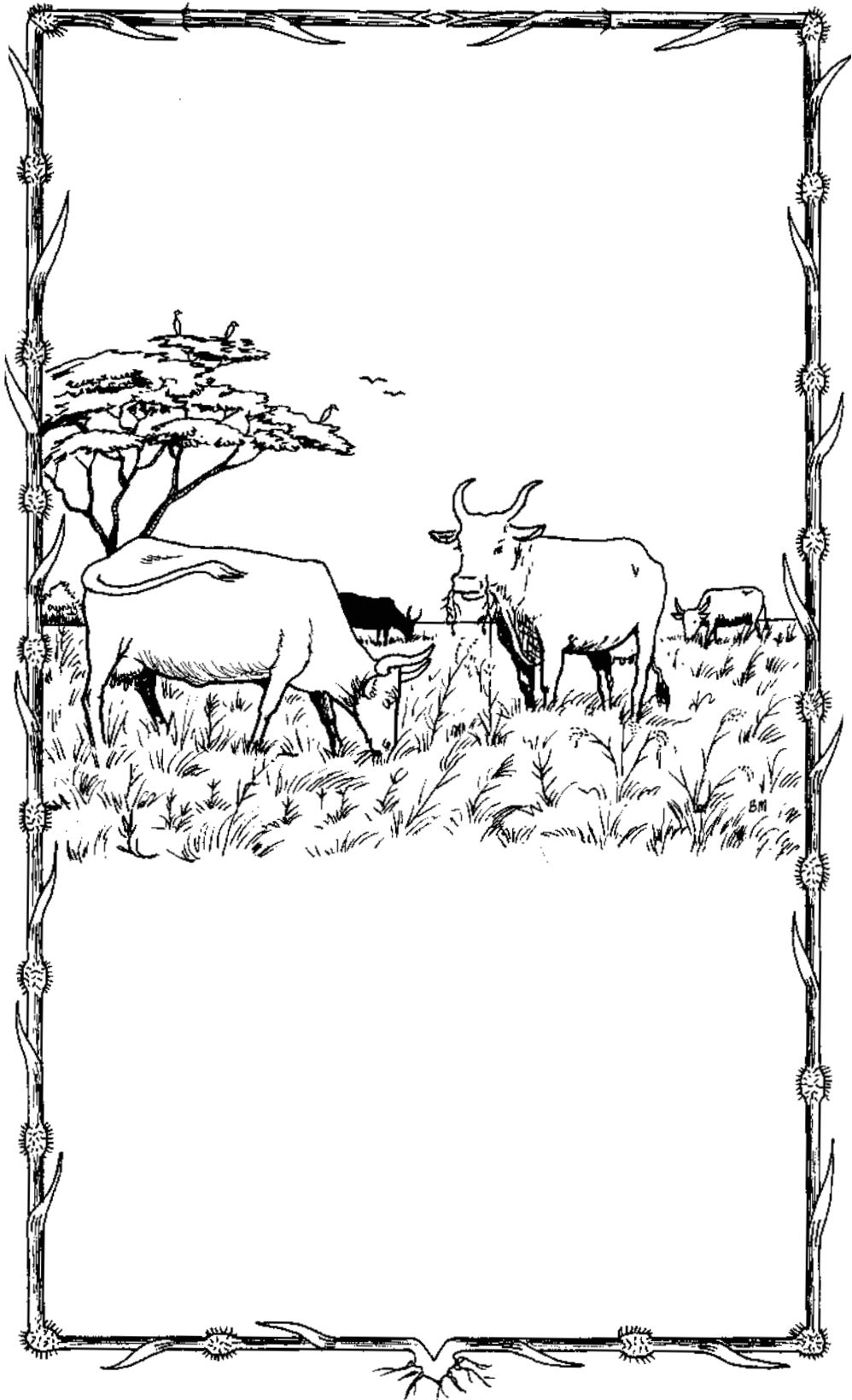
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RELMA

Regional Land Management Unit (RELMA)
2002

Publisher

Regional Land Management Unit (RELMA), ICRAF House, Gigiri
P.O. Box 63403, Nairobi, Kenya

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Photographs

All photos from RELMA archives

Cover photos:

Top: Large tracts of rangelands provide livestock with diverse and sufficient nutrition

Middle: During the rain season, grasses grow tall

Bottom: A homestead in Southern Province, Zambia

Design and layout (except front and back cover)

Jane Karimi

Editing

Helen van Houten

Editor of RELMA series of publications

Anna K Lindqvist (RELMA)

Cataloguing-in-publication data

Evaristo C.C and Kitalyi A. Management of rangelands: Use of natural grazing resources in Southern Province, Zambia. 2002. RELMA Technical Handbook No. 28. Regional Land Management Unit (RELMA), Swedish International Development Cooperation Agency (Sida). Nairobi, Kenya. 68 p. + viii p.

ISBN 9966-896-61-9

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Printed in Dubai, by AG Printing & Publishing LTD, P.O. Box 43863, Nairobi, Kenya

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Foreword

The Regional Land Management Unit (RELMA), before the Regional Soil Conservation Unit (RSCU), and Land Management and Conservation Farming (LM&CF), before SCAFE, have jointly supported documenting technical information on agroforestry and soil fertility in Zambia. These documents are written and illustrated in a style easy for frontline extension workers (the camp officers and some farmers) to understand and use in transferring technology.

Traditional livestock production in Southern Province in Zambia is characterized by communal grazing, which implies that any cattle may graze anywhere, except where damage to standing crops must be avoided. In addition to this open grazing system, burning natural pasture is a widespread practice throughout the province, thus encouraging dominance of species that are low in quality for grazing and poor in palatability. There are, however, indigenous grasses whose feeding value is relatively good, if they are properly established, managed and used.

Since 1998, LM&CF has been dealing with this issue of range management, but because of the problems associated with the communal grazing system, it has been difficult to encourage or establish communally managed grazing schemes. Farming communities have seen exotic pasture seeds introduced, but their introduction has had little impact because management and labour have been poor in trying to establish the pastures.

From 1998, LM&CF and RELMA have adopted an integrated approach to land management. In 1998, LM&CF in Southern Province presented a proposal to inventory of natural grasses and their potential in livestock production. This would be a first step towards producing a manual on establishing, managing and using natural grasses in the rangelands of Southern Province in Zambia.

In 1999, LM&CF and RELMA supported a study on the potential of natural grasses in the livestock production sector in Southern Province. The study was carried out in the wake of appreciation of local, indigenous knowledge in understanding the potential and use of natural grazing resources. A farmer participatory approach was employed in collecting and analysing the data.

This extension manual is one of the outputs of the study. The manual should be of value to all agricultural extension workers in Southern Province and other areas with similar climate and vegetation types.

All investigations and experiences are the result of a combined effort of farmers and extension workers in the LM&CF areas of Southern Province.

Åke Barklund
Director, RELMA

Acknowledgements

The work presented in this manual would not have been possible if it had not been for the good cooperation of the Ministry of Agriculture, Food and Fisheries, both at the head office in Lusaka and in Southern Province. Special thanks to the Director of the Department of Research and Specialist Services, Mr Dakar, and Dr. Yamba Yamba at the Ministry headquarters. Similarly the farmers and the technical officers from Choma, Gwembe, Kalomo, Livingstone and Monze districts, who participated in the workshop to review the first draft of the manual deserve special mention for their contribution. Many thanks go to Dr Kebede Tato, LM&CF Advisor for Southern Province, for initiating the activity and coordinating some of the field activities and to Mr Jonas Åkerman, LM&CF/SCAFE Project Leader 1998–1990, for his great support to the study and the production of this manual.

Mr B. Maliwa of Mongu, Zambia, prepared many of the illustrations, including the one on page ii, using live specimen in the field. Several of the illustrations on trees and shrubs were drawn by Ann Birnie and published in earlier RELMA handbooks. The participants of a course in botanical illustration, arranged by RELMA, prepared some of the illustrations. These artists are Andrew Kamiti and Patrick Adoyo Milenye, Kenya; Janet Nabakooza and Paul Ssegawa, Uganda; Njekwa Sitwala and Howard Zulu, Zambia.

We are grateful to the Food and Agriculture Organization of the United Nations for permission to use illustrations taken from *Tropical grasses* by P.J. Skerman and F. Riveros. We also acknowledge with thanks the National Herbarium and Botanical Garden (Zimbabwe) for use of one illustration that appear in *Common trees of the central watershed woodlands of Zimbabwe* by R.B. Drummond. The copyright to all the above illustrations remains with the original publishers.

1 Introduction

Southern Province has the largest number of cattle of all Zambia's provinces, comprising 33% of the traditional herd (figure 1). Over 90% of the livestock is managed extensively, depending entirely on in situ grazing in the rangelands for nourishment.

Apart from feeding the ruminant population, these grasses form an important element in conserving soil and improving the fertility of the rangelands. In periods of severe drought, local people eat grass seeds such as *Urochloa* spp. ('mpunga'). Furthermore, grass is used for thatching, making mats, flavouring food and drink, and extracting medicines.

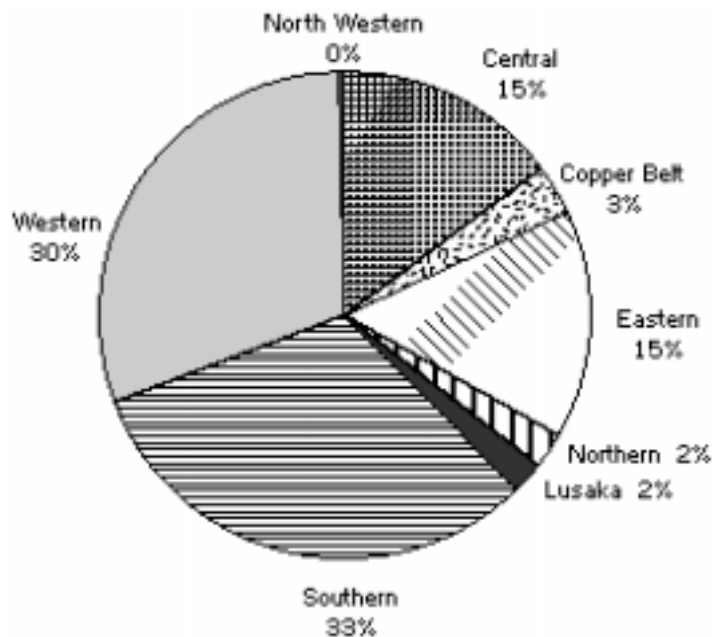


Figure 1 Cattle population of Zambian provinces.

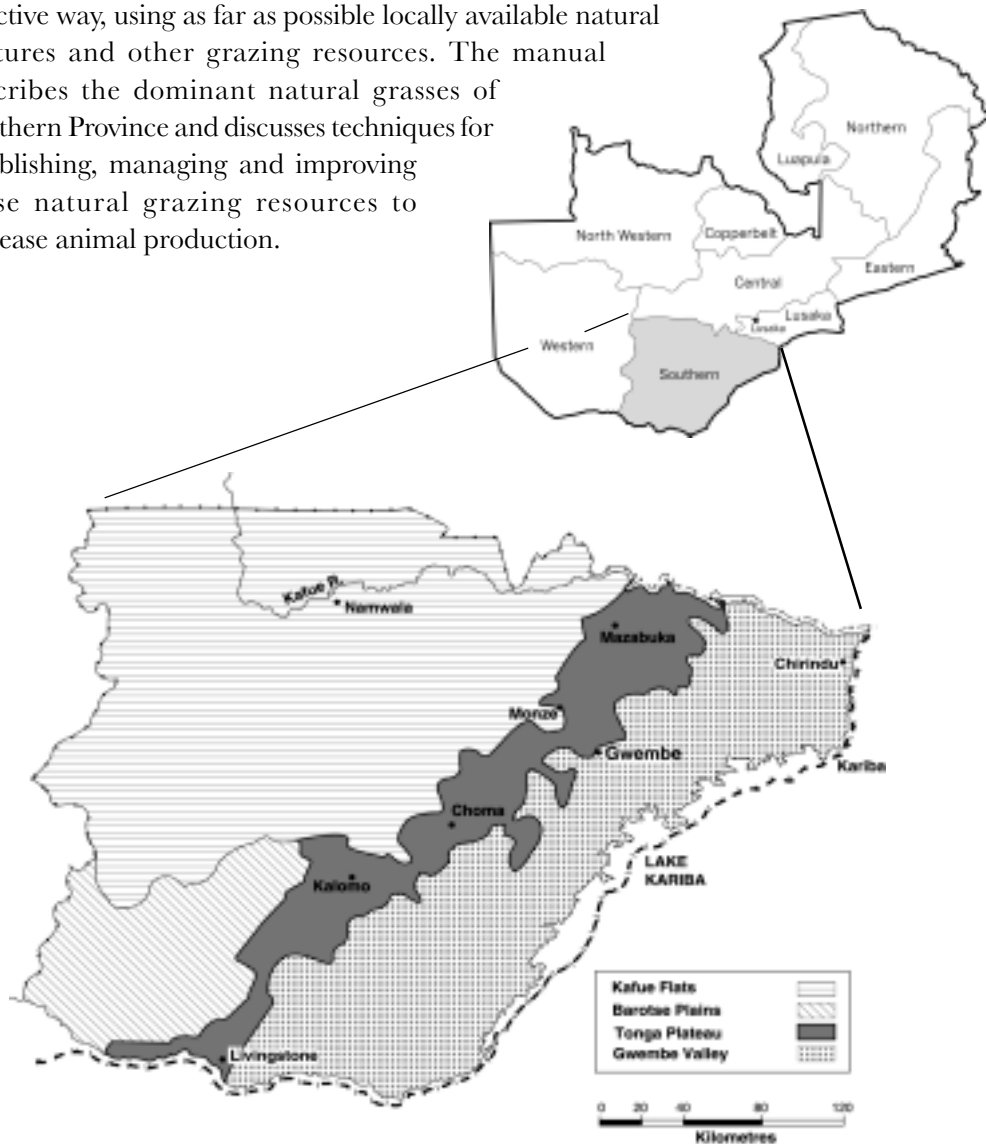
Except for disease, nutritional stress is the single factor most limiting increased animal production in the traditional sector of Southern Province. The potential of natural grazing lands has not been exploited. Farmers and extension workers have little knowledge of the potential of natural grasses and no strategic improvement techniques are in place to increase production from rangeland resources.

With rains tailing off in April or earlier, the natural pasture quickly depreciates, turning brown and coarse until the advent of rains in November. This calls for improved management and use of natural pastures.

Although Southern Province is well endowed with large areas of rangeland with good grazing potential, these natural grazing resources are not used in a sustainable manner. They have been generally neglected by both farmers and pasture research officers.

However, productivity can be increased by using techniques to improve the natural grasslands, such as matching livestock numbers to the grazing resource available, controlling the grazing, introducing new species, and giving supplementary feeds to vulnerable stock.

The measures proposed in this manual can substantially improve the present nutritional status of livestock in a cost-effective way, using as far as possible locally available natural pastures and other grazing resources. The manual describes the dominant natural grasses of Southern Province and discusses techniques for establishing, managing and improving these natural grazing resources to increase animal production.



Major ecological zones of Southern Province, Zambia (after G. de Souza).

2 Vegetation types of Southern Province

All three animal feed components—grasses, forage legumes and fodder trees—are found in Southern Province, growing in different and specific vegetation types. However, the vegetation structure in the province has been changing drastically over the years, mainly because of shifting cultivation and bush fires.

The vegetation types are influenced by rainfall, soil type and human intervention. Southern Province has five main types:

- miombo woodland
- dambo
- munga woodland
- mopane woodland
- kalahari woodland

Miombo woodland

The miombo in Southern Province is characterized by moderately dense to open stands of deciduous trees, usually over 6 m high. In the Zambezi escarpment, which is between Gwembe Valley and the Tonga Plateau, and on the plateau itself, the trees have been degraded over a long period and the regeneration of most plant species is prominent today.

Characteristic tree genera are *Brachystegia* and *Julbernardia*, which are degrading. Other common genera are *Combretum*, *Parinari* and *Pericopsis*. *Acacia* spp. are found in the high water-table areas of the province.

Most notable grass genera are *Andropogon*, *Brachiaria*, *Digitaria*, *Heteropogon*, *Hypparrhenia*, *Hyperthelia*, *Panicum*, *Pogonarthria*, *Tristachya* and *Urochloa*. Among these genera, identified species were *Heteropogon contortus*, *Hyperthelia dissolute* and *Pogonarthria squarrosa*. *Dactyloctenium giganteum*, *Eleusine indica* and *Melinis repens* are found in the fallow fields.

Dambo

The dambo in this context includes plains and pans, described as grassy depressions in seasonally inundated bottomlands, with or without streams. The dominant plant species are grasses, sometimes covered with scattered trees and herbs. This vegetation type accommodates many palatable and productive grass species.

Characteristic grass genera include *Brachiaria*, *Digitaria*, *Echinochloa*, *Hypparrhenia*, *Oryza*, *Setaria* and *Vossia*. Identifiable species are *Cyperus papyrus*, *Imperata cylindrica*, *Leersia hexandra*, *Loudetia simplex*, *Miscanthidium*, *Pennisetum clandestinum*, *Phragmites* and *Sacciolepis africana*.

Munga woodland

The munga woodland is open and parklike, one to two storeyed, with scattered or grouped deciduous trees. The characteristic and important tree species in this vegetation are *Combretum*, *Ptilostigma thonningii* and *Terminalia sericea*. Thickets of *Acacia* and *Combretum* are also common.

