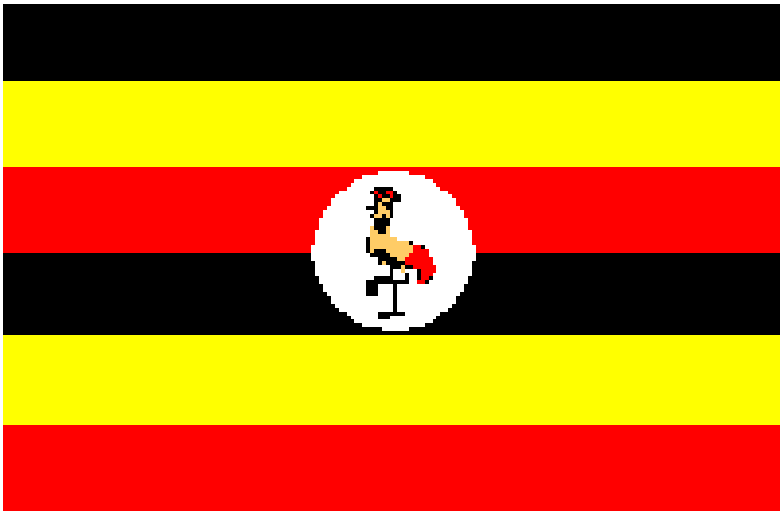
Country Pasture/Forage Resource Profiles

UGANDA



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1. INTRODUCTION

Uganda lies astride the Equator, between latitudes 4° 12′ N and 1° 29′ S and longitudes 29° 34′ W, and 35° 0′ E. Temperatures are in the range of 15°–30 °C. More than two-thirds of the country is a plateau, lying between 1 000–2 500 metres above sea level. Precipitation is fairly reliable, varying from 750 mm in Karamoja in the Northeast to 1 500 mm in the high rainfall areas on the shores of Lake Victoria, in the highlands around Mt. Elgon in the east, the Ruwenzori mountains in the south-west and some parts of Masindi and Gulu.

Uganda has a total land area of 241 548 km², and is administratively divided into 39 districts (Figure 1). Lakes, swamps and Protected Areas constitute 25%. More than 75% of the country (over 18 million hectares) is available for both cultivation and pasture (Table 1). Pastures and grazing land are estimated at over 16 million ha, half of which (8.4 million ha) is extensive grazing. Improved pastures are estimated to comprise only 1.8 million ha. This land resource, together with the bodies of water, are the base upon which most of the 20 million Ugandans (1997 census estimates) and their livestock depend for their livelihood (according to the World Factbook the July 2006 population was estimated at 28 195 754 with a growth rate of 3.37%). The capacity of this land resource to sustain the rapidly increasing populations largely depends on the influence of edaphic (relief and soil fertility), climatic and biotic factors and how well they can be managed to increase and sustain its productivity.

Figure 1. Map of Uganda

Figure 2. Map of Districts in Uganda

The country can be conveniently divided into seven broad agroecological zones which have similar economic and social backgrounds, and in which ecological conditions (soil types, topography, rainfall), farming systems and practices are fairly homogeneous. These are often further split into sub-zones usually identified by such factors as similar crop combinations, size of holdings, average plot sizes and yields. Based on these divisions, defined mapping units are often worked out, together with outlines of potential for use, as a basis for zoning and stratification for production.

Table 1. Current and potential grazing areas of Uganda

Land classification	km²	Percentage
Grassland	51 118.6	21.16
Farmland	83 931.0	34.75
Woodland	40 277.7	16.67
Bush	14 198.6	5.88
Total potential grazing land	189 525.9	78.46
Total land area	241 548.0	100

Source: Statistical Abstracts, MFP&ED, June 1997

Agriculture is the backbone of Uganda's economy; 95% of the population farms (both crops and livestock) on small farms for food and cash income, and on fairly large, farms including ranches, of an average size of 1 200 ha and crop farms (5–20 ha). Agriculture contributes over 40% to the Gross Domestic Product (GDP) and over 90% to the country's foreign exchange earnings. It also contributes over 60% of total Government revenue in addition to employing more than 80% of the total labour force and providing over half of the total income for the bottom three-quarters of the population (MFP&ED, 1996).