The notable grass genera are *Andropogon*, *Brachiaria*, *Digitaria*, *Hyparrhenia*, *Setaria* and *Tristachya*. *Dactyloctenium giganteum*, *Melinis repens* and *Pogonarthria squarrosa* species are common and abundant in old fields.

Mopane woodland

The mopane woodland is one storeyed, with an open, deciduous canopy 6 to 18 m high. *Colophospermum mopane* is always found in almost pure stands. Other trees associated with mopane are *Adansonia digitata*, *Combretum imberbe* ('mufula'), *Terminalia sericea* and some *Acacia* species.

Characteristic grass species include *Chloris virgata*, *Digitaria eriantha*, *Hyparrhenia* spp., *Setaria* spp. in wetter areas and *Andropogon* spp., *Heteropogon contortus* and *Urochloa* in drier and hilly areas.

Kalahari woodland

The Kalahari woodland is two storeyed with the upper storey comprising open or partially closed, deciduous or semi-deciduous trees, 18 to 24 m high. It is characterized by *Brachystegia spiciformis*, *Burkea africana*, *Combretum collinum*, *Cryptosepalum exfoliatum*, *Dialium engleranum*, *Erythrophleum africanum*, *Parinari curatellifolia* and *Quibourtia coleosperma* as the most important tree species. However, this woodland, like miombo woodland, tends to carry a wide range of species.

Kalahari woodland has the following characteristic grass genera and species: *Andropogon*, *Brachiaria*, *Digitaria*, *Elyonurus*, *Hyparrhenia*, *Hyperthelia dissoluta*, *Panicum maximum*, *Pogonarthria squarrosa*, *Setaria* and *Tristachya nodiglumis*.

3 Natural grazing resources

Natural grasses are the main grazing resource in Southern Province. Other resources include forage legume, fodder trees and shrubs and crop residues from the field. The predominance of these different grazing resources is associated with the prevailing vegetation type.

Natural grazing resources ('machelelo angombe') are the palatable grasses, legumes and fodder trees found naturally in any given grazing area. Livestock graze or browse them.

Natural grasses

The natural grasses are the most important grazing resource as they form the bulk of the animal feed in many rangelands. A major feature of the natural grazing lands of Southern Province is that the available herbage varies in quantity and quality. Whenever the quantity is inadequate or the quality low, the effect on animal production is major, because the grazing animals face serious nutritional stress. This is the key issue in using and managing natural grazing lands in the traditional set-up.

As used in this manual, the term 'natural grass' includes

- native grasses
- grass not cultivated, such as *Digitaria eriantha* ('nsangazi') as differentiated from Rhodes grass (*Chloris gayana*)
- grass sown long ago and run down as opposed to recently sown grass
- grass vegetatively established from local material collected within the same vicinity, such as *Cynodon dactylon* ('nzinza') rather than grass established from seed, such as Rhodes grass.

Natural grasses can be either annuals or perennials, and both are important as animal feed.

Annual grasses complete their life cycle in one growing season and die. Characteristically they

- are established by seed only
- produce plenty of seeds within one growing season
- have little ability to compete with weeds or other grasses
- mature early during the growing season

Perennial grasses have a life cycle of more than two years. Characteristically they

- may be established in a number of ways, by cuttings, splits, stolons and seed
- produce few seeds as compared with annuals, and sometimes their seeds are not as viable or as vigorously competitive as those of annuals.

Advantages of natural grasses

Natural grasses have many advantages, a number of which are listed here.

- They are a major animal feed in the traditional sector of Southern Province.
- They are used to control soil erosion in the farming systems of Southern Province.
- They are used as raw material for building houses and for making baskets, mats and brooms.
- They are used for medicinal purposes.
- They are readily available.
- They require minimal management as compared with improved pasture grasses.

Disadvantages of natural grasses

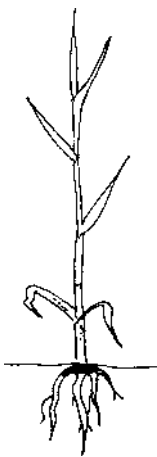
- They produce feed seasonally and usually produce little in the dry season.
- They mature early and their nutritive value declines shortly after they flower.
- They grow fast and quickly become rank.

Growing habits

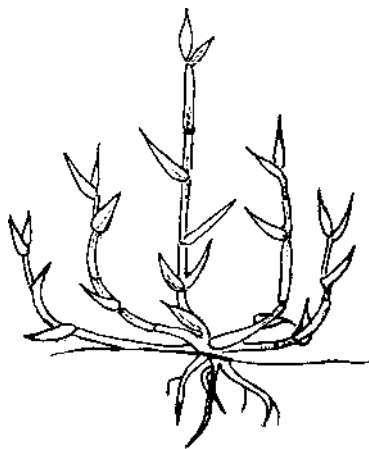
Natural grasses have different growing habits (see figure 2).

Common are

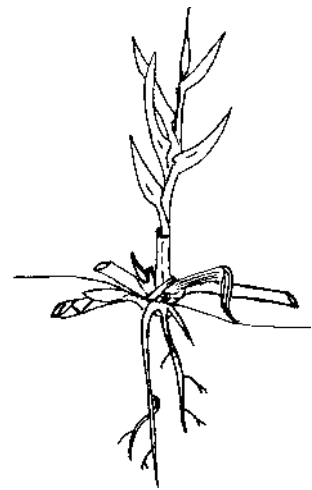
- erect, tufted; example: *Hyparrhenia* spp.
- decumbent; example: *Urochloa* spp.
- creeping, stoloniferous; example: *Cynodon dactylon*



Erect



Decumbent



Stoloniferous

Figure 2 Common growing habits of grasses.

Erect grasses like *Hyparrhenia* grow clustered or in a clump of vegetative shoots or culms that come from a single crown or from the base of the grass plant. They are easily destroyed by grazing, trampling and fire.

Decumbent grasses grow horizontally at the base and then curve upwards. A good example is *Urochloa mosambicensis*.

Creeping or stoloniferous grasses, like *Cynodon dactylon*, have stems that creep above the ground, rooting at the node and giving rise to new plants. They are resistant to grazing, trampling and fire.

Ecological status

Ecological status of rangelands is determined by range condition (state of vegetation and soils), trend recognition (direction of change in range condition) and value of indicator species. In assessing the ecological status of rangeland, the most important factors to consider are species composition and the regenerative capability of desirable species.

Three groups of grasses form natural pasture and contribute greatly to the ecological status of any vegetation:

- decreaseers
- increasers
- pioneers or invaders

Decreasers are desirable grass species that are likely to decrease in number and productivity with continuous grazing pressure.

Increasers are intermediate grass species, which occur between the pioneer and the climax stages in the plant succession. They can either be annual or perennial.

Pioneer or invader grasses are generally not desirable but are likely to increase with heavy grazing pressure, especially after the decreaseers and increasers have been grazed out.

Forage legumes

Legume plants also form part of the natural grazing resources and are found in the grazing lands of Southern Province.

The growing habits of legume plants can be erect, climbing or creeping. Although farmers of Southern Province use the legume plants found in the natural grazing lands, this feed resource has not been fully exploited.

Legumes in natural grazing lands are important:

- They provide high-quality feed for the animals, especially during the dry season.
- They remain green during the dry season.
- They enrich the soil through nitrogen fixation.
- Some are resistant to fire, browsing and trampling.

However, there are problems associated with using legumes:

- Some do not withstand heavy grazing or fire.
- They may cause bloat or diarrhoea if animals ingest too much.
- Some are difficult to control once they become established in the grazing area.

Fodder trees and shrubs

Fodder trees and shrubs are the third component of natural grazing resources. Fodder trees are defined as browsable plants that are palatable to animals. They include a wide range of low-growing species that have palatable leaves, flowers, small stems and twigs.

Fodder trees and shrubs are important for a number of reasons:

- They are used as animal feed and are palatable to the animals.
- They remain green during the dry season when most natural grasses have dried up.
- Their nutritive values are higher than those of natural grasses.
- Some fodder trees enrich the soil by fixing nitrogen and adding it to the soil.

However, a few problems are associated with using fodder trees and shrubs:

- Some may be mildly toxic.
- Accessibility may be difficult, as animals cannot feed above two metres, and some fodder plants are thorny.
- Some browsable plants have an unpleasant odour, which makes them unacceptable to cattle.
- They have so-called antinutritional substances, which make them unsuitable as the only feed. They are still valuable as a complement of the diet, and as dry season and drought feeding.

Among the fodder trees and shrubs, only species that farmers identified as important for animal feed are described in detail in this manual. They are listed in chapter 10.

Management of fodder trees and shrubs

The management practices of lopping, coppicing, pruning and pollarding can increase the amount of fodder possible to harvest from trees. The purpose is to cut away branches for fodder and firewood and to improve the potential of the tree to produce more of the desired products.

It is important to carry out these practices without killing the tree. Different tree species can withstand the harvesting of branches to varying degrees, as indicated for each individual species in chapter 10.

Branches should not be cut away from young trees (two to three year old), to allow them to first develop a strong root system. It is equally important to not damage the bark or split the stem when cutting.

Lopping

Lopping is to cut away one or more branches from the trunk or stem of the tree to obtain fodder as well as firewood.

Only small portions of branches should be cut to allow the tree to continue to grow well. Lopping is illustrated in figure 3.

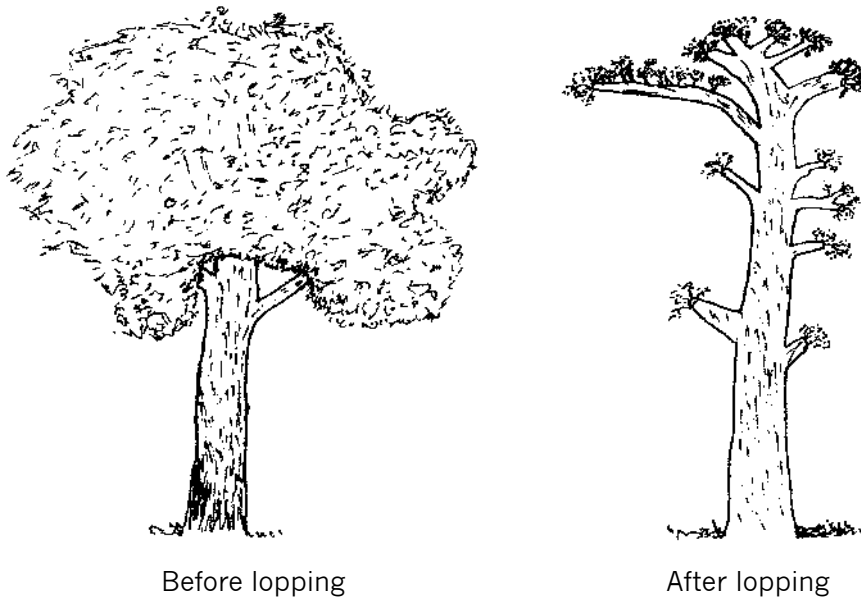
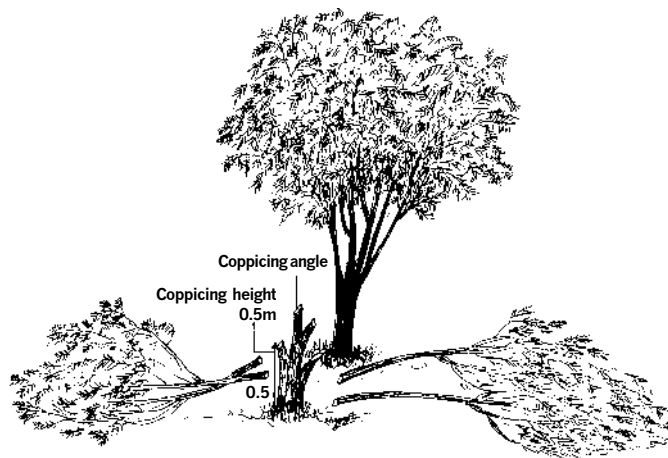


Figure 3 Lopping.

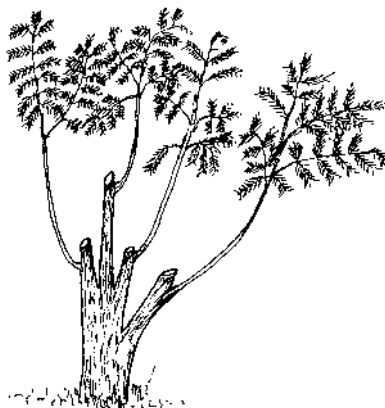
Coppicing

Coppicing is the practice of cutting back a tree to knee height to stimulate it to produce new shoots. This method is ideal for producing forage where livestock are not browsing on the tree directly. Coppicing will enhance a bushy regrowth to produce many branches for fodder. If coppicing is done also to produce timber, most of the new shoots should be removed, leaving only two or three branches.

Coppicing should only be done towards the end of the dry season, or just at the beginning of the rainy season, so the coppiced plants have an opportunity to regrow. It is important that the branches are cut at an angle (slanting cut). Figure 4 shows how coppicing is done.



Cut the tree to knee height at a slanting angle.



Let the tree regrow.

Figure 4 Coppicing.

Pruning

Pruning is the removal of side branches along the stem of the tree, to about two-thirds the height of the tree, leaving the crown untouched. Except for harvesting branches for fodder or fuelwood, trees are usually pruned to reduce their shading effects on adjacent crops and to encourage growth of a straight stem for timber.

The branches should be cut close to the stem—to let the wound heal over well and give good knot free timber—still avoiding destruction of bark on the stem. Figure 5 illustrates the pruning process.

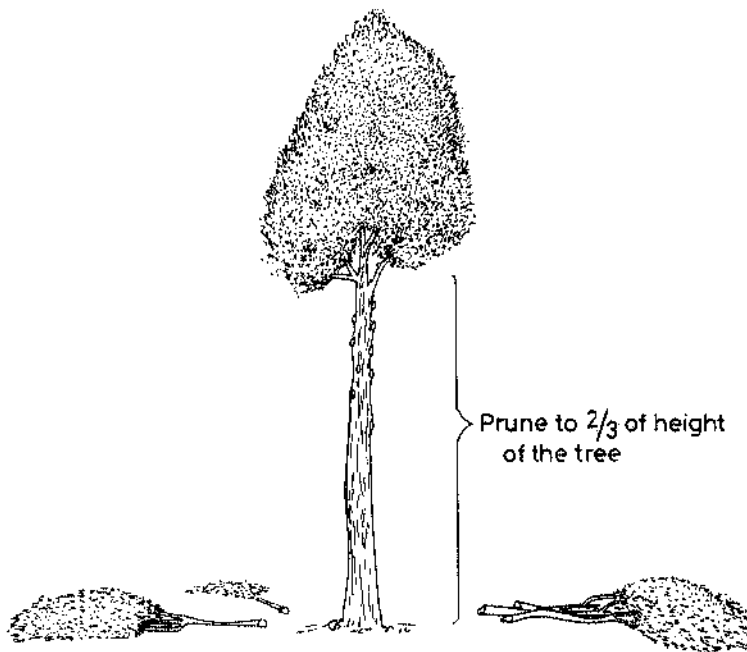


Figure 5 Pruning.

Pollarding

Pollarding is the cutting back of all branches of a tree several metres from the ground. The main purposes are to harvest branches and leaves, to stimulate the growth of a new, well-formed productive crown and to produce high-quality timber. The branches can be used for fodder and firewood.

Only trees that are able to produce new shoots after cutting should be pollarded. Figure 6 shows a tree before and after pollarding.

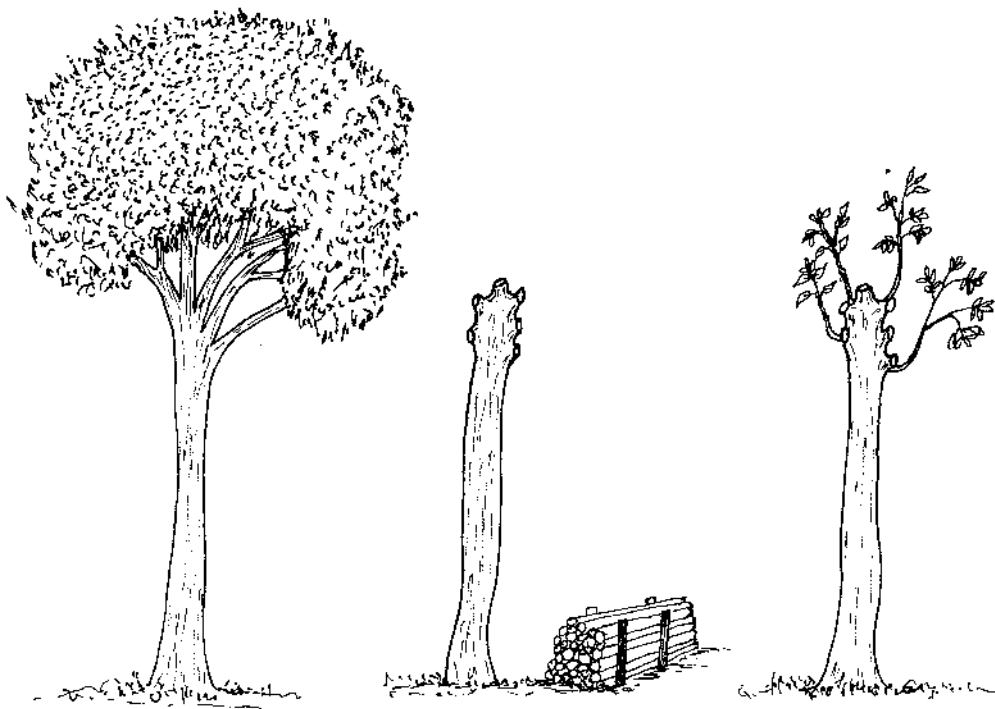


Figure 6 Pollarding.