The major livestock species in Uganda include cattle, sheep, goats, pigs, rabbits and poultry. Livestock production is an important sub-sector of agriculture contributing about 7.5% to total GDP or 17% to AGDP. It is estimated that mixed farming small holders and pastoralists own over 90% of the cattle herd and all of the small ruminants and non-ruminant stock; they produce the bulk of domestic milk and slaughter animals. From an economic point of view, cattle are the most important livestock with significant contributions, though to a lesser extent, from goats and sheep (see meat production data in Table 3). Pig and chicken meat production are also important.

Table 2. Livestock numbers: 1992–2001

Year	Cattle ´000	Sheep ´000	Goats ´000	Pigs ´000	Poultry ´000
1991	5 121	820	4 950	1 210	20 020
1992	5 209	845	5 070	1 228	20 576
1993	5 370	871	5 227	1 266	21 214
1994	5 106	897	5 383	1 304	21 404
1995	5 233	924	5 545	1 343	21 832
1996	5 301	951	5 684	1 383	22 050
1997	5 460	980	5 826	1 425	22 271

Source: Statistical Abstracts; MFP&ED, June 1997.

Official statistics (MFP&ED, 1996) put the ruminant livestock population at 5.46 million cattle, 5.83 million goats and 980 000 sheep in 1997 (Table 2) while by 2004 numbers had increased to: cattle 6.1 M, goats 7.7 M and sheep 1.6 M (see Table 3). FAO figures (see Table 3) are similar. Improved breeds are mostly kept under intensive management on small and medium sized farms under zero grazing. The indigenous breeds, on the other hand, are kept under extensive traditional methods. Livestock production has continued to grow in response to increasing demand for milk as new milk plants open up, and increased demand for meat in the local market. Eighty percent of the national cattle herd is in Southern and Western Uganda where the average number of cattle per household is 2.11 compared to Northern Uganda at 0.67 and the national average of 1.37. Uganda continues to import dairy products (see Table 3) and in 2003 milk equivalent imports were some 7 222 tonnes costing the country US$ 2 765 000.

The 1995 constitution of the Republic of Uganda recognises the following land tenure systems; Customary, Freehold, Mailo and Leasehold. The different systems have had different effects on land productivity. In communal grazing areas, since the individual does not have legal ownership of the land, they take very little responsibility for the damage caused by their activities. On private land, the traditional system of land inheritance has gradually resulted in land fragmentation.

2. SOILS AND TOPOGRAPHY

Table 3. Uganda statistics for livestock numbers, meat and milk production and milk imports for the period 1996–2005

Item	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Cattle nos. (,000,000)	5.3	5.5	5.7	5.8	6.0	6.1	6.3	6.6	6.1	6.1
Sheep nos. (,000,000)	1.0	1.0	1.0	1.0	1.1	1.2	1.1	1.6	1.6	1.2
Goat nos. (,000,000)	5.7	5.8	6.0	6.2	6.4	6.6	6.9	7.8	7.7	7.7
Pig nos. (,000,000)	1.4	1.4	1.5	1.5	6.4	6.6	1.7	1.2	1.3	1.3
Poultry nos. (,000,000)	22.1	22.3	22.3	22.6	27.0	29.7	32.6	23.0	24.0	33.0
Beef & veal prod. (,000 mt)	87.5	88.5	93.0	96.0	96.8	101.4	106	110	106	106
Sheep meat prod (,000 mt)	4.6	4.8	5.0	5.1	5.3	5.8	5.8	8.1	8.1	5.8
Goat meat prod. (,000 mt)	21.6	22.3	23.0	23.8	24.6	25.4	25.3	28.8	28.8	28.8
Pig meat production (,000 mt)	69.0	70.8	72.5	75.0	77.4	80.9	84	60	60	60
Chicken meat production (,000 mt)	36.4	36.1	36.0	37.2	44.1	48.8	53.6	37.7	37.7	37.7
Total milk prod. (,000 mt)	463.8	468.7	493.5	509.3	511.0	511.0	700	700	700	700*
Milk equivalent imports (,000 mt)	7.0	3.5	8.2	3.4	2.4	1.6	5.9	7.2	4.7	n.r.

Source: FAO Database 2006; n.r. = no record;
** cow milk fresh*

According to Parsons (1970), the soils of Uganda have been classified as:

- Soils of high productivity – 8% of the land area
- Soils of medium productivity – 14% of the land area
- Soils of fair productivity – 43% of the land area
- Soils of low productivity – 30% of the land area
- Soils of negligible productivity – 5% of the land area

The main soil types are 18 divided into seven groups based on their occurrence and agricultural productivity:

- The Uganda surfaces cover most areas south of Lake Yoga. This group embraces five types of deep, sandy clay loams with medium to high productivity.
- The Tanganyika surfaces cover most areas north of Lake Kyoga, West Nile and some parts of the South Western tip of Uganda, embracing five types of sandy clay loam with low to medium productivity.
- The Karamoja surfaces cover the North Eastern part of the country and embrace two soil types of sandy clay loams and black clays with very low productivity.
- Rift valley soils in the Western and Northern parts of the country, bordering on the Western Rift Valley, embracing two types of mainly sandy clay loams with alluvial parent rock of medium to high productivity.
- Volcanic soils are dominant in Mt. Elgon, Northern Karamoja, and the extreme South Western tip of Uganda (Kabale and Kisoro) with medium to high productivity except in N. Karamoja where their productivity is low.
- Alluvial soils are found outside the Rift Valley, mainly in Central Northern Uganda (Lango and Acholi) as well as West of Lake Victoria. The productivity of these sandy soils is very low.

The last group of soil types is in Northern Uganda and their productivity is low.

Based on topography, Uganda has been divided into four relief regions:-

- Above 2 000 m – 2% of the land area
- 1 500–2 000 m – 5% of the land area
- 900–1 500 m – 84% of the land area
- Below 900 m – 9% of the land area

3. CLIMATE AND AGRO-ECOLOGICAL ZONES

Uganda's temperatures show little variation throughout the year with maxima ranging between 25°–31 °C for most areas.

- Rainfall distribution has generally been categorised as:
- High: Over 1 750 mm per annum – 4% of the land area
- Moderate: 1 000–1 750 mm per annum 70% of the land area
- Low: Under 1 000 mm per annum 26% of the land area

Rainfall distribution in Southern Uganda is bimodal, allowing two crops annually, and adequate grazing for livestock throughout the year. Around Lake Victoria the annual rainfall averages 1 200–1 500 mm, and is well distributed. To the north, the two rainy seasons gradually merge into one. Dry periods at the end of the year become longer, with annual rainfall ranging between 900–1 300 mm, this restricts the range of crops that can be grown. These conditions are not suitable for bananas but favour extensive livestock production. The influence of soils,topography and climate on the farming systems (Figure 2) in Uganda has led to the dividing of the country into seven broad agroecological zones (see Table 4). These zones are based on soils, topography, rainfall and major crops grown:-

3.1 Banana-coffee system

In this system, rainfall is evenly distributed (1 000–1 500 mm) on soils of medium to high productivity. The areas cultivated per capita are small, under 1 ha. Banana and coffee are the main cash crops; root crops and several annual or biennial food crops are on the increase. Maize is a secondary cash crop and sweet potatoes a secondary food to bananas. Livestock is generally not integrated into the system, but dairy cattle are gaining prominence. The typical land holding is 2–4 ha. The vegetation is mainly forest-savanna mosaic with pastures suitable for intensive livestock production.

3.2 Banana-millet-cotton system

Rainfall for this system is less stable than for the banana-coffee system, so there is greater reliance on annual food crops (millet, sorghum and maize). In the drier areas, livestock is a main activity. The vegetation is moist *Combetrum*/*Terminalia*/*Butyrospermum* savanna with moderate biomass production.

3.3 Montane system

This is found at higher elevations between 1 500–1 750 m above sea level. The area receives high and effective rainfall and cloud cover. Banana is a major staple as well as sweet potatoes, cassava and Irish potatoes. Arabica coffee is prevalent at above 1 600 m. Some temperate crops like wheat and barley are grown. High population intensities and intensive agriculture are the norm because of small holdings of about 1.5 ha. Feeding crop residues to livestock is a common practice.