4 Management and use of natural grazing resources

Managing range is managing natural vegetation for specific objectives or reasons related to different forms of land use. In agriculture, the objective of managing range is to produce livestock products such as milk, meat, manure and services such as draught power, by maintaining the natural vegetation in a stable and productive manner. It is aimed at obtaining maximum sustainable livestock production from natural grazing resources without destroying them. Good management of grazing resources will achieve benefits by protecting and improving the resources. It will promote continued welfare of the soil and vegetation of natural grazing lands and of the grazing animals, to gain optimum production of milk, meat, manure and draught power.

Good management practice of grazing resources involves

- proper use of forage in the range
- controlled grazing
- proper season for grazing according to the stage of plant development
- proper distribution of grazing throughout the grazing land, by strategic distribution of water points
- proper use of fire

Good management stimulates growth of key decreaser species and prevalence of grass species in this group. A high composition of decreaseers in the range ensures sustainable sward and good nutrition for the grazing animals. Good management of the range will also protect the soil from erosion.

Grazing management practices

All grazing management systems are based on the following principles:

- controlled frequency and length of the grazing periods
- resting period from grazing to provide sufficient rest during the growing season, allowing the natural grasses to seed and build up food reserves
- development of a dense cover
- efficient use by the animals
- controlled number of grazing animals in one grazing area

Other important practices include the following:

- stocking rate
- animal species ratio
- rotational grazing
- range burning

Stocking rate

Stocking rate is the actual number of animal units (AU) at a specific time per unit of land. AU is a measure of animal biomass, and one AU is equivalent to 250 kg (ILCA 1990). The stocking rate depends on the grazing capacity of the range, which is greatly influenced by the condition of the grass sward.

Animal species ratio

Cattle, sheep and goats have different feeding habits, which have an influence on the grazing lands. Therefore, the ratio of bulk grazers (cattle) to concentrate grazers (sheep) and light grazers (goats) has an influence on the composition and productivity of the vegetation. Goats, for example, are mainly browsers. They can open up closed land and reduce encroachment, while cattle can easily cause soil erosion if they graze in the same area for a long time. The normal management strategy is that cattle precede sheep and goats.

Rotational grazing

Rotational grazing is when a group of animals successively occupy different parts of the grazing area during the year so that not all is grazed simultaneously.

Rotational resting is a rotational grazing system. In it, successive areas of range are rotationally withdrawn from grazing for specific reasons, commonly

- to restore plant vigour
- to provide fodder reserves for periods of scarcity, as during the dry season
- to develop dense cover
- to make the animals use the resource efficiently

This practice is important and essential in a livestock management system. Resting the range to restore plant vigour is necessary under all range conditions. However, implementing a rotational resting programme is more easily applied in a livestock production system where the grazing area has been subdivided into grazing camps.

How can rotational resting be achieved under traditional conditions? It may not be easy to implement, but it can be done by artificially dividing areas using known physical benchmarks and making a simple grazing programme according to available grazing vegetation units in the area, such as uplands, dambos or river fringes.

Strategically burning different grazing areas at different times will provide rotational grazing and stimulate animals to graze in different vegetation units at different times, thus creating a way to rest the areas.

Grazing regime. The first step in setting up a grazing regime is to identify the vegetation types in any grazing area—for example, upland, dambo or pan, and river plain. The grazing strategy starts from here, because each of these areas will likely have different moisture-holding capacity, different soil types, and different grasses and browsable plants.

The second is to allocate the grazing months for these areas. A simple schedule can be made, such as

- December to April rainy season
- May to July cold, dry season
- August to November hot, dry season

The third step is to know when different grazing areas are more productive. For example

- uplands more productive during the rainy season
- lowlands depending on soil moisture, productive during the cold, dry season
- river plains more productive during the hot, dry season

During the grazing year, graze the animals according to the productivity of each grazing area. Using fire in these areas can also prolong the grazing.

Range burning

Range burning is an essential and important practice in range management. The most important factors to consider when developing a burning programme are the reasons for burning and the appropriate fire regime to be applied, that is, the season and the timing.

Among the many reasons for burning the range that have been identified, common ones are

- to stimulate regrowth for the grazing animals
- to remove the moribund or unacceptable grass materials
- to eradicate or prevent encroachment of undesirable plant species

Season of burning

The reason for burning will determine when to burn. Normally, the grass sward undergoes the least damage if it is burnt when the grass is dormant. If bush is to be cleared, the burn will have to be hot, and the burning is most effective if done late in the dry season, in October or November. Fire used wrongly can be extremely destructive and can destroy animal feed.

To stimulate grass regrowth, soil moisture is important. Therefore, only the areas that are likely to maintain adequate soil moisture should be burnt, and the burning should be done in May or June—early enough to allow regrowth.

In uplands, soil moisture is low in the dry season. If this area is burnt during this time there will be little or no regrowth for the animals to feed on. The best time to burn is late in the dry season to clear the dry grass and prepare the area for the next regrowth during the rainy season.

Wet dambos or pans can be burned early in May. Burn in patches to prolong the grazing period, and burn late in the dry season to clear the top hamper—the dead grass that has not been grazed and obstructs the growth of young tillers. This burning also prepares the area for the next growing season.

River-plain vegetation should not be burnt as the plain accommodates the most valuable species throughout the dry season. If the area is big, burn in controlled patches during the late dry season just to clear the top hamper and old grasses.

The point to note is that proper firebreaks should be marked in all these grazing areas to improve management and grazing strategies. Firebreaks can also prevent uncontrolled fires from destroying grazing resources.

This grazing regime allows the farmer to manipulate the grazing resources. It allows the grasses to rest and regrow while the animals are grazing in other areas. It allows the farmer to cut grass for hay in different grazing areas and to incorporate other grazing materials such as forage legumes and crop residues. However, this regime requires tight control of animals and calls for herding them at all times except when they go into the fields for crop residues.

Problems that can affect good management

A number of constraints that affect good management practices in the communal sector have been identified:

- complicated system of herding
- multiple ownership of resources
- lack of freedom to destock because of obligation to relatives
- croplands interspersed with grazing areas
- traditional rules of land ownership
- lack of incentive to turn cattle into an economic asset
- lack of range resource monitoring system

Communal grazing

Livestock owners in Southern Province use their grazing resources communally but with very little communal management of them. In this system no individual farmer will take

the initiative to manage the range even when a farmer knows that the grazing land is under pressure or overgrazed. Neither does this system encourage collective management of the grazing resource. This kind of arrangement usually leads to misuse of the grazing resources because of the following:

- Animals graze in the same area for a long time, leading to depletion of the grazing resources.
- Too many animals graze in one area.
- There is no collective management responsibility.
- Only boys and old people herd the animals.

Misuse

Once the grazing land is abused or misused, a number of problems occur. Prominently:

- The grazing resources are overgrazed.
- The soil erodes and its fertility is depleted.
- Good and palatable grass species disappear.
- Regrowth vigour, leaf production and grazing value of grass species are reduced.
- Undesirable plant species encroach the grazing lands.
- Animal productivity is reduced.
- Plant biodiversity is lost.

Land cleared for agriculture in Monze and Mazabuka in Southern Province is an example of what happens as a result of these problems. Through clearing and overgrazing by animals, large tracts of grazing areas now accommodate unpalatable grass species that produce little feed, such as *Eleusine indica* ('kaata', 'lukata', 'makata' in Toka), *Eragrostis* spp, *Perotis patens* and *Sporobolus* ('busambo', 'buungwa').

Nutritional requirements of livestock and the feeding value of natural grasses

The nutritional requirements of grazing animals in natural grazing lands are seasonal. The values for cattle listed here, although the data are from Western Province of Zambia (Jeanes and Baars 1991), are relevant:

- | | |
|-------------------------------|--|
| • Standard weight | 260 kg liveweight |
| • Standard intake (kg/day) | in dry season, 2% of liveweight
in wet season, 2.5% of liveweight |
| • Standard intake (kg/AU/day) | in dry season, 5.2 kg dry matter per day
in wet season, 6.5 kg dry matter per day |
| • Standard net energy | 28.6 MJ daily requirement |
| • Crude protein concentration | 65 g/kg dry matter |
| • Phosphorus concentration | 1.2 g/kg dry matter |

(AU – animal unit; MJ – megajoule)

Table 1 shows the average chemical composition and feeding value of native grasses in the natural grazing lands as estimated in the study in Western Province. These amounts, which are likely to be similar to those in Southern Province, indicate that the animals cannot get adequate nourishment throughout the year from these grasses alone, particularly during the dry season. The productivity of the natural grazing lands can be increased by introducing improved pastures as well as introducing strategic management and use of other available feed resources.

Table 1 Chemical composition and feeding value of grasses, Western Province, Zambia

Type of grass	Composition as % of DM			Energy (MJ/kg DM)		P : E ratio (g CP/MJ ME)
	Crude protein	Digestibility	Phosphorus	Metabolizable energy	Net energy	
Standing crop	2.9	38	0.08	4.7	2.9	0.6
Young growth	5.1	45	0.11	5.7	3.5	0.9
Shoots after burning	8.3	57	0.16	8.0	5.3	1.0

Source: Jeanes and Baars 1991

DM – dry matter; MJ – megajoule; CP – crude protein; ME – metabolizable energy;

P : E – protein : energy ratio

5 Other feed resources

Other feed resources, which include improved pastures and crop residues, form part of the grazing resources.

Feeds such as maize stover and groundnut tops are an important source of livestock feed in Southern Province, while improved pastures such as pennisetum, Rhodes grass, siratro and stylo provide better quality feed capable of producing high levels of dry matter, and they increase the crude protein content of the pasture.

Improved grasses

A number of improved pasture grasses have been introduced to Southern Province, for example, buffel grass, Rhodes grass and elephant grass. Management and use of them are discussed in chapter 6.

Improved forage legumes

Traditionally, many small-scale farmers in Southern Province use forage legumes in their cropping systems. They have the potential to improve animal nutrition and grow well in a variety of Southern Province soils. Some beneficial improved species are *Leucaena leucocephala*, *Macroptilium atropurpureum*, *Macrotyloma axillare* and *Stylosanthes guianensis*.

The advantages of improved legumes are the following:

- They fix nitrogen, which later enriches the soil.
- Their nutritive value is high.
- They stay green in the dry season.
- They can be grown in association with natural pastures and improve the nutritive value of the sward.

The disadvantages of improved legumes are the following:

- Many are slow to establish.
- They suffer from severe grazing more than from cutting.
- They are less tolerant to trampling than are grasses.
- They can easily be grazed out because of their palatability.
- They suffer from frost.

Crop residues

During the dry season, especially during the latter part of the year, animals suffer severe nutritional stress. Little feed is available, and what is available is of poor quality and far from the homestead so that animals must walk long distances to find it.

Crop residues of cereals, grain legumes and agricultural by-products such as bran can play an important role in supplementing livestock feed. Although their quantity is relatively little compared with the natural grazing resources of grasses and woody species, they can contribute towards maintaining cattle and goats during the dry season.

Crop residues commonly used in Southern Province include cereals (maize, sorghum, rice and millet), grain legumes (groundnut, cowpea and bambara) and rootcrop tops (cassava and sweet potato). The proportion fed to livestock can range from one-third of the total crop residues in cereals to over two-thirds in grain legume haulms (Hoek 1995).

Feeding in situ

In situ feeding, which means allowing the animals to graze on the crop residues in the fields after the grain is harvested, is the most common feeding system used in Southern Province. Farmers turn the animals into the crop fields and allow them to graze the crop residues. Although the system is the cheapest in use of labour, it has disadvantages:

- Lodging, termite attack, trampling and burning may cause the feed resource to be used inefficiently.
- Animals trample the soil, compacting and degrading it.

Improving the feed value of crop residues

There are ways to improve the feed value of crop residues at a low cost. The individual farmer should choose a step that is compatible with the method of farming practised:

- To get the most out of crop residues, particularly for milking and draught animals, their most nutritious parts should be used. The lower leaves of cereals can be stripped at different stages of grain maturity and fed without adverse effect on grain yield.
- After harvesting the grain, the lower part of the stem, which is of low feeding value, should remain in the field to contribute to soil cover and help return nutrients to the soil.
- At feeding, chopping the stovers into small pieces about 3 or 4 cm long and soaking them in water can increase feed intake.
- Adding molasses and urea can also increase the value of the feed. However, urea must be used cautiously, because it can be toxic. Ask your urea supplier or the extension officer for advice.

6 Establishment, management and use of improved pasture

Establishment

The decision to establish an improved pasture must be weighed against a number of factors. Establishing a pasture is generally costly in labour, land preparation, fertilizer, purchase of seed supply and installation of fencing. Using the established pasture also costs in labour for cut-and-carry harvesting, controlling grazing time, preparing hay, and storing and maintaining the herbage.

The grasses that a farmer needs to establish should be reliable. The farmer should find it easy

- to establish the grass
- to cover the ground rapidly
- to maintain it weed free
- to manage it for grazing and conservation
- to eradicate it when it is old or when it is to be replaced by crops

In the tropics, pasture establishment greatly depends on

- weather after planting
- quality of seed planted
- soil characteristics and management
- grazing management

Moisture availability affects germination and the emergence and survival of seedlings. Seed should be planted with the first good rains.

Light is important for most tropical natural grasses, because light stimulates and increases the germination rate. It is important that seeds are not planted in shaded areas.

Seed quality. To get good germination, collect and plant good, viable seeds. Select seeds that are whole; avoid damaged, diseased and rotten seeds.

Land preparation

Ploughing is the beginning of all good farming in the traditional tilling system, especially so with establishing pasture. As grass seed is small, the land needs to be well prepared, with fine tilth of the soil to ensure good and even emergence. The land should be well ploughed then disked several times. Where expensive equipment is not available, hoeing can produce a fine, flat field.

Planting time

Because early sowing in the rainy season is essential, the land must be prepared in good time.

If the ploughed land is free from grass weeds, it is best to sow as early in the rainy season as possible. Speed of germination declines as the rainy season advances. At the onset of the rains the soil is warmer and better in structure. Soil temperature declines rapidly as the season progresses. The best time for sowing grass seed is with the first rains, usually in November, or as early as possible thereafter. Planting after December will result in poor germination, slower establishment and poor yield of the grass crop.

Depth of sowing

The seed must be sown on top of freshly prepared soil so that the seed settles among the soil particles and is in close contact with them following a rain. Sowing the seed even 1 cm deep may mean failure of establishment.

The land should not be harrowed after sowing, not even raked lightly, as any such action is likely to bury the seed deep, which is a widespread cause of germination failure. A common practice among smallholders is to drag a tree branch over the freshly sown land, which brushes the seed into close contact with the soil.

Planting methods

Grasses can be established by direct seeding, cuttings or root splits. The method of establishment will depend on species, availability of seed and environmental conditions. The farmer should not plant more than can be properly handled and managed with the labour available at any peak time.

Broadcast sowing

Broadcasting is customary for establishing pasture. Because the seeds of tropical grasses are light, low seed rates are adequate. The usual practice, especially on a small acreage, is to broadcast the seed by hand. However, scattering small quantities of seed evenly over the land requires considerable skill. Mixing the seed with sawdust, rough sand or fertilizer makes the task easier. If fertilizer is used, the mixture should be broadcast immediately to prevent scorching the seed. After broadcasting, allow animals to run through the field or use tree branches to cover the seeds.

Advantages of broadcast sowing:

- The method is quick.
- It is practical for planting a large piece of land.

Disadvantages of broadcast sowing:

- It requires a lot of labour.
- Pasture establishment may be patchy.
- Distinguishing weeds from the crop is difficult.
- It requires a higher seed rate.

Drill sowing

Seed is drilled in lines spaced 80 to 100 cm apart. Divide the seed according to the number of lines in a hectare and use that amount to cover the entire length of the line. Mix the seed with a filler, such as dry soil, to make it easier to distribute the seed evenly over the entire line. Cover the seed lightly by hand or with a tree branch.

Advantages of drill sowing:

- Is ideal for small fields of less than 10 ha with a labour force of at least 10 people.
- Pasture is established more uniformly and quickly.
- Identifying weeds from the grass crop is easier.
- Weeding becomes easy.
- Fertilizer mixed with the seed remains in closer contact and is more effective than when seed and fertilizer are broadcast over the whole area.

Disadvantages of drill sowing:

- It requires intensive labour.
- Only a limited area can be planted.
- Seed may be planted too deep.

Vegetative propagation

Vegetative propagation through stolons, splits or cuttings is used with species that do not produce viable seeds or those that produce only small quantities of seed. This planting method can be done on heavily grazed or burnt grazing land, on strips made by ploughing or by scratching with branches on arable land.

When propagating through stolons, use mature stolons or runners with at least three nodes. When planting, cover the stolons with soil, leaving only a small portion exposed.

For splits, cut the grass low, dig up the complete tuft and separate it into splits, leaving the roots attached since the stem does not regenerate growth. Plant in rows, 50 cm between plants and 90 cm between rows.

Vegetative propagation through cuttings is suitable for fodder legume species (especially tree legumes). Make the cuttings from mature branches about 30 to 50 cm long, about the thickness of the thumb. Cut at an angle of about 45 degrees to increase the surface. Keep cuttings moist and transport them within hours for transplanting into a moist soil bed. Prepare and transport the cuttings to coincide with the start of the rains or when soil moisture is reliable. This method is cheaper and avoids the cost of purchasing seed or producing seedlings in a nursery.