3.4 Teso system

The area receives bimodal rainfall on sandy-loams of medium to low fertility. The dry season is longer, from December to March. The vegetation association is moist *Combetrum/Butyrospermum* and grass savannas; short grassland that is ideal for grazing. The staple foods are millet, maize and sorghum; other crops are oil seed crops (groundnuts, simsim – *Sesamum indicum* – and sunflower) with cotton as the major cash crop. Mixed agriculture (crops and livestock) is practised, cultivation by oxen is the main agricultural technology. Livestock are kept extensively in those areas that are tsetse-fly free. The use of crop residues is very common in the Teso System. The average farm size is about 3 ha.

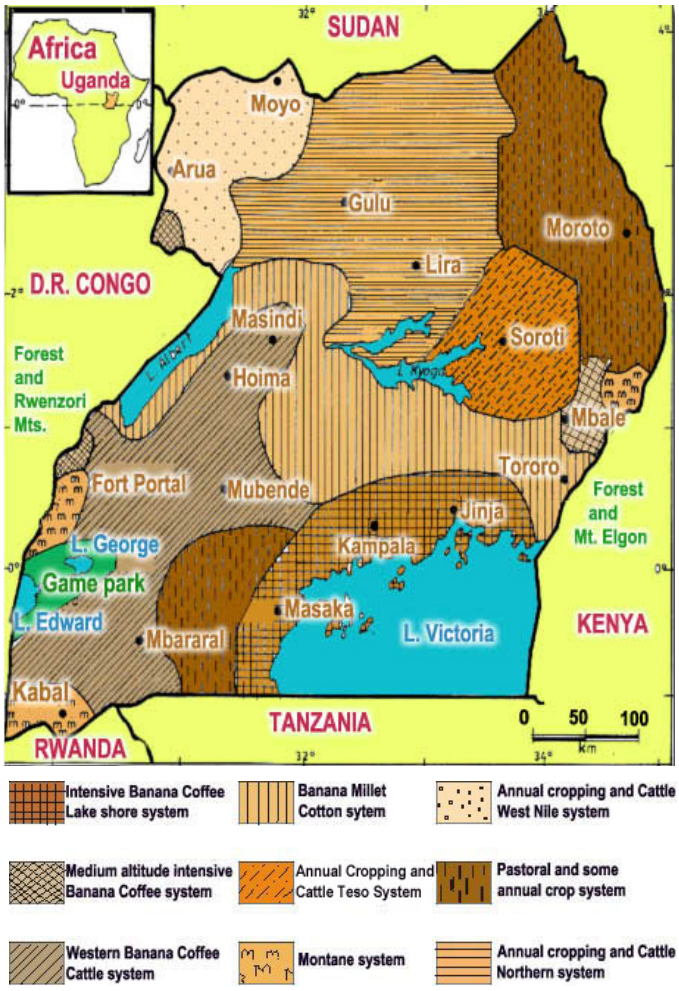

Figure 3. Agro-ecological zones

Table 4. Summary of agricultural systems of Uganda

Farming system	Districts
Banana/Coffee System	Bundibugyo, parts of Hoima, Kabarole, Mbarara, Bushenyi, Mubende, Luweero, Mukono, Masaka, Iganga, Jinja, Kalangala, Mpigi and Kampala
Banana/Millet/ Cotton System	Kamuli, Pallisa, Tororo, parts of Masindi and Luweero
Montane System	Kabale, Kisoro, parts of Rukungiri, Bushenyi, Kasese, Kabarole, Bundibugyo, Mbarara, Mbale and Kapchorwa
Teso systems	Soroti, Kumi, Kaberamaido
Northern System	Gulu, Lira, Apac, Kitgum
Pastoral System	Kotido, Moroto, parts of Mbarara, Ntungamo, Masaka, Ntungamo, Masaka and Rakai
West Nile System	Moyo, Arua and Nebbi

Source: Basic facts on agricultural activities in Uganda, MAAIF; 1995

3.5 Northern system

The rainfall in areas of this system is less pronouncedly bimodal with about 800 mm annually. Rainfall in the far north and north-east of the country (Kotido and Moroto) is unimodal and too low (under 800 mm) and erratic for satisfactory crop production. The dry season is so severe that drought tolerant annuals are cultivated; these include finger millet (*Eleusine coracana)*, simsim, cassava and sorghum. Tobacco and cotton are major cash crops. The grassland is short and communal grazing abounds. This area is well-known for its pastoral system with seminomadic cattle herding.

3.6 West Nile system

The rainfall pattern resembles that of the northern system, with more rain at higher altitudes. Mixed cropping is common with a wide variety of crops. The system is in the sub-humid zone where the vegetation community is moist *Butyrospermum*/*Combetrum*/*Terminalia* grassland. Livestock activities are limited by the presence of tsetse fly. As in the northern system, tobacco and cotton are major cash crops.

3.7 Pastoral system

This system covers some districts in the north-east; parts of Western and Central Districts. Annual rainfall is low (under 1 000 mm). The system is characterised by short grassland where pastoralism prevails with nomadic extensive grazing. Mixed herds are common but with no sound information on cattle:small ruminant ratios for optimum grassland use.

4. RUMINANT LIVESTOCK PRODUCTION SYSTEMS

Livestock are an integral part of agriculture in most of Uganda; production systems have evolved over time to suit the agroecological zones and the socio-economic setting. Mbuza (1991) identified two main types of system in Uganda, based on the extent of inputs and outputs. They are:

- The traditional system, with minimal inputs and correspondingly small outputs which depends on natural grazing and local breeds.
- Improved systems which have some investment such as fencing, pasture and grassland improvement, provision of water, breed upgrading and others.

The main livestock production systems have the following grazing methods:

i. Communal /pastoral system
ii. Tethering
iii. Enclosed ranching
vi. Fenced dairy farms
v. Zero grazing

4.1 Communal/pastoral system

This is prevalent in the South West of the country (Ntungamo, Mbarara, Bushenyi, Masaka, Sembabule and Rakai Districts), Luweero, Kibaale, Kibooga Districts in the Central areas and in the North and North East (Kotido, Moroto, Soroti and Kumi). Poulation density in these areas is low, with nomads who have no permanent homes, and transhumants who have permanent homes. Milk and meat are the main sources of livelihood for the graziers. Milk is exchanged or sold for food. There is no control over the feed resources and no opportunity for pasture improvement, hence the low productivity of the livestock. The graziers move with their, mostly mixed, herds of cattle, goats and sheep; their movements are dictated by weather as they search for fresh grazing and water.

Only indigenous breeds are kept. Indigenous livestock forms 98% of the national herd and feeds exclusively on natural pasture. The breeds are predominantly Ankole and local zebu cattle, the Small East African goat, Mubende and Kigezi goats which are adapted to low quality pastures and have good resistance to trypanosomiasis and tick-borne diseases. The cattle are poor milkers (300 litres per lactation), and very modest beef producers (mature at four years with a carcass weight of about 150 kg) (Mahadevan and Parsons, 1970). The level of commercial inputs is low to non-existent so the cost of production is relatively low. The opportunities for marketing surplus milk are also minimal so the surplus is churned to make ghee (clarified butter) for home use.

Under this system, the factors limiting production:

- chronic water scarcity and sparse population;
- the extensive pastures on the hilly, semi-mountainous plateaux are poorly conserved, eroded and overgrazed;
- land is owned and grazed in common, ways of caring for it have not yet evolved;
- the sparse vegetation has low quality grasses with many thickets and bushes;
- diseases are widespread, but drugs and veterinary services are expensive;
- breeds are genetically poor performers for meat and milk;
- reproductive wastage is high due to poor management and disease control;
- low literacy rate (less than 20%) of the farmers;
- lack of effective extension service penetration;

4.2 Agropastoral system

Agropastoralists are sedentary farmers who grow food crops both for subsistence and sale, while keeping some livestock which graze on communal land, fallows and on crop stubble after harvest. Livestock is used for draught, savings and milk. Shifting cultivation is common. Agropastoralists have little control over the feed resources, common grazing land and crop residues. Milk production fluctuates with seasonal availability of feed. Nowadays, with the increase in population and land pressure, this system often evolves into mixed farming.