Factors affecting natural pasture establishment

The following factors can hamper good establishment of natural grasses (table 2):

- Seed are lost to harvest ants or birds eating them.
- The seeds are sown too deeply into the ground.
- The seeds lose their viability.
- Germinated seeds fail to emerge because of environmental stress or formation of a soil surface crust.
- Emerged seedlings die because of environmental stress, plant competition, attack by disease or pests, or by rodents and birds feeding on them.

Table 2 Problems associated with natural pastures

Characteristics	Condition applicable to
Low site potential	<ul style="list-style-type: none">• infertile, non-arable land—swampy, rocky, steep or inaccessible land
Low control over the land	<ul style="list-style-type: none">• communal grazing land• lack of grazing control• overgrazing and continuous grazing
Low frequency of good grasses	<ul style="list-style-type: none">• bush and weed encroachment• plants usually known as weeds of arable land• coarse and unpalatable plants• poisonous plants
Low productivity of existing grasses	<ul style="list-style-type: none">• coarseness and lack of quality• poor performance in the dry season• short growing season

Source: after Boonman 1993

These shortcomings, although valid, do not apply to all types of natural grasslands and some are equally valid for cultivated pastures. What is important is that the natural grasslands occupy large areas of grazing land in the province and that they present considerable opportunity for development.

Pasture management

The aim of management is to regulate growth in a way that herbage is available throughout the year. It is a matter of matching supply and demand. Rapid establishment is essential to achieve the best and cheapest pasture available in the first year. This is a precondition if grasses are to serve their purpose in crop-and-pasture rotations, not only to provide early grazing but also to suppress arable weeds and restore the productive capacity of the soil. A priority in managing natural grasslands is to prevent deterioration. Stabilizing and maintaining cover is important.

In grasslands of mixed botanical composition, the value of the natural resource depends on the kinds of species present and the frequency with which they occur. Good practice is to graze the pasture lightly in the first year that it becomes established. Many farmers prefer to use the primary growth of the first-year pasture for either a late hay crop, harvested at the beginning of the dry season, or a seed crop, or both. Extra care needs to be spent on establishing the pasture, so that in the dry season maximum use can be made of the first year's production.

Herbicides should not be a substitute for good management. Benefits can be achieved in the short term by preparing the best conditions for establishing grass seed in the field, such as

- sowing as early as possible at the onset of the rainy season
- preparing a fine seed bed
- sprinkling seed on top of freshly prepared land and not harrowing or raking it in

Weed control

Weed seedlings are usually more vigorous than those of sown tropical grasses. Weeds must be thoroughly controlled, because they compete with grasses for light, moisture and nutrients. Broad-leaved weeds will emerge in large numbers. They compete most seriously when grass plants are small. Unless precautionary measures are taken, grass seedlings can be completely overgrown. But after the grass seedlings reach a height of about 50 cm, their growth is rapid and they will outstrip most of the weeds.

Failure to control weeds can reduce yield by a third or more. Chemical control can be expensive, and for a small field, mechanical weeding using a hoe can be very effective. Where botanical composition of the grassland is mixed, the undesirable weeds and grasses should be suppressed through control, tight grazing and a planned burning regime.

Seed harvesting

As seed harvesting is usually labour intensive, it requires good planning and organization of the labour force.

Pasture seed should be harvested when it is ripe. Harvesting immature seed reduces seed quality and increases the chance of poor germination and subsequent poor pasture establishment.

The farmer should decide to harvest the seed only after randomly checking the whole field. Make sure that most of the seeds in the heads are mature. Check by testing if it is easy to remove the seed. Take particular care to prevent undesirable mixing of seed during harvesting.

Seed harvesting is usually carried out about 6 or 7 weeks after the head emerges, when shedding is already well on its way. Valuable seed is lost more by harvesting too early than too late. Most grasses are harvested by hand or by combine.

Seed harvesting by hand is simple and harvesting is weather tolerant, as heads can be reaped whether wet or dry. Threshing, however, is more difficult when reaping and stooking are done in a dry period. Threshing can be a source of loss unless seed is collected properly. Hand rubbing the heads or beating the sheaves with sticks may be necessary to free the seed.

Farmers should cut the ripe heads with a sickle. In a process called sweating, the cut heads are put in heaps not more than 10 cm high and dried outside for at least 2 or 3 days (or in well-ventilated sheds, see page 27). The seed is then shaken off the heads. Seed that resists coming off easily is usually immature. Sometimes the seed is sun dried before it is threshed and winnowed.

The seed should be dried under the shade to avoid direct sunlight. It should be thinly spread to avoid moulding, turned regularly and dried well for good storage.

Advantages of hand harvesting:

- Normally mature seed heads are harvested.
- Hand harvesting produces good quality seed.

Disadvantages of hand harvesting:

- The hand work is labour intensive.
- Only a small hectare can be harvested.

Mechanized harvesting by combine is useful for a large hectare, because a large amount of seed can be harvested in a short time. The seed is force dried by electricity. This method is out of the reach of most small-scale farmers and is used principally by commercial farmers.

Advantages of combine harvesting:

- Combining is quick and efficient.
- It can cover large fields.

Disadvantages of combine harvesting:

- It is expensive.
- The risk of harvesting immature seed is higher.

Seed drying step by step

- Collect seed heads.
- Stack bundles of seeds on the floor of a well-ventilated shed at a depth of not more than 5 cm.
- Leave to dry for 2 to 3 days (sweating), turning at least once a day to reduce temperature.
- After 3 days, shake the seed from the seed heads.
- Dry the seed by spreading it in thin layers in a shady place.
- Turn the seed frequently.

Seed storage

Seeds must be stored well to maintain their quality and viability.

First, before the seed is finally stored, clean it to separate out the foreign material from the seeds. Seed can be cleaned by winnowing using a shallow basket.

The way the seed is stored after it is dried influences seed quality and viability. The moisture content and storage temperature also determine seed longevity. Generally, pasture seed stores better in a cool, dry, well-ventilated and clean building. After the seed is harvested, a test can be performed to determine the germination percentage.

If the seeds are not to be used immediately, they should be stored in airtight containers, like bottles, tins, plastic bags or boxes that are impervious to rodents and other pests. If possible, seeds should be refrigerated at a temperature of 4–5° C.

Where possible, treat the seeds with a fungicide before packing them. Label the packs, indicating

- name of the plant species
- weight of seeds in the container
- place where the seed was collected
- date

Storing seed in bulk on a bare floor, however, also has disadvantages:

- The seed is likely to absorb moisture from the floor.
- The seed is subject to rodent and insect attack.

Live fences

Any farmer considering growing improved pastures should also be thinking of fencing the pastures to enhance their protection and proper use. Usually fences, especially those made of wire and posts, can be very expensive, and small-scale farmers may not find them economically justifiable. However, other cheaper options are available such as live fences, grown with trees and shrubs. The principal cost for growing them is labour.

Live fences are barriers of closely spaced trees or shrubs grown to protect a given area against livestock and human interference. As growing one requires many trees or shrubs, a cheap, sustainable propagation method is required. Directly sowing seed and using cuttings are the methods usually recommended.

Live fences have the following advantages:

- Live fences can be used to protect fields, gardens, fodder banks, woodlots, paddocks and can also be planted around homesteads.
- Once a field is fenced, the farmer can improve use of crop residues and can better maintain pastures and trees by keeping livestock and humans out of the fenced area.
- Live fences are cheap to establish compared with wire fences.
- Once established, they are permanent and are seldom vandalized.
- An economical way of fencing large areas, they do not need regular repair.
- Live fences may also produce poles, fruits and firewood.

Species used for live fences should have the following characteristics:

- Able to keep off livestock by being thorny or densely branched.
- Easy to establish and manage.
- Able to tolerate waterlogging or grow anywhere.
- Resistant to fire and drought.
- Able to provide useful by-products, such as fruits, timber, poles.

Farmers are using several species that can be recommended to protect fields and gardens (local name is in Tonga unless otherwise specified):

Agave sisalana, mukusa

Balanites aegyptiaca, mulyanzovu (Nyanja)

Caesalpinia decapetala, molisha

Commiphora africana, mubwabwa

Euphorbia tirucalli, mbala

Faidherbia albida, musangu, muunga

Riciodendron rautanenii, mungongo

Ziziphus mauritiana, musau

Fodder conservation

A constant supply of good quality fodder is essential to maintain maximum production from a herd. Because the animal feed supply is seasonal, nature on its own does not provide a constant supply of fodder for a beef or dairy herd. The basic idea of fodder conservation is to store it when there is surplus and feed it to the animals during the dry season when fodder in the field is in short supply. It is better to cut and make hay than to burn over-mature grass or let it rot.

The farmer faced with a surplus of grass in the wet season and a shortage in the dry season has to choose between saving the surplus or losing valuable grasses. Grasses make good hay when the weather conditions are good and their hay can be relied on as a source of feed. In many countries hay has been made since time immemorial.

Mature and unpalatable stands of grass can, when turned into hay, be well liked by livestock. Another benefit of cutting hay is that the succeeding growth of grass will be edible and useful for grazing for at least another month.

Feeding with hay

Hay can be fed from May to October, as much as the animals can eat in addition to what they graze. The best way to give hay is in the feed trough in the kraal before nightfall or in a hay rack. If less hay is available, select which animals to feed, for example, oxen that are used for transport and ploughing, and give each animal about 5 kg per day.

Hay has many benefits if cut and fed to the animals at the right time.

- It provides high-quality feed during the dry season.
- It bridges the gap between forage produced and food required for the livestock.
- It fits well into small-scale situations.
- It can be used in intensive dairying and fattening operations.

Mixing hay with forage legumes can easily double the quality of the forage.

Procedure for haymaking

- cutting the grass
- drying the grass
- baling and transporting
- storing the hay

Cutting the grass

A compromise must be made between quality and quantity, because as the yield increases the quality decreases. Therefore, grass for hay should be cut just before it flowers or when it starts to flower.

If the cutting is done late, the quality and digestibility will be low because the nitrogen content will be low and the fibre content high. Cut the grass with sickles, not slashers.

Drying the grass

After the grass is cut, it should be dried until the dry matter content is about 80%. This is when it feels dry and warm in the hand, all through the material. In good dry weather, the grass should be ready for baling within 1 to 3 days after cutting. To ensure quick drying of both bottom and top layers of the cut grass, turn or rake it daily for 3 or 4 days to ensure that it dries uniformly. Turn gently to minimize loss of leaves. Prolonged drying will result in the loss of nutrients caused by prolonged respiration. Too much sun bleaching after the green colour has disappeared will reduce the digestibility, protein and vitamin content of the hay.

Hay made from legumes should be turned as little as possible, because leaves of legumes break off easily. Turn it during the evening or early in the morning on every second day until the legumes are dry.

Baling and transporting

Because forages are bulky, the hay needs to be baled for easy transportation and storage. Although this practice is not commonly used in managing natural grasslands in Southern Province, it is necessary when conserving fodder. Large commercial farms bale mechanically. In eastern Africa, where small-scale producers practise fodder conservation, simple manual baling techniques have been tested and have proved to reduce transportation costs by 30% and storage space by 70% (Massawe 1999).

Storing the hay

Hay can be stored under a roof or in a haystack. It can be stored in many ways, but it is important to protect hay from rain and sun. The storage room should be clean and cool with free circulation of air. Protection from termites, rodents and other pests is a must.

Haymaking losses

Haymaking losses can occur in the field through mechanical damage, leaching of plant nutrients by rain or development of mould. Loss during storage can occur through plant respiration, its heating up (especially if the hay is stacked while wet), development of mould if the weather is moist or the hay is rained on, or mechanical damage.

Good-quality hay

Good-quality hay should have a good proportion of leaves—stemmy hay usually is low in value. It should be green in colour—yellow indicates bleaching, brown or black suggests mould. Developed flowers indicate that the grass was cut long after flowering. This hay usually is of poor quality.

Use of forage legumes

Forage legumes should always be fed as a supplement to a bulk feed like grass. When it supplements maize stover, for example, forage legume produced from a quarter of a hectare (locally known as a lima) can feed two draught oxen for at least 3 months.

Farmers generally use two systems: 1) in situ grazing, or 2) harvesting the hay and feeding the animals at home or in the kraal.

Grazing in situ

The animals are let into the forage field and left there to graze for about 5 to 10 minutes, preferably in the evening after normal grazing.

Advantages of grazing legumes in situ:

- Labour requirements are low.
- Light grazing stimulates plant growth.

Disadvantages of grazing legumes in situ:

- Overgrazing, which is a high risk, may kill the legumes.
- Controlling intake is difficult.
- The seed has to be harvested before the area is grazed.
- Requires labour for fencing to keep animals out of the legumes.

Harvesting and feeding

Optimal harvest time is difficult to establish, but once the farmer gains experience, this problem will be resolved, because a farmer will determine the right time to harvest the legume crop. The number of times the legumes can be cut will depend on how well they are established and the grazing regime employed. The legumes can then be fed directly to the animals in the kraal or can be stored and fed later. Leaves and stems can be chopped, dried and put on racks or in sacks with free air circulation. Avoid exposing the harvested crop directly to sunlight to reduce scorching and mineralization, and to protect it from termites and other pests.

Hoek (1995) recommended the amounts given below to be fed to local animals in the dry season in Western Province of Zambia:

Oxen	maintenance	1 kg
	when working	2 kg
Milking cows	maintenance	1 kg
	lactating	2 kg
Calves	maintenance	1 kg

Advantages of harvesting and feeding legumes:

- Easy to feed to animals that have been selected.
- Feeding can extend into the dry season.
- Daily intake can be controlled.

Disadvantage of harvesting and feeding legumes:

- Labour is required for cutting, drying, storing and feeding.

Miombo woodland.



Dambos.



Munga woodland.





Mopane
woodland.

Natural grasses
constitute the main
grazing resource.



Natural grasses
mature early and
their nutritive value
declines shortly
after flowering.

At the worst of times, during extreme drought, natural grasses remain the principal form of nourishment.



Legume plants in the natural grazing lands.

Fodder trees remain green during the dry season.





Burning is sometimes used to stimulate regrowth in the rangelands.

Cenchrus ciliaris forms high stands of grass in the rain season.



Stylosanthes guianensis intercropped with maize improves the feed value of dry season forages.

7 Range assessment and monitoring

The initial step in formulating a range management programme is to assess the condition of the range in each vegetation type. Each land user or farmer needs to assess the extent of degradation of the particular grazing resource and institute a regular monitoring system for this purpose. Effective management of natural grazing resources requires knowledge of the relationship between the present land productivity and its long-term potential under proper management.

Assessing a range means observing it regularly during a certain time of the year; for example, it can be assessed every 2 years, or more or less frequently, depending on what information the farmer wants to get. The idea behind range monitoring is to assess the condition of the vegetation and to determine noticeable changes or trends.

These changes can be

- improved vegetation
- declining or deteriorating vegetation and grazing resources
- effects of these changes on vegetation and the grazing animals

Factors that accelerate vegetation change are

- range burning
- agricultural cultivation
- precipitation—rainfall or drought
- uncontrolled grazing

Community involvement in range assessment

The key people to assess the grazing areas are the community members themselves. They are the major users of these range resources; they know all the different types of grazing areas, their potentials, their locations and the type of grazing resources available in each vegetation type.

Communities have important information based on past experience, such as

- what was the previous state of the vegetation
- what plant species were there
- what new plant species have come in and their importance for grazing
- what plant species have disappeared
- reasons why such changes have taken place
- important events that might have led to such vegetation changes

The same farmers can use this important information to work out management solutions and possible improvements. Basic technical training can easily supplement and increase the assessment knowledge of the community in understanding the process.

Assessment teams formed within a community will provide local training to other members of the community and increase awareness on vegetation assessment and on how they should look after their respective grazing areas with little damage to the grass, the grazing animal and the soil.

8 Palatable natural grass species

Cynodon dactylon

ENGLISH: couch grass; **TOKA:** lwanda; **TONGA:** nzinza

A sward-forming perennial, rhizomatous and stoloniferous; height to 35 cm. **HABITAT:** Grows on both uplands and lowlands and around residences, cattle kraals, old fields. Usually spread by cattle. **FLOWERING TIME:** From September to May. **ESTABLISHMENT:** Can be established from fresh rhizome splits (underground stems) and stolon cuttings. If planted at the onset of the rainy season, it establishes rapidly and will compete with other grasses in the sward.

MAIN ATTRIBUTES

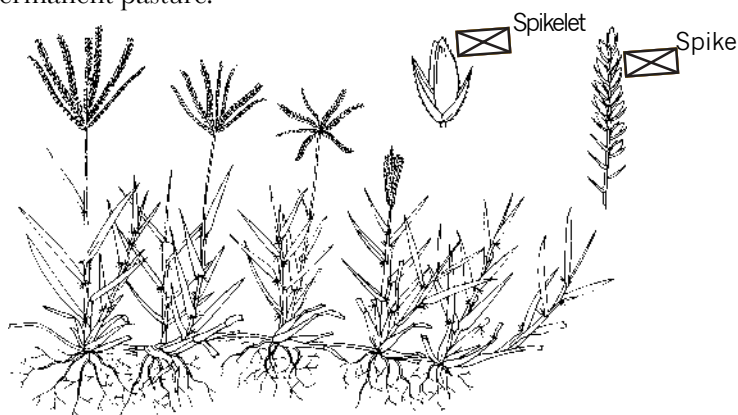
- Grazing value high. Grazed throughout the year. The demand for grazing is high in the dry season.
- Used in soil erosion control.
- Resists drought and withstands salinity.
- Withstands close grazing.
- Withstands severe fires.
- Is high in feeding value when managed by short grazing intervals.
- Is easy to propagate.