The limiting factors of this system include:

- little control over grazing land, crop residues and other feed resources;
- partial penning at night, without bedding, leads to high mortalities and unthriftiness, particularly in the young;
- transmission of disease and uncontrolled mating;
- reduced grazing time due to competition for labour, between children and school and between adults for food growing;
- young stock not properly fed, resulting in poor growth and high mortalities.

4.3 Tethering system

This semi-intensive system, where livestock are restrained by a rope, is common in urban, peri-urban and intensively cultivated areas where herd size is small (1–5 animals). It is meant to protect crops and, at the same time, the farmer does not have to herd. Crop production is the farmers' main activity. Livestock feed within the limits of the rope; and will mostly be calm. As the number of animals increases, the next option for most farmers who tether is to get into the communal grazing system.

The factors limiting production are those mentioned above. But more specifically, under tethering:

- it is illegal to keep livestock in urban areas if existing laws were enforced;
- if animals are not properly tethered they will roam, leading to road accidents, disease and often, theft;
- small numbers of livestock using one, or a few, village males leads to in-breeding, reducing optimal growth and productivity;
- herd hygiene, veterinary care and provision of water are often neglected;
- unimproved breeds are not cost-effective.

4.4 Extensive system

Mixed herds (cattle, goats and sheep) are kept under this system, which includes pastoralism and ranching, and depends on natural resources (pasture and water).

The limiting factors include:

- losses of livestock through disease and predators;
- scarcity of water and veterinary attention and a weak extension service;
- negative genetic selection because good males are sold;
- ranch boundaries are often fenced with barbed wire which is expensive;
- appropriate species ratios for mixed herds are unknown;
- no fodder banks or preparation for drought;
- environmental degradation is a serious threat as nobody manages the natural resources.

4.5 Fenced dairy farming system

This is an intensive or semi-intensive system of dairy farming where farmers use part or all of their land to plant or improve pastures and grow fodder. They may also buy concentrates. Most are small farms with between 2 and 4 ha and keep 1–5 dairy cows, medium farms with 5–10 ha and 5–15 dairy animals and large scale dairy farms of over 10 ha and more than 20 animals. Milk is the main product, so mostly exotic and cross-bred animals are kept. Common breeds are Friesians, Guernseys, Jerseys and their crosses with the local zebu. Most of the small-scale farms depend on Artificial Insemination (AI) for breeding their cows; while medium and large-scale farms use bulls. A new concept is being popularised to improve dairy breeds; this is the village bull scheme for farmers living in areas without access to AI. Dairy animals are not used for draught This system is found in South Western Uganda, Central and South

Eastern parts of Uganda. The cattle are kept in fenced units because of their high susceptibility to tick-borne diseases and under-feeding. The production level depends on rainfall and soil fertility to produce enough fodder and grazing. Most farms are close to urban areas with easy access to markets. This system accounts for less than 5% of the national herd.

4.6 Zero-grazing system

This is on the increase in and around urban areas where land is scarce but there is a good market for milk and other livestock products (chicken, eggs, rabbit meat, etc.); it is not traditional and is intensive where the "cut and carry" stall feeding uses fodder crops (Elephant grass, Giant Setaria, Guatemala) and crop residues, and recycles manure. The livestock is continuously housed and owners have to establish fodder gardens to provide green forage. The main sources of feed are fodder, crop residues, domestic wastes, and agroindustrial by-products (brewery waste, maize, rice and wheat brans, oil seed cake). Most dairy farmers have 1–3 exotic or cross-bred cows; with a few exceptionally large-scale zero-grazing farmers with over ten. Dairy goats are also kept under zero-grazing. Women show a stronger preference for zero grazing than men.

In both the intensive systems, the limitations to production are:

- they are labour intensive; there is no appropriate machinery for cutting, carrying and chopping forage:
- forage occupies land so food crops are not grown
- high capital outlay compared to other systems
- lack of thorough knowledge of animal biology and management and undeveloped extension services;
- keeping of bulls is not as cost effective as A.I. if cows are few;
- use of low grade animals;
- high cost of supplementary feeds;
- weed problems on farms;
- difficulty of providing water.

4.7 Mixed farming systems

In Uganda it is common to combine crop and livestock production; the two enterprises are complementary. Crops are the main agricultural activity. The average farm size is small about 1–5 ha. Livestock are kept for draught, milk and/or meat for sale. Mixed farming is the commonest smallholder dairy system in the South-west, Central and South Eastern parts. Exotic and cross-bred dairy animals are kept; usually in fenced units, to facilitate control of tick borne diseases and for pasture management.

4.8 General factors that limit livestock productivity

- Over-grazing leading to bush encroachment and other obnoxious plants and soil erosion; these in turn reduces the available pasture and browse;
- Uganda has not yet a comprehensive land use policy to promote stratification according to resource potential and market opportunities. The land tenure system favours a few people and does not encourage development;
- Some farmers still keep livestock for important social events such as religious sacrifices, ceremonial feasting, payment of dowry and other social dues;
- Traditional and cultural beliefs do not favour women's ownership of resources, including livestock, yet they provide 70–80% of agricultural labour;
- The literacy level of most livestock farmers is low and this hinders the adoption of modern technology. According to Vanegas and Akwang (1992), an exception to this is dairy farmers who were found to have attained levels of education as follows: 29.7% (primary education), 33.1% (secondary education) and 32.2% (advanced education and above).
- Poor market outlets for milk due to a poor rural road network and poor rural electrification;
- Cost of production in the intensive systems is high but returns are low;
- Inadequate feeding in all systems due to shortage of quality and quantity of forage and fodder particularly during the dry season;
- Lack of access to high quality seed and vegetative planting material.

4.9 Government efforts in overcoming constraints to livestock productivity

Livestock is an important sub-sector of Ugandan agriculture and is an integral part of farming in many parts of the country. Ruminants produce the bulk of domestic milk and slaughter animals. Government development strategy aims to maximize the potential of the livestock sub-sector so as to achieve self-sufficiency in meat, milk, poultry and other livestock products. The key elements of the strategy include:

- Limiting public sector activities to those which the private sector cannot provide satisfactorily;
- Developing a resource allocation and external investment programme that matches country resources and management capabilities and avoids burdensome external loan obligations;
- Allowing free market prices to prevail, which would encourage the production to meet increasing consumer demand;
- Halting the decline in livestock numbers and rehabilitating the sub-sector to meet domestic demand while seeking opportunities for export;
- Increasing productivity in the mixed livestock-crop systems where most of the domestic livestock are;
- Improving research, training and extension to support development of livestock production;
- Rehabilitating and improving the marketing infrastructure to increase the efficiency of the processing and distribution;
- Providing an expanded source of production credit and investment incentives to increase animal inventories and related agribusiness investment.
- Establishing an efficient disease-control system based on cost recovery;
- Promoting and developing industrial linkages for livestock products;
- Encouraging the export of livestock and livestock products;
- Strengthening research on livestock breeding to upgrade the quality and productivity of herds.

5. PASTURE RESOURCES

As a result of the influence of soils, climate, topography and land development, Uganda has six major natural grassland communities which are associated with the farming systems and agroecological zones. The natural pastures of Uganda are fairly productive and contain many desirable grasses and browse plants. They are, therefore, a valuable natural resource, which if well managed can be very productive. The natural grasslands have little or no legume component leading to low dry matter yields and poor nutritive value for the greater part of the year. The present poor utilization and low productivity is largely attributed to lack of well articulated management guidelines for these grasslands. It is important to note that although some nutritional and yield studies have been done with some grasses and a few herbaceous legumes, mainly on experimental stations, little is known about their relative contribution to the overall feed value of the grasslands where they occur. Public and private efforts are geared towards improving natural pastures by removing weeds and oversowing with legumes. Farmers, particularly dairy farmers, are establishing grass/legume pastures but data on farmers who have done this is not yet available.