MAIN DEFICIENCIES

- Is difficult to eradicate once established.
- Unpleasant odour during the rainy season makes it unpalatable to cattle.

MANAGEMENT AND USE

Cynodon is an increaser. It requires minimal management because of its potential to compete with other grass species. It can be grazed throughout the year; however, demand for grazing is high in the dry season. It is not good for haymaking but can be grazed in situ. Very good for permanent pasture.



Cynodon dactylon

Dactyloctenium giganteum

ENGLISH: crowfoot; **TOKA:** sonko; **TONGA:** bwambo, chalachankuku

Tufted annual with branched culms to 1 m tall. Most farmers consider it a weed in cultivated fields. It may be difficult to differentiate between this species and *Dactyloctenium aegypticum*, which is usually smaller with the flowering spikes spreading. Both are palatable to cattle.

HABITAT: Occurs in disturbed and fallow fields, around roadsides and cattle kraals. Sometimes found in uncultivated places in both the valley and the plateau. **FLOWERING TIME:** From November to May. **ESTABLISHMENT:** Propagation is by seed. The grass naturally forms a dense sward in ley and fallow areas; therefore, propagation may not be necessary as it comes naturally in the fields.

MAIN ATTRIBUTES

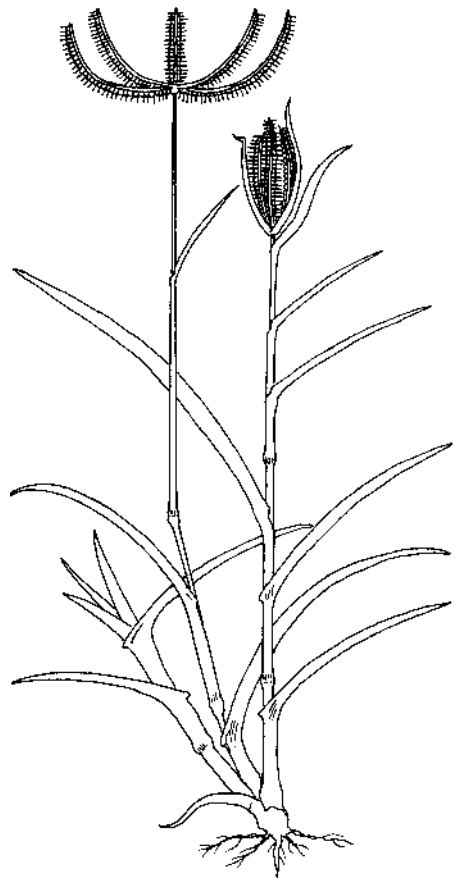
- Grazing value very good. Palatable, high-yielding pasture grass.
- Matures and seeds early and can escape drought.
- Is a good seeder.
- Provides good ground cover.
- Biomass production is high.
- Has high feeding value.
- Can be made into good hay.
- Can also be used as green manure.

MAIN DEFICIENCIES

- Early maturation makes haymaking difficult.
- Dries up quickly, making it unavailable to the grazing cattle.

MANAGEMENT AND USE

Dactyloctenium is an increaser. Once it is established, weeding is not necessary, because it competes well with other grasses. Protect it from fire and animals until the grass is ready to be grazed or made into hay.



Dactyloctenium giganteum

Digitaria species

This genus has many species. Most are similar in appearance, and it may be difficult to distinguish one from the other. Most are palatable. The best known and most readily identified by farmers are *D. eriantha* ('nsangazi') and *D. milaniana* ('nsekwa'); *D. eriantha* is the more popular with farmers.

Digitaria eriantha

ENGLISH: common finger grass; **TOKA:** chibunze; **TONGA:** sangazi, isangani **WE:** sangazi

A stoloniferous perennial with a compact rhizome. It is an indicator of good range condition. **HABITAT:** This grass is found prominently in Kalomo Central, Munjika and Mungaila areas in Monze District and in Munyumbwe, Gwembe District. **FLOWERING TIME:** January to April. **ESTABLISHMENT:** To propagate this grass, the field should be prepared during the dry season and planting should take place before the onset of the rains. Establishment is by seed, stolons or rhizomes.

MAIN ATTRIBUTES

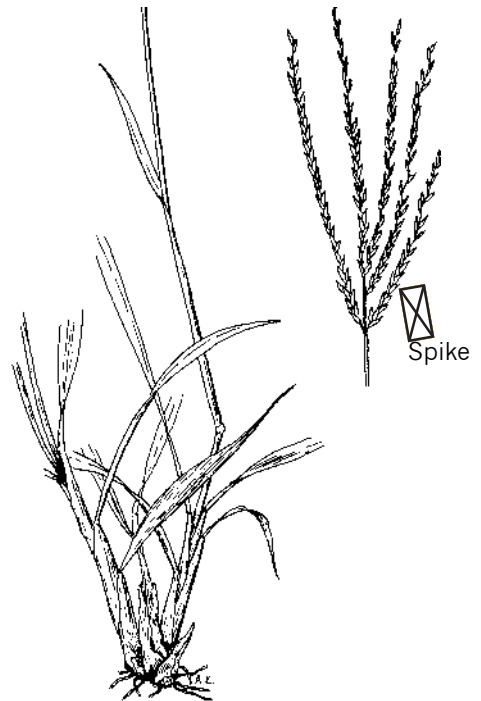
- Grazing value is high and the grass is very palatable.
- Grows on a wide range of soils, wet sands to heavy clays and at low fertility levels.
- Has nitrogen-fixing ability.
- Is easily propagated.
- Grows vigorously.
- Suppresses weeds.
- Grows well with legumes such as *Centrosema pubescens* and *Macroptilium atropurpureum*.
- Can be used to control soil erosion.
- Feeding value is high and yields biomass up to 10 t/ha.

MAIN DEFICIENCIES

- Cannot withstand heavy grazing.
- Is susceptible to rust.
- Nitrogen content declines rapidly with age.

MANAGEMENT AND USE

As this grass is sensitive to both grazing and trampling, it must be managed well. It needs to be protected from fire and animals so that it is preserved until the dry season. Performs well in association with *Urochloa* spp. ('mpunga'). Avoid continuous grazing to protect the grass from depletion. Can be grazed in situ or preserved for hay.



Digitaria eriantha

Eleusine indica subsp. *africana*

ENGLISH: goose grass; **TOKA:** makata; **TONGA:** kaata, ikaata, lukata

Tufted annual to weak perennial with culms to 0.6 m tall. Difficult to eradicate once it is established. Considered a widespread weed of disturbed areas. **HABITAT:** Grows on uplands and usually in old fields and fallow in catchment areas and around cattle kraals. **FLOWERING TIME:** From December to April. **ESTABLISHMENT:** Can be propagated by seed or by dividing the tufts. There is no need to establish this grass, as it comes normally, usually through cattle manure, once a field is left fallow.

MAIN ATTRIBUTES

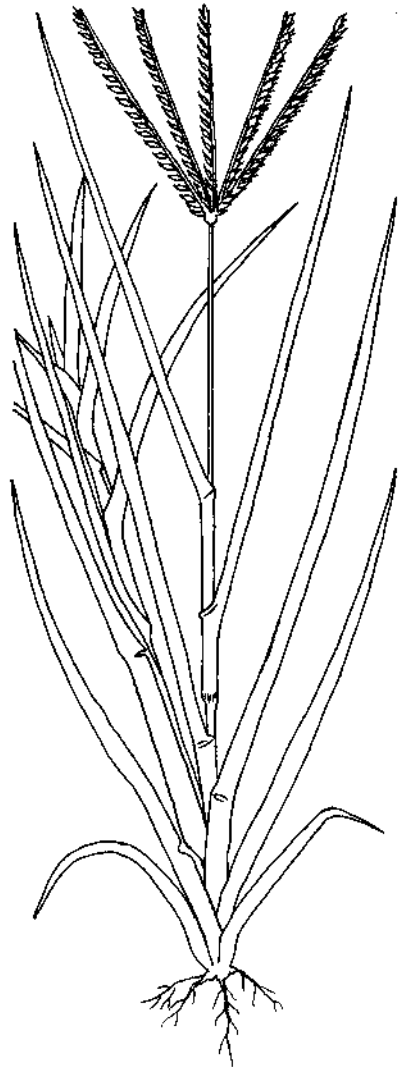
- Can be made into hay and fed in the dry season.
- Emerges early in November providing early animal feed.
- Used for mulching and making compost manure.

MAIN DEFICIENCIES

- Grazing value is low. Cattle generally graze it in its young stage during the rainy season, but it is also occasionally grazed in its dry stage during the dry season.

MANAGEMENT AND USE

An increaser to indicator grass of disturbed areas. Requires minimal management. Is usually considered a weed and removed from fields. But where a farmer wants to use it as animal feed, the fallow should be protected from fire and animals trampling it or the grass should be harvested as hay.



Eleusine coracana subsp. *africana*

Heteropogon contortus

ENGLISH: spear grass; **TONGA:** njonya; **WE:** chisina

Perennial, tufted, to 1 m tall. A fast-growing pasture grass. **HABITAT:** Found along roadsides, around hilly and rocky places of Choma, Kalomo, Gwembe and Munyumbwe areas. **FLOWERING TIME:** October to June. **ESTABLISHMENT:** Grows naturally on its own but can be propagated by seed. It may not be necessary to establish this grass where better grasses are alternatively available.

MAIN ATTRIBUTES

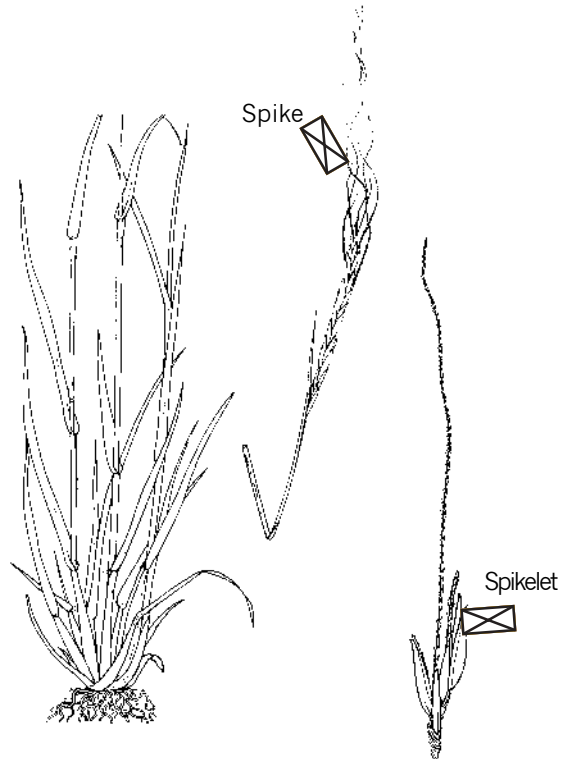
- Grazing value is high if fed early in the rainy season before flowering. Best used while it is young.
- Tolerates severe fire.
- Can grow on poor soil.
- Is palatable in the early vegetative stage.

MAIN DEFICIENCIES

- The seeds can penetrate the skin of animals and cause injury, especially to sheep.
- Gets rank quickly after emerging early in November.

MANAGEMENT AND USE

H. contortus can be an increaser or a decreaser, depending on the type of soil on which it grows. It is rarely sown, because it has an excellent ability to spread naturally, especially in burnt areas. It is a hardy perennial but feeding value and palatability is reduced drastically at maturity, because of the numerous robust awns it produces. However, it is an important grass in hilly areas of Choma East and Gwembe Districts. Can be grazed in situ only while young.



Heteropogon contortus

Hyparrhenia species

Hyparrhenia is the most widely spread genus in Southern Province. Generally, it may be difficult to distinguish species in this group, except *Hyparrhenia filipendula* ('masanga', 'matenganya') and *Hyparrhenia hirta* ('kafumbe', 'kanyambote'). Grasses commonly known as 'busubwamanda', 'buyu' and 'manyengele' are also *Hyparrhenia* species.

Hyparrhenia hirta

ENGLISH: common thatching grass; **TONGA:** kafumbe, kanyambote, kanyambuli

A rhizomatous, tufted, perennial grass with culms to 2.5 m tall and occasionally even taller.

HABITAT: Found in all vegetation types of Southern Province but common on the plateau; found on all soils within the dambos and on hills in Gwembe, Mapangazya, Mazabuka and Monze Districts. An indicator of climax grass in the vegetation. **FLOWERING TIME:** From September to March. **ESTABLISHMENT:** By seed and by dividing the tuft bases.

MAIN ATTRIBUTES

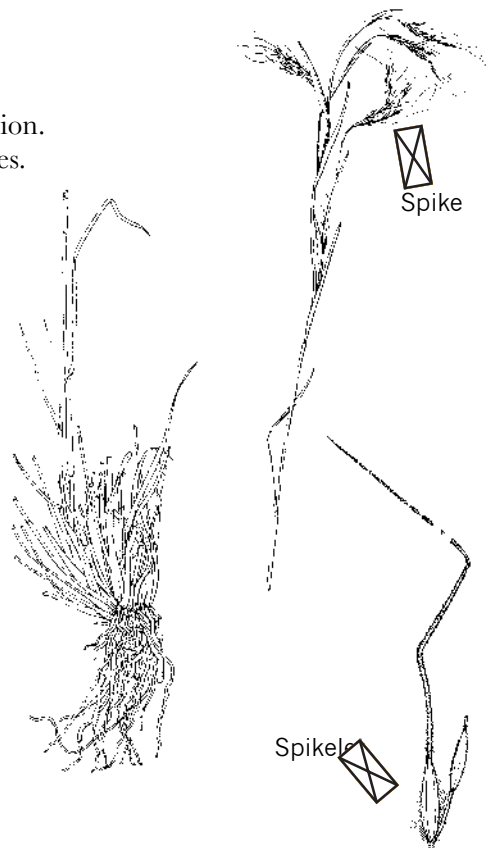
- Good pasture grass, particularly early in the rainy season and late in the dry season and especially after burning.
- Is highly resistant to drought and cold.
- Is a good pasture grass.
- Stays green longer than other grasses.
- Stabilizes soil and is used to control soil erosion.
- Used for thatching houses and making fences.
- Can be cut as hay.
- Produces tillers, especially after burning.

MAIN DEFICIENCIES

- Becomes hard and fibrous quickly.
- Grows fast and loses quality with maturity.

MANAGEMENT AND USE

An increaser. Needs to be burnt early, in June or July, to stimulate regrowth in areas where soil moisture is not limiting. In drier areas, it should be burnt late in the dry season in November to remove the top hamper and to take advantage of the first rains. Hay can be cut and stored for dry-season feeding. It should be cut just before or at flowering to maintain high feed value. Some farmers sprinkle common salt on the hay to make it more palatable. Where fence protection is available, feeding can be in situ.



Hyparrhenia hirta

Leersia hexandra

TONGA: kalamba

A perennial, water-loving grass, about 60 to 70 cm tall. Has sharp leaf-blade edges that can damage grazing animals, especially sheep. **HABITAT:** Found mainly in floodplains, streams and other permanently wet places. Forms extensive colonies in streams and rivers in Choma, Monze and Kalomo. **FLOWERING TIME:** June to July. **ESTABLISHMENT:** By dividing the tuft bases.

MAIN ATTRIBUTES

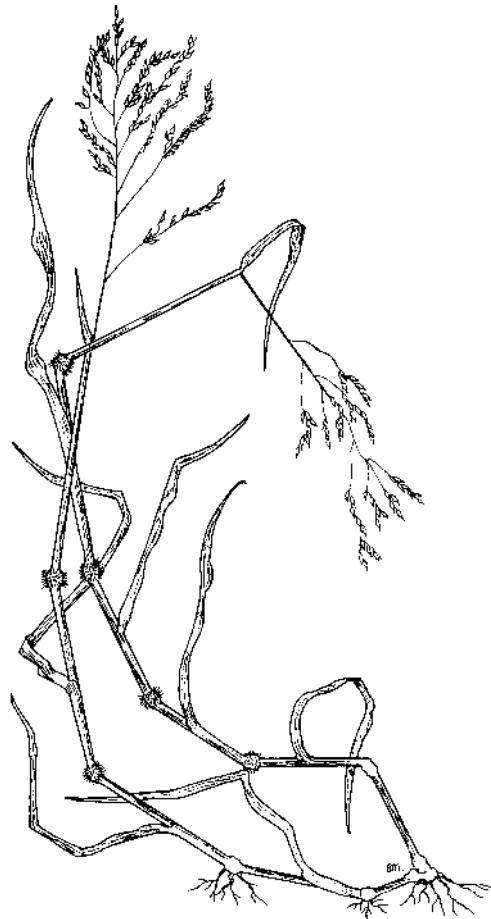
- Grazing value good. An important grass for animals during the dry season.
- Is a good pasture grass and can be cut for hay.
- Is high yielding.
- Is good for making composite and mulch.
- Used as litter for poultry.
- Used for filling pillows and mattresses.

MAIN DEFICIENCIES

- Can easily be grazed out once water goes down.
- Sharp leaf blades cause injury to both young animals and humans.

MANAGEMENT AND USE

A decreaser. Protect the grass from fire during the dry season. Avoid heavy grazing during the growing period, especially when the water level is low. Burn late November, so that production will be high in the next growing season. Can be cut and prepared as hay and stored for future use.



Leersia hexandra

Phragmites mauritianus

ENGLISH: reed; **TONGA:** matete

A water-loving perennial grass with long rhizomes; grows to a height of 5 m. Another species, *Phragmites australis*, also grows in the area, and farmers are not able to distinguish between the two. **HABITAT:** Found in wet, lowland areas, river and stream banks, dambos and plains throughout Southern Province. **FLOWERING TIME:** From January to June. **ESTABLISHMENT:** By root splits and rhizomes. Because it grows naturally in wet places, establishing reeds for grazing will likely not be necessary.

MAIN ATTRIBUTES

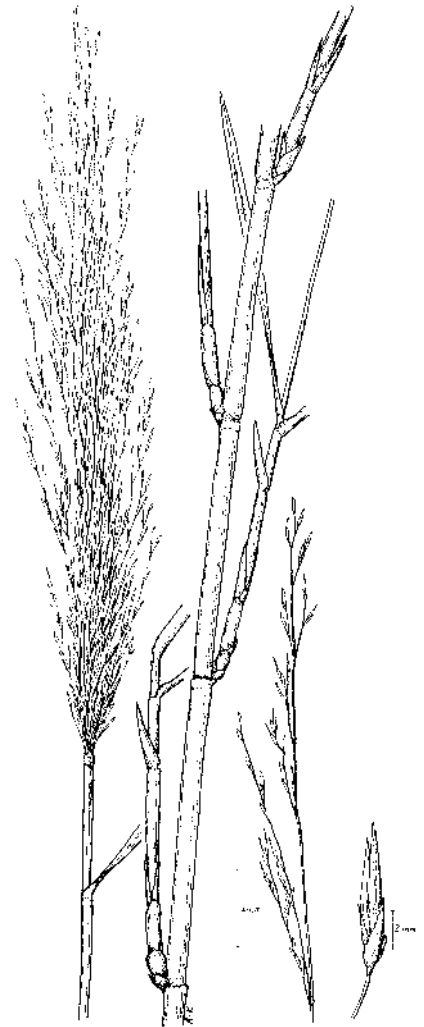
- Grazing value is good. Mostly used during the dry season, especially the new tillers after burning.
- Is drought resistant.
- Withstands heavy grazing.
- Highly palatable and available all the time.
- Used for building wall fences and for making mats, baskets and fish traps.

MAIN DEFICIENCIES

- Is difficult to harvest for zero grazing.
- Once mature, its nutritive value is low.

MANAGEMENT AND USE

Needs little management apart from protecting it from fire and humans. Fire can be used late in the November dry season to promote tillering. The grass is usually grazed in situ, but it can also be used in the cut-and-carry system.



Phragmites mauritianus

Sporobolus pyramidalis

ENGLISH: catstail grass; **TOKA:** busambo; **TONGA:** buungwa, nzete

A densely tufted and rhizomatous perennial, height to 1.5 m. A common weed in depleted soils and an indicator of poor rangeland condition, usually associated with overgrazing.

HABITAT: Found in lowland areas where the water table is high and in depleted areas throughout the province. This grass, like *Hyparrhenia* species, is found in all vegetation types within the plateau and the dambos. Sometimes found on uplands and around cattle kraals. **FLOWERING TIME:** November to May. **ESTABLISHMENT:** By dividing the tuft bases. However, the grass grows naturally and comes as an indicator after the area has been overexploited.

MAIN ATTRIBUTES

- Farmers appreciate its palatability, although available literature indicates that the feeding value and palatability are low. It is grazed during the rainy season and when it regrows after burning.
- Used in erosion control.
- Used in making brooms, hats and baskets.

MAIN DEFICIENCIES

- Difficult to eradicate once established.
- Low feeding value and poor palatability.
- Smothers most desirable species.

MANAGEMENT AND USE

An increaser. The grass should be burnt early to get regrowth. Late burning in November clears the top hamper and clears the way for early growth. Grazed only in situ.



Sporobolus pyramidalis

Urochloa mosambicensis

TONGA: haankanda; **WE:** mpunga, simunsenene

An annual to weak perennial, stoloniferous and tufted, grows to 1 m in height. **HABITAT:** Occurs around homes, in fallow fields and along roads in all catchment areas. Dominant throughout the valley; also in Choma, around the Mboole area and Mazabuka. **FLOWERING TIME:** From November to May. **ESTABLISHMENT:** By seed and stolon cuttings.

MAIN ATTRIBUTES

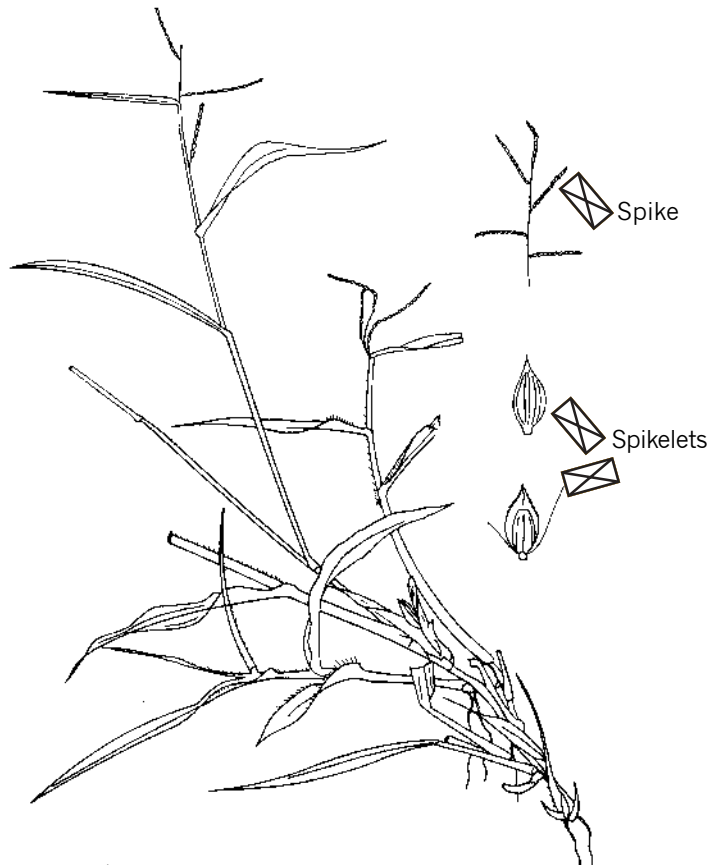
- Provides good early grazing in the rainy season.
- Can easily be cut as hay and stored for dry-season feeding.
- Seeds are used as cereals during hunger time, especially in February, commonly in Gwembe Valley.
- Is highly productive.

MAIN DEFICIENCIES

- Matures early and dries up quickly, by March or April.
- Is valuable as feed only for a very short period, early in the rainy season. Thereafter the feed value is reduced.

MANAGEMENT AND USE

An increaser. Grass can be harvested for hay and stored for dry-season feeding. In low-rainfall areas like Gwembe and Livingstone Districts, the grass can be cut by January or February before it matures, thus reducing damage from termites. It can also be fed in situ where protection is provided, especially from fire.



Urochloa mosambicensis

9 Improved grass and legume species

Cenchrus ciliaris

ENGLISH: African foxtail, buffel grass

A perennial, widely variable in growth habit. It has a large rhizomatous root, grows to about 1.2 m in height; a short variety is about 0.9 m at flowering. **HABITAT:** Buffel grass is adaptable in its soil requirements but prefers light-textured neutral to alkaline soils. Grows well in regions with 300–800 mm annual rainfall. **ESTABLISHMENT:** Establishes from seed, which can be either drilled at 1.1 to 2.2 kg/ha or broadcast at 2.2 to 3.4 kg/ha at a depth of 1.2 cm. Mix the seed with sand or sawdust to help broadcast it more evenly.

MAIN ATTRIBUTES

- Is drought resistant.
- Withstands heavy grazing.
- Is good animal feed.
- Is suitable for permanent pastures in drier areas.

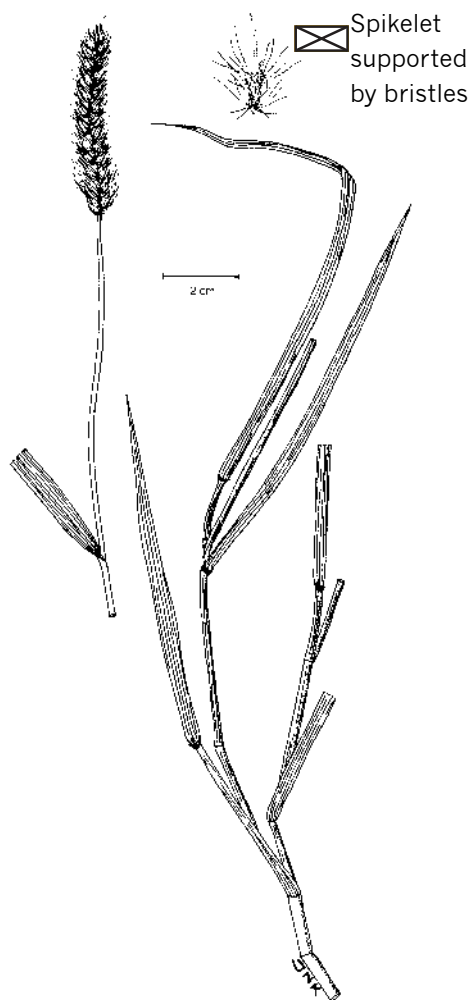
MAIN DEFICIENCIES

- Difficult to eradicate once established.

MANAGEMENT AND USE

Responds well to nitrogen fertilizer, and once established it withstands heavy grazing. Seed is harvested by hand-stripping the crop several times in the season. Should not be sown in leys, because it is difficult to eradicate.

If grazing is controlled, feeding can be in situ, or the grass can be cut for hay.



Cenchrus ciliaris

Chloris gayana

ENGLISH: Rhodes grass

A stoloniferous perennial; grows to a height of 0.9–1.2 m. Vigorous, spreads by stolons.

HABITAT: Rhodes grass is indigenous to southern Africa. It is adapted to a wide range of soils and climates, responding well to areas receiving more than 750 mm rainfall annually; does well on heavier soils and those with improved fertility. **ESTABLISHMENT:** Establishes by seed, rooted and unrooted cuttings. The germination of freshly harvested Rhodes grass seed is low, and storage of seed for at least 8 months improves the germination rate. Can be established by broadcasting the seed at the rate of 2–7 kg/ha. Can also be sown under maize at its first weeding.

MAIN ATTRIBUTES

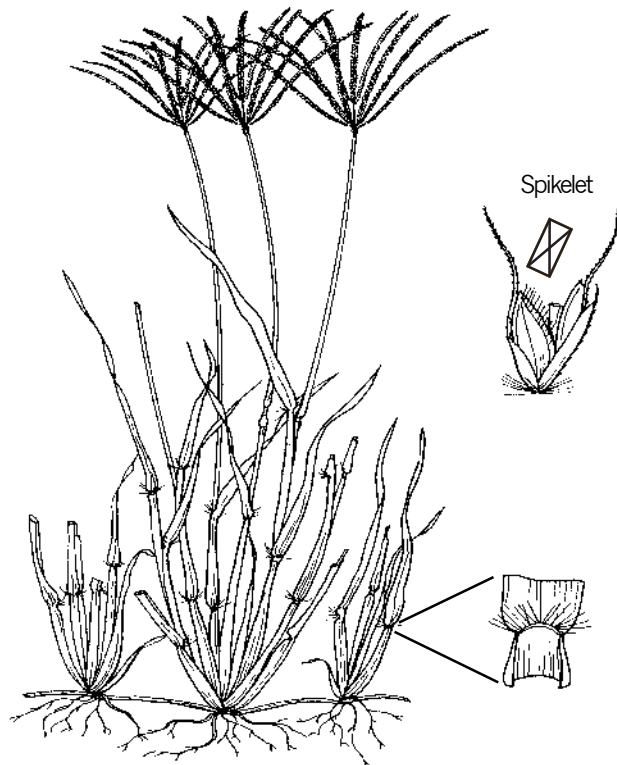
- Produces much biomass.
- Can easily be sown under maize.
- Is highly palatable when young.
- Some varieties, like Kattombora, are resistant to nematodes.

MAIN DEFICIENCIES

- The stems of the established grass can become hard and unpalatable, especially if the grass is not grazed.

MANAGEMENT AND USE

Rhodes grass is used for grazing, hay or sometimes silage. Under ideal conditions, Rhodes grass can be grazed as early as 6 weeks after it is established, but in principle it should be grazed lightly during the first year of establishment. Where it overgrows, slashing and heavy grazing are recommended.



Chloris gayana

Leucaena leucocephala

COMMON NAME: leucaena

A small tree with a deep root system. Roots can reach 2 m in 1 year and 5 m in 5 years. The pods are thin and flat. **HABITAT:** Found throughout the tropics of Africa, it has become naturalized in most African countries. It tolerates a wide range of pH soils from acid to alkaline (pH 5.0 to 8.0). **ESTABLISHMENT:** Does not do well in cold climates, is slow in early growth stages. Requires no land preparation. Established from seed, drilled about 1 m in rows at 2.5 to 5.0 cm deep, at a rate of 2 to 10 kg/ha. Physical treatment with hot water may be required to break the dormancy.

MAIN ATTRIBUTES

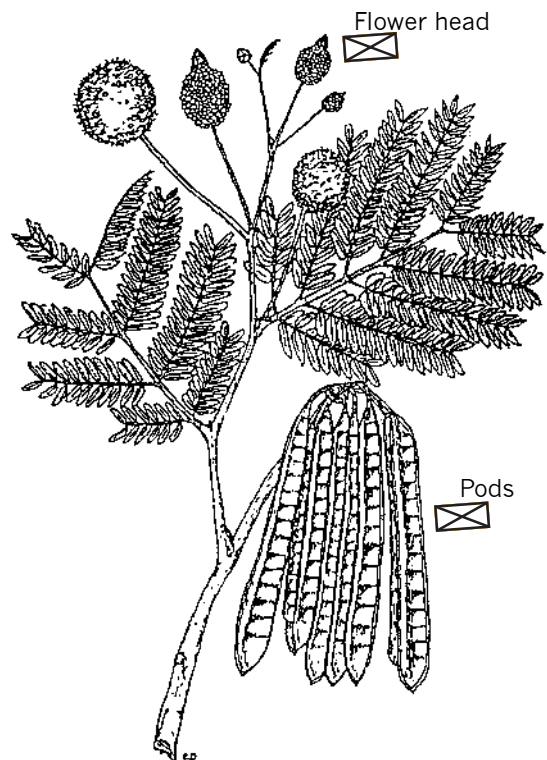
- Tolerates high levels of aluminium and low levels of iron.
- Grows vigorously in the wet season and produces a large volume of foliage.
- Has high nitrogen-fixing ability.
- Withstands high levels of defoliation.
- Used for hedges.

MAIN DEFICIENCIES

- Toxic to animals if overfed because the leaves and seeds contain the amino acid mimosine, at a concentration of 10% in the growing points.
- Cattle browsing on leucaena for a long time develop a yellow-coloured fat.
- This species is badly infested by leucaena psyllid (*Heteropsylla cubana*), a new pest.

MANAGEMENT AND USE

The plant should be browsed lightly in the first year and thereafter can be browsed frequently. Care should be taken to ration browsing to prevent feeding animals from suffering unduly from toxicity. Can be cut and preserved as hay or silage, especially if mixed with grasses like elephant grass (*Pennisetum purpureum*). Leucaena is best used as a feed supplement rather than a sole feed. Research on the psyllid pest problem has produced resistant species such as *Leucaena diversifolia*.



Leucaena leucocephala

Macroptilium atropurpureum

COMMON NAME: siratro

A deep-rooted perennial with trailing stems that can climb to a height of 2.5 m in tall grass. Stems also root at the nodes. Main growth is during the wet season but plant also remains green in the dry season if the weather is favourable. **HABITAT:** Siratro is adapted to a wide range of soils and climatic conditions. It is non-specific in its rhizobium requirements. **ESTABLISHMENT:** Established from seed. Drilled at 1 to 3 kg/ha or broadcast at 3.5 kg/ha. Does well when it is oversown on burnt pasture. Its seeds are very hard and should be scarified mechanically when possible to improve germination.

MAIN ATTRIBUTES

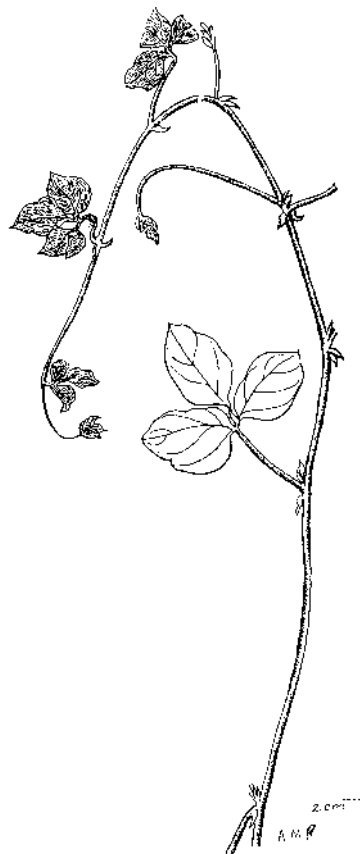
- Is highly resistant to drought.
- Tolerates waterlogging.
- Is resistant to root-knot nematode.
- Is very palatable as animal feed.
- Withstands heavy grazing once it is established.

MAIN DEFICIENCIES

- Is susceptible to frost.
- Is susceptible to web blight (*Rhizoctonia solani*), which causes heavy leaf loss.
- Ripe pods shatter easily.

MANAGEMENT AND USE

Siratro is good for mixed leys, such as in combination with Rhodes grass (*Chloris gayana*) and silver leaf desmodium (*Desmodium uncinatum*). Once established, it withstands heavy grazing and can provide valuable feed at the end of the rainy season. Because the ripe pods shatter easily, it is necessary to harvest the seed twice a week during the ripening period. Shelling is easy once the pods have been collected. Animals can either be fed the hay or graze in situ if grazing is controlled.



Macroptilium atropurpureum

Macrotyloma axillare

COMMON NAMES: axillaris, Archer dolichos

Deep-rooted, twining and short-lived perennial. It retains green leaf well into the dry season. Combines well with tall grasses, particularly *Hyparrhenia* and Napier grass (*Pennisetum purpureum*). **HABITAT:** Does well in areas receiving more than 1000 mm rainfall but is also tolerant of poor conditions. Is sensitive to waterlogging. **ESTABLISHMENT:** Established by seed, best drilled to 1.2 cm depth at a rate of 2.2 to 3.4 kg/ha. Can be established under maize together with Napier grass by sowing along the ridges at the time the maize is planted.

MAIN ATTRIBUTES

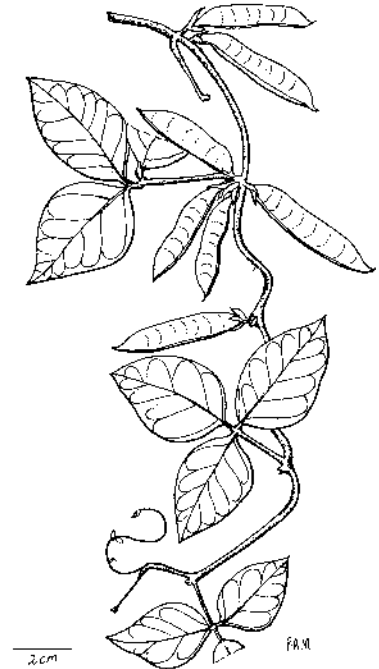
- Competes well with grasses.
- Is very palatable.
- Seeds prolifically.

MAIN DEFICIENCIES

- Aphids and virus diseases attack it.
- Does not persist with frequent defoliation.

MANAGEMENT AND USE

Flowers from July through to the end of the dry season. Seed is collected by plucking the individual pods. Harvesting must be carried out weekly to avoid seed loss because of shattering. The harvested pods are spread out to dry and shatter in the sun, then threshed. The herbage can be used as hay or cut-and-carry fodder, or it can be grazed in situ where animals are controlled.



Macrotyloma axillare

Pennisetum purpureum

ENGLISH: Napier grass, elephant grass; **TONGA:** bukuba, mantebya, matebe

Originates in tropical Africa. Tall, thick-stemmed perennial, can grow to a height of 4.5 m if left ungrazed. It is known as one of the world's most productive grasses. **HABITAT:** Grows wild in Zambia, mainly along waterways. Prefers, warm, moist conditions. It grows well in high rainfall areas but can also thrive in drier areas if planted on dambo margins. It responds well to improved soil fertility. **ESTABLISHMENT:** It is established from stem cuttings (setts) or rhizome splits (underground stems), because it produces few viable seeds. With good nutrient management, Napier grass can be established successfully under a crop of maize without significantly reducing the yield of either maize crop or stover.

MAIN ATTRIBUTES

- Is drought resistant.
- Is highly productive.
- Tolerates a wide range of soil types.
- Used in soil reclamation.

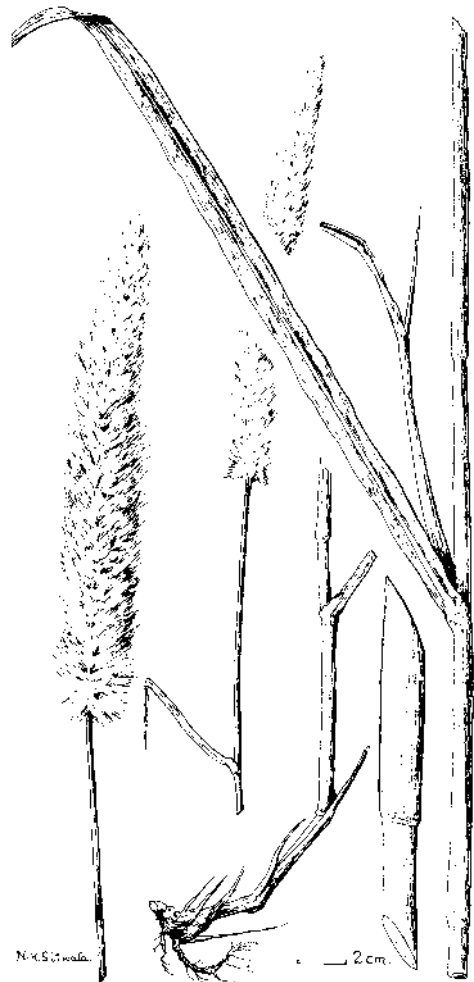
MAIN DEFICIENCIES

- Is susceptible to frost.
- Produces little viable seed.
- Is susceptible to nematodes.

MANAGEMENT AND USE

Napier grass should not be allowed to grow to a height of more than 1.5 m before it is harvested. Taller plants have too much stem and are unpalatable, resulting in a high proportion of waste.

At harvest the stems are cut back to a height of 15 cm. Responds well to nitrogen fertilizer. This is the grass usually used in zero-grazing programmes as cut-and-carry fodder, especially by small-scale dairy farmers, or it is grazed in situ where the height of the grass has been controlled to less than 1 m. Should not be included in a tobacco rotation because of its susceptibility to nematodes.



Pennisetum purpureum

Stylosanthes guianensis

COMMON NAME: stylo

A deep-rooted perennial that grows to a height of about 0.9 m and retains its green leaves long into the dry season. Different *Stylosanthes* species respond to soil and climatic conditions differently. **HABITAT:** Stylo grows well in a wide range of soil types and conditions. It absorbs phosphorus from the soil and grows well in acid soils. **ESTABLISHMENT:** Established from seed drilled at 2 to 4 kg/ha or broadcast at 4.5 kg/ha. Applying single superphosphate at the rate of 100 to 200 kg/ha has a marked effect on the establishment and early growth. Combines well with short grasses and withstands heavy grazing once established.

MAIN ATTRIBUTES

- Suited for oversowing on natural pastures, such as on dambo margins and grasslands.
- Tolerates waterlogging.
- Used for improving natural pastures.

MAIN DEFICIENCIES

- Mature ungrazed stylo is susceptible to termite attack.
- Does not stand up to vigorous grass competition on fertile soils.

MANAGEMENT AND USE

On old cultivated land, weed competition is usually a serious problem. Hand weeding during the first year is essential. Established stylo should not be burnt to avoid damaging the crown. Stylo can readily be used for wet season grazing or made into hay to be used during the dry season. The pods mature unevenly and seed is harvested by hand from plants grown in pure stand. The harvested seed is allowed to dry before threshing.



Stylosanthes guianensis

10 Fodder trees and shrubs

Brachystegia boehmii

TONGA: mubondo

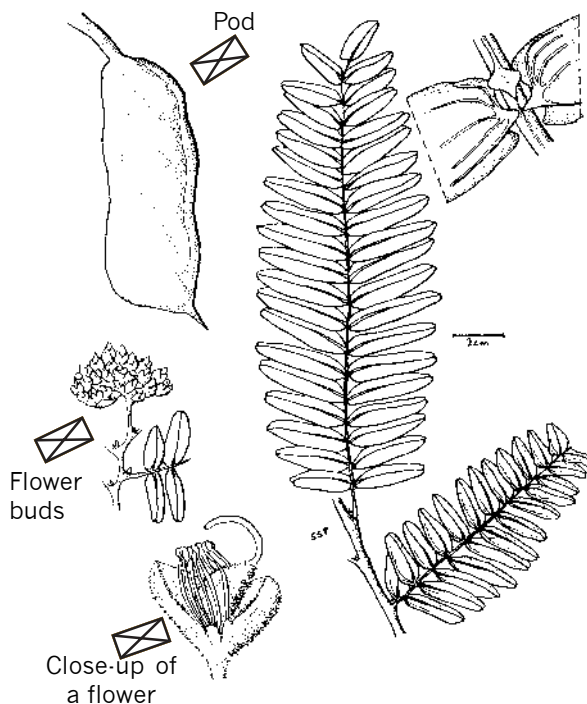
A medium-sized semi-evergreen tree growing to 18 m in height. **HABITAT:** Common in open deciduous woodlands and frequently dominant locally, especially on poorly drained soils on the plateau and the Zambezi escarpment of Southern Province. **BARK:** Varies from brown to grey-black; rough and scaly. **FLOWER:** Short, compact, branched heads with sweetly scented smell; blooms September to December. **FRUIT:** Normally a large brown pod, maturing May to July, to 15 cm long. Contains tannin, used for tanning hides.

MAIN ATTRIBUTES

- Serves as animal feed, with tender leaves in the dry season.
- Durable fibre is used for making baskets, fish traps and mats.
- Widely used for fuel, both wood and charcoal.

MANAGEMENT

Managed by lopping and coppicing.



Brachystegia boehmii

Brachystegia spiciformis

TONGA: musewe

A medium to large semi-evergreen tree growing 8 to 15 m high but can grow to 30 m in favourable conditions. The branches are heavy, growing upwards and outwards, often twisting and curving, giving the tree a beautiful shape and balance. **HABITAT:** The most widespread tree over large areas of range. Occurs in open, deciduous woodland and tolerates a wide range of soil types. Most common in the Kalahari sands of Livingstone and the plateau areas. **BARK:** Pale grey and smooth when young, later becoming rough and dark grey. Contains 13% tannin, used for tanning hides. **FLOWER:** Small and sweetly scented, blooming August to November. **FRUIT:** A large woody pod, dark and smooth when mature, May to August. Usually splits explosively. **ESTABLISHMENT:** By seed.

MAIN ATTRIBUTES

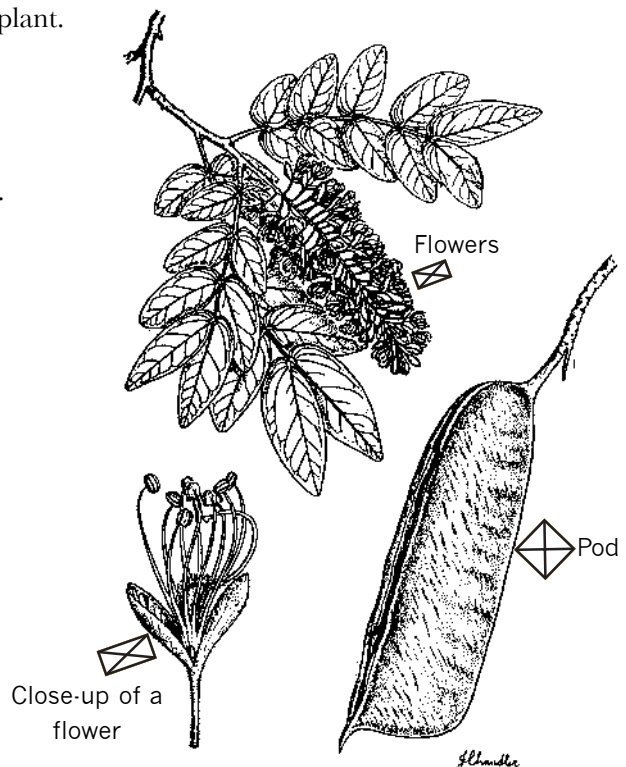
- Tree is cultivated for the shade it provides.
- Young leaves provide animal feed.
- Tannin from the bark is used in tanning hides.
- Is widely used for fuel, both wood and charcoal.

MAIN DEFICIENCIES

- Seedlings are difficult to transplant.
- Trees grow slowly.
- Timber is inferior.

MANAGEMENT

Managed by lopping and coppicing.



Brachystegia spiciformis

Burkea africana

LOZI: mubulwebulwe; **TONGA:** museshe

A medium-sized tree 8 to 10 m in height. Young branches are covered with rusty hairs. Discharges a red or yellow gum when damaged. **HABITAT:** Occurs in various types of woodlands and over a wide range of altitudes. Common in hot, low-lying areas of Southern Province, such as sandy dambo margins and lower slopes of rocky hills of the escarpment. **BARK:** Dark grey and rough. **FLOWER:** Creamy white, producing long, graceful, pendulous spikes, September to November. **FRUIT:** Usually a thin, flat pod, maturing February to July. **ESTABLISHMENT:** By seedlings and wildings. Soak seed in hot water for 2 minutes and allow to cool.

MAIN ATTRIBUTES

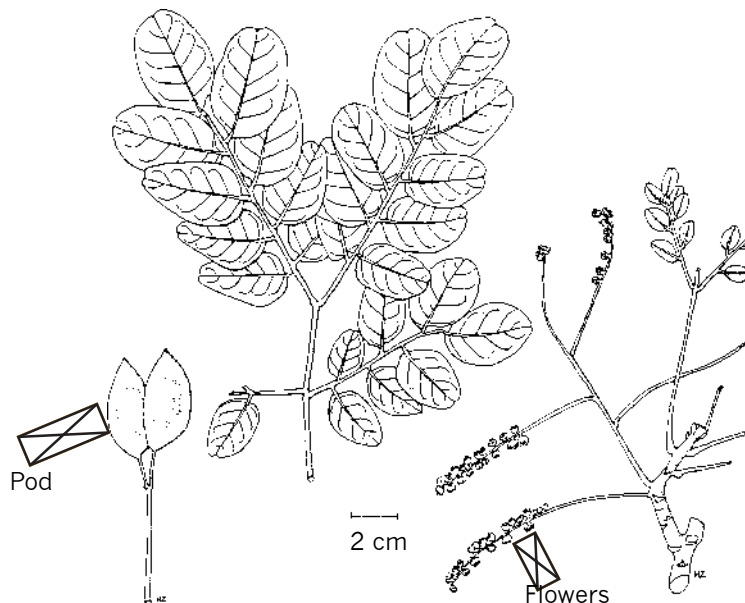
- Wood is hard and tough.
- Young leaves are used as fodder.
- Tannin is used for tanning hides.

MAIN DEFICIENCY

- Unripe pods are pois-onous and can affect animals.

MANAGEMENT

Pruning and lopping.



Burkea africana

Combretum molle

TONGA: mubinda

A small tree 5 to 7 m tall; thin trunk, often crooked or leaning, with heavy branches.

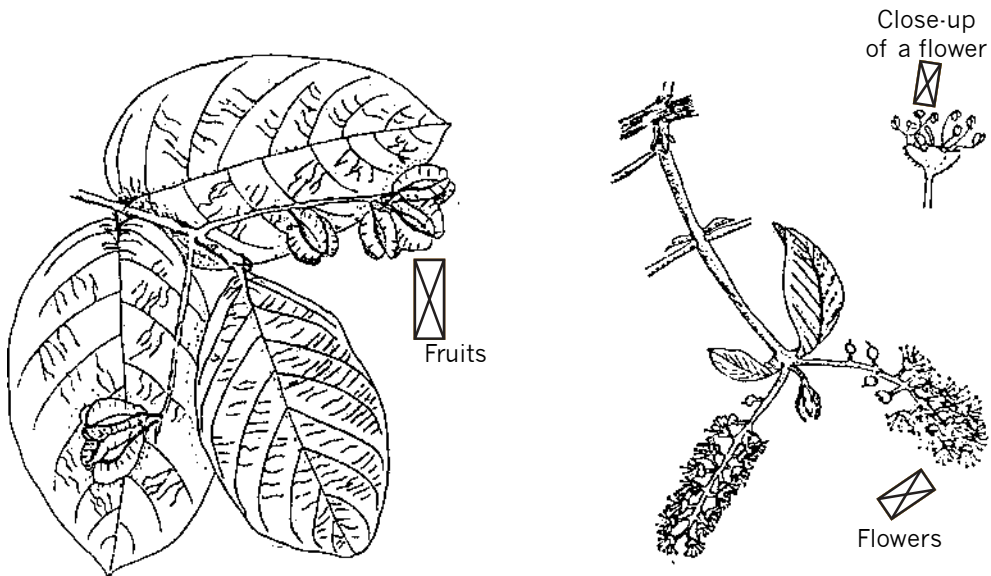
HABITAT: Found in most parts of the province, especially in the munga, miombo and Kalahari woodlands. **ESTABLISHMENT:** By seedlings and root suckers.

MAIN ATTRIBUTES

- The tree grows fast.
- Serves as animal feed.

MANAGEMENT AND USE

Coppicing or pollarding to stimulate new leaves. Provides fodder for cattle; only the young leaves are browsed.



Combretum molle

Faidherbia albida

(formerly *Acacia albida*)

TONGA: musangu

A large tree about 30 m tall with grey-brown bark, cracked when old. Has thorns with pairs of spines about 2 cm long. Loses leaves in the rainy season. **HABITAT:** Found in all of Southern Province, especially in lowland areas with a high water table. Common in the munga woodlands. **FLOWERING TIME:** May to June. The pods are ready July to September. **ESTABLISHMENT:** By seedlings and direct sowing.

MAIN ATTRIBUTE

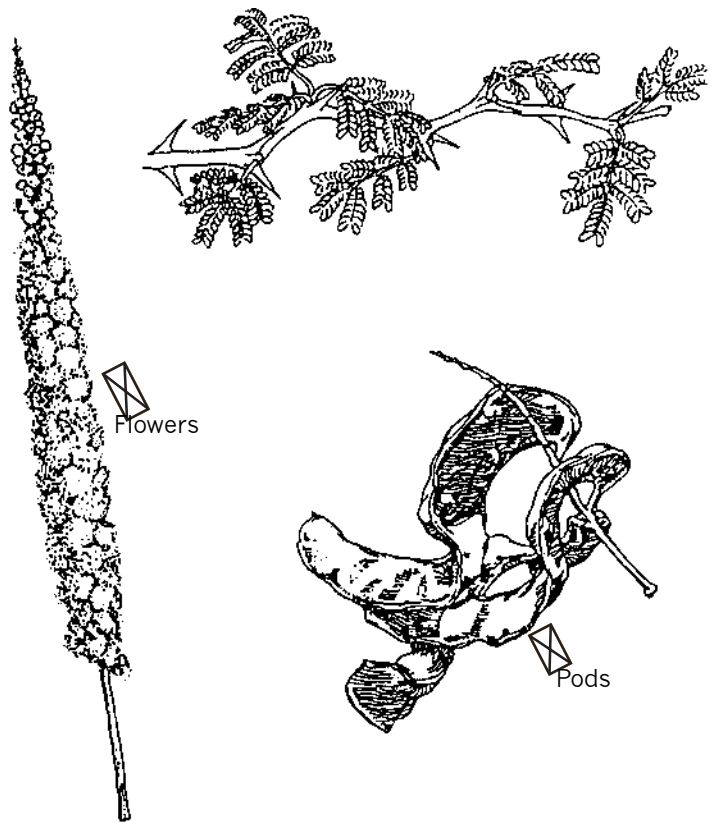
- Green leaves and ripe pods are available in the dry season.

MAIN DEFICIENCIES

- Unripe pods can be poisonous to cattle.
- Initial growth is slow.

MANAGEMENT AND USE

Tall trees may require lopping or pollarding. Fruits and pods are eaten by cattle and goats. Leaves are eaten during the dry season as long as they are green.



Faidherbia albida

Ficus sur

TONGA: mukuyu

A semi-deciduous tree about 20 m tall; branches spread to a large crown. **HABITAT:** A large tree found near rivers and drier parts of the province where the water table is high. Common in the valley of Southern Province. **BARK:** Grey, rather smooth; milky latex present. **FRUIT:** Produced in large, heavy, branched clusters directly from the trunk or large branches; fruits become red mottled with cream or pink when ripe, September to March. **ESTABLISHMENT:** By cuttings.

MAIN ATTRIBUTES

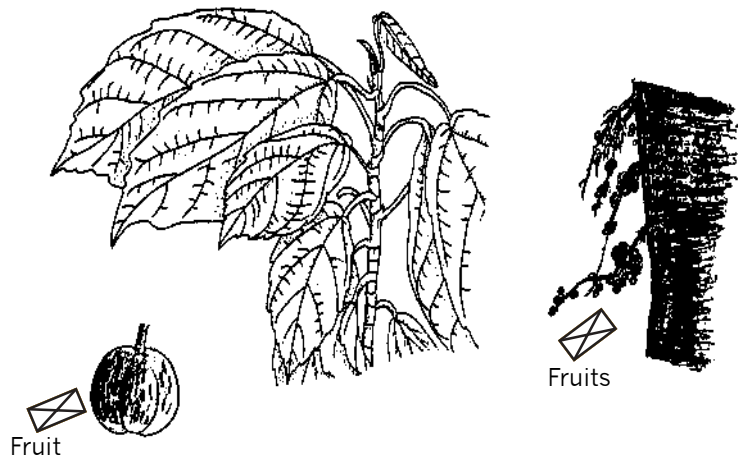
- Tree is fast growing.
- Fruits are eaten by humans, birds, monkeys and bats; fruits and leaves by cattle and goats.
- The fruits are used for jam and the wood for drums.
- Sticks are used to produce fire by friction.

MAIN DEFICIENCIES

- Seed is difficult to germinate.
- Surface roots are a nuisance in gardens.

MANAGEMENT

Pruning and lopping. Avoid fires, especially when the fruit is ripe.



Fruit

Ficus sur

Julbernardia globiflora

TONGA: muumba

A well-branched, deciduous, rounded tree, growing to 15 m in height. **HABITAT:** Occurs in mixed deciduous woodland. Codominant with *Brachystegia spiciformis*, it is ecologically important, growing over large areas of the escarpment and the Tonga plateau. **BARK:** Grey, smooth when young, becoming rough when mature. **FLOWER:** White with dark brown, velvety hairs, blooming January to May. **FRUIT:** Dark brown, velvety pod, splitting explosively when mature, beginning from May to July and through to November.

MAIN ATTRIBUTES

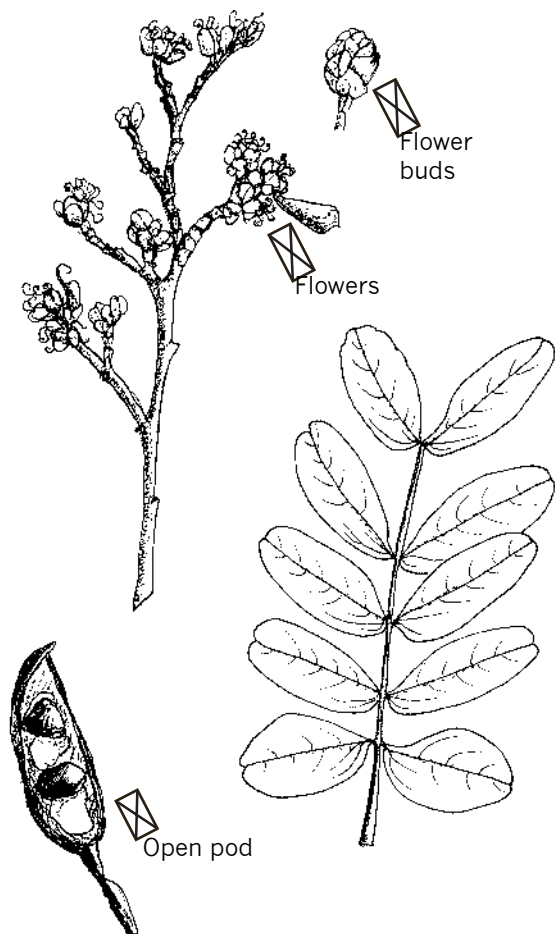
- Tender leaves are fodder for live-stock.
- Timber is used for canoes.

MAIN DEFICIENCIES

- The fibre it produces is poor.
- Timber is readily attacked by wood weevil.

MANAGEMENT

Managed by lopping, coppicing and pruning.



Julbernardia globiflora

Parinari curatellifolia

TONGA: mubula

An evergreen tree, to 15 m in height, with straight trunk, erect branches, and dense, rounded crown. **HABITAT:** Occurs in the Tonga plateau, especially Kalomo, Monze, Choma and the Kalahari sands of Livingstone. An indicator of a high water table. **ESTABLISHMENT:** By seedlings and root suckers.

MAIN ATTRIBUTES

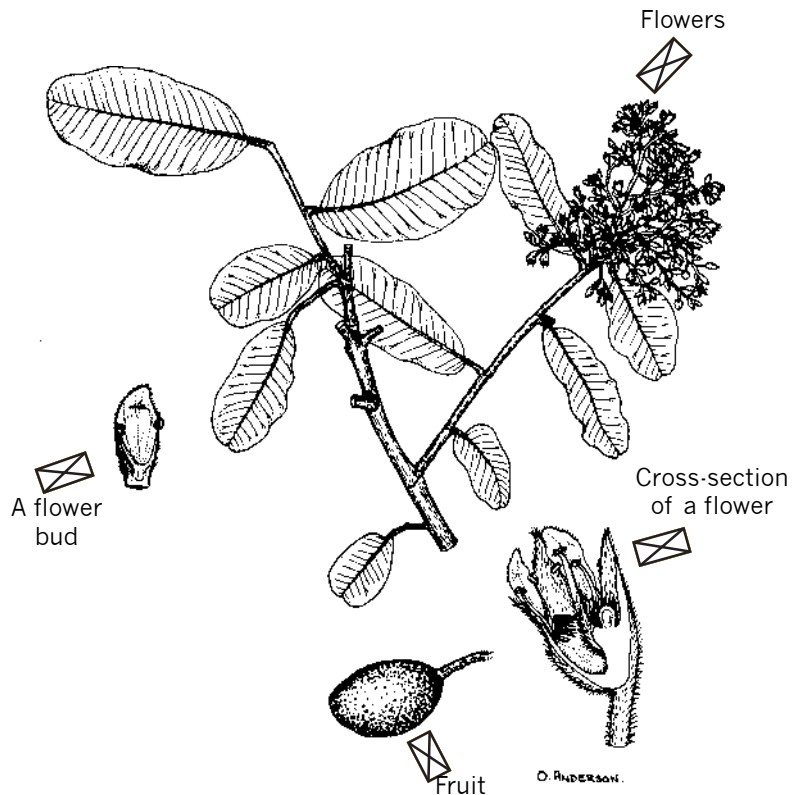
- Is fire resistant.
- Fruit is eaten by humans, cattle, bats and birds.

MAIN DEFICIENCIES

- The trees are scattered.
- Produces bad smell when flowering.

MANAGEMENT

Coppice to encourage new leaves. Avoid bush fires.
Avoid indiscriminate cutting.



Parinari curatellifolia

Piliostigma thonningii (*Bauhinia thonningii*)

ENGLISH: camel foot, monkey bread; **TONGA:** musekese

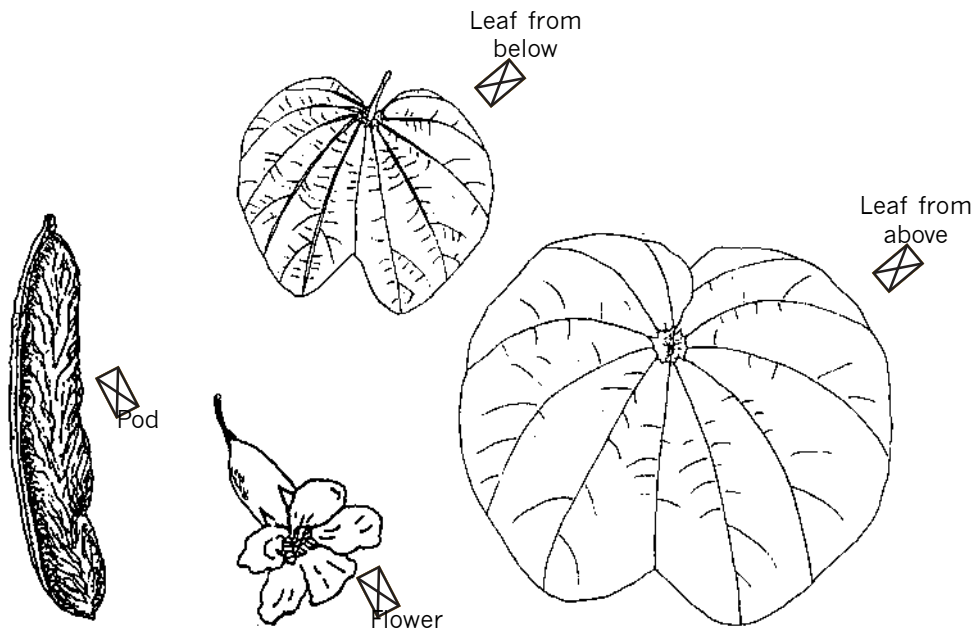
A semi-deciduous tree, usually 3 to 5 m in height, reaching 10 m under ideal conditions. Branches often twisted. **HABITAT:** A shrubby tree found in all parts of Southern Province, especially in wooded grasslands at medium to low altitudes. An indicator of high water levels. **BARK:** Dark brownish-grey and rough. **FLOWERING TIME:** December to February. **FRUIT:** A large pod, 22 x 7 cm, thick, woody, reddish-brown and tough, not splitting on reaching maturity but falling to the ground, maturing June to September. **ESTABLISHMENT:** By seedlings. **USE:** Pods can easily be collected and stored for use in the dry season. Sometimes they are pounded and given to selected cattle as a ration supplement.

MAIN ATTRIBUTES

- Pods and shoots are eaten by cattle; in Choma, pods are crushed and fed to pigs.
- Green fruits used as soap.
- Pods eaten by humans, especially children; can be ground into a meal during hunger times.
- Produces many seeds.
- Good germination rate.
- Resistant to termite attack.

MAIN DEFICIENCY

- Trees few and scattered.



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Appendix

Common names of fodder species

Grasses

Local name (Tonga unless specified)	Scientific name
bukuba	<i>Pennisetum purpureum</i>
busambo (Toka)	<i>Sporobolus pyramidatus</i>
busubwamanda	<i>Hypparrhenia</i> species
buungwa	<i>Sporobolus pyramidatus</i>
buyu	<i>Hypparrhenia</i> species
bwambo	<i>Dactyloctenium giganteum</i>
chalachankuku	<i>Dactyloctenium giganteum</i>
chibunze (Toka)	<i>Digitaria eriantha</i>
chihenene	<i>Panicum maximum</i>
chisina (We)	<i>Heteropogon contortus</i>
haankanda	<i>Urochloa mosambicensis</i>
hikabbuele	<i>Chloris mosambicensis</i>
ikaata	<i>Eleusine indica</i> subsp. <i>africana</i>
isangani	<i>Digitaria eriantha</i>
kaata	<i>Eleusine indica</i> subsp. <i>africana</i>
kafumbe	<i>Hypparrhenia hirta</i>
kalamba	<i>Leersia hexandra</i>
kansinde	<i>Setaria sphacelata</i>
kansonje	<i>Imperata cylindrica</i>
kanyambote	<i>Hypparrhenia hirta</i>
kanyambuli	<i>Hypparrhenia hirta</i>
kapinga	<i>Cynodon aethiopicus</i>
kolokoto	<i>Tristachya nodiglumi</i>
lukata	<i>Eleusine indica</i>
lwanda (Toka)	<i>Cynodon dactylon</i>
mafulamvuvu (Toka)	<i>Brachiaria brizantha</i>
makata (Toka)	<i>Eleusine indica</i> subsp. <i>africana</i>
mantebya	<i>Pennisetum purpureum</i>
manyengele	<i>Hypparrhenia</i> species
masanga	<i>Hypparrhenia filipendula</i>
matebe	<i>Pennisetum purpureum</i>
matengenyā	<i>Hypparrhenia filipendula</i>
matete	<i>Phragmites mauritianus</i>
matumbo	<i>Miscanthus capensis</i>
mbombo	<i>Melinis repens</i>

mpolwe	<i>Tristachya nodiglumi</i>
mpunga (We)	<i>Urochloa mosambicensis</i>
mutaka (Toka)	<i>Echinochloa pyramidalis</i>
njonya	<i>Heteropogon contortus</i>
nsekwa	<i>Digitaria milanjiana</i>
nzete	<i>Sporobolus pyramidalis</i>
nzinza	<i>Cynodon aethiopicus</i> , <i>C. dactylon</i>
nsangazi	<i>Digitaria eriantha</i>
nsekwa	<i>Digitaria milanjiana</i>
sangazi (also We)	<i>Digitaria eriantha</i>
simunsenene (We)	<i>Urochloa mosambicensis</i>
sonko (Toka)	<i>Dactyloctenium giganteum</i>

Trees and shrubs

Local name	Scientific name
katenge	<i>Dicrostachys cinera</i>
mopane	<i>Colophospermum mopane</i>
mubinda	<i>Combretum molle</i>
mubondo	<i>Brachystegia boehmii</i>
mububu	<i>Adansonia digitata</i>
mubula	<i>Parinari capensis</i> , <i>P. curatellifolia</i>
mubulwebulwe (Lozi)	<i>Burkea africana</i>
mukuyu	<i>Ficus sur</i>
mulundu	<i>Swartzia madagascariensis</i>
muminambebele	<i>Combretum mossambicensis</i>
mupondwe	<i>Bauhinia petersiana</i>
musangu	<i>Faidherbia albida</i>
musau	<i>Ziziphus mauritiana</i>
musekese	<i>Piliostigma thonningi</i>
mushakashela (Toka)	<i>Swartzia madagascariensis</i>
museshe	<i>Burkea africana</i>
musewe	<i>Brachystegia spiciformis</i>
mutowa	<i>Diplorhynchus condylocarpon</i>
muumba	<i>Fulbernardia globiflora</i>

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The Swedish International Development Cooperation Agency (Sida) has supported rural development programmes in eastern Africa since the 1960s. Through its Regional Land Management Unit (RELMA), Sida promotes initiatives to increase agricultural production in order to enhance food security and reduce poverty.

RELMA, the successor of the Regional Soil Conservation Unit (RSCU), is based in Nairobi and operates mainly in six eastern and southern African countries: Eritrea, Ethiopia, Kenya, Tanzania, Uganda and Zambia. RELMA's goal in the region is to improve livelihoods of small-scale land users and enhance food security for all households. In pursuit of this goal, RELMA promotes environmentally sustainable, socially and economically viable farming and marketing systems, and supports policies that favour small-scale land users.

RELMA organizes, on a regional level, training courses, workshops and study tours. It also gives technical advice, facilitates exchange of expertise and produces information materials for the dissemination of new knowledge, techniques and approaches. A variety of reports, handbooks, posters and other information materials are published and distributed in the region on a non-profit basis.

About this book

Traditional livestock production in Zambia is characterized by free-range grazing on communal lands, sometimes with a damaging effect on the environment. With improved grazing practices, both livestock performance and condition of the land can be improved.

Management of rangelands describes the different vegetation types of the rangelands in Southern Province of Zambia, and what potential there is for improving the natural grasses. The manual suggests management practices to improve the natural rangelands as well as techniques to establish improved pasture. It contains descriptions of the most valuable species of natural and improved grasses and legumes, and trees and shrubs, suitable for livestock.

The book will be of use for extension agents and development workers in Zambia and other areas with similar climate and vegetation types.

ISBN 9966-896-61-9



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