Indigenous grasses are, of course, well adapted to the prevailing growing conditions; they include: *Panicum maximum, Brachiaria ruziziensis, Chloris gayana, Hyparrhenia rufa, Pennisetum clandestinum, Setaria anceps*, with *Pennisetum purpureum* as the only indigenous fodder grass. New superior varieties of *P. purpureum* have been developed at Kawanda Agricultural Research Institute and others introduced from neighbouring Kenya and ILRI, Ethiopia. Introduced fodder grasses which have been tested, evaluated and adopted in various agroecological zones are *Tripsacum laxum* and *Setaria splendida*.

The only major indigenous legume which has been evaluated in detail and showed great potential is *Neonotonia wightii*. Introduced legumes that have performed best and are in use include *Centrosema pubescens, Macroptilium atropurpureum, Desmodium intortum, D. uncinatum* for areas receiving over 1 000 mm of annual rain; while *Stylosanthes guianensis, S. hamata, S. scabra, Aeschynomene americana* and *Cassia rotundifolia* are suitable for areas receiving under 1 000 mm and poor soils.

The six major natural grassland communities are:

5.1 *Pennisetum purpureum* grassland

This is a coarse grassland dominated by *P. purpureum* (Elephant grass); it occurs in the better watered areas between 1 000 and 2 000 m above sea level with fertile soils. *P. purpureum* is an important fodder, though it is often grazed under lax management. Other grasses of grazing value associated with *P. purpureum* are *Brachiaria spp, Cynodon nlemfuensis, Panicum maximum* and *Hyparrhenia rufa*.; the only legume is *Neonotonia wightii*. Useful introduced legumes include *Centrosema pubescens, Macroptilium atropurpureum, Desmodium intortum, D. uncinatum*. Fodder grasses used are *P. purpureum, Tripsacum laxum, Setaria splendida;* herbaceous legumes are *Lablab purpureus* and *Stizolobium spp*. Tree legumes in use include *Leucaena leucocephala, Calliandra calothyrusus* and *Sesbania sesban.*

5.2 Moist *Hyparrhenia* grassland

The grass stratum of this moist savanna community is dominated by *H. rufa* and *P maximum* which occur on fertile soils with annual rainfall of 1 000–1 500 mm. Other common grasses important for grazing are *Chloris gayana, Brachiaria* spp., *H. variabilis* and *Imperata cylindrica* var. *africana*. Most of the grasses and legumes suitable for this system are those mentioned in the grassland community above. Crop residues are a source of livestock feed in this system.

5.3 Dry *Hyparrhenia* grassland

This is found where growing conditions are not as favourable as for the previous one. The dominant species are *H. filipendula* and *H. dissoluta* in the dry *Combetrum* savannas. Other grasses are *Setaria sphacelata, Themeda triandra, Cenchrus ciliaris, Cynodon nlemfuensis* and grasses of minor feed value like *Andropogon gayanus, A. schriensis*, and *Heteropogon contortus.* The quality of the herbage is rather low, especially in the dry season because they grow in dry, poor places.

5.4 *Themeda triandra* grassland

This is a fire-climax community of the southern cattle corridor stretching from the shores of Lake Kyoga to the Tanzanian border. It is very nutritious when young. It occurs in savanna communities associated with *Acacia* spp., on light texture soils at altitudes of 1 200 metres. Some of the *Acacia* trees, for example, *A. hockii* are important as fodder. Shade loving grasses like *Brachiaria brizantha* and *Panicum maximum* thrive amongst *Acacia*, provided that the trees are scattered. Other important grasses are *C. gayana, Cynodon nlemfuensis*, and *Setaria sphacelata*. The grazing value of the grasses is being reduced by weeds such as *Cymbopogon afronadus* and *Imperata cylindrica.* Some of the adapted forages include *Leucaena leucocephala, Stylosanthes spp.* and *Calliandra calothyrusus.*

5.5 *Setaria-Chrysopogon* grassland

This community covers substantial areas of the north-eastern part of the country; it is dominated by *Setaria incrassata* which is characteristic of the clay plains of Karamoja. Other common grasses are *Themeda triandra, Sorghum* spp., *Eriochloa nubica* and *Dichanthium papillosum*. The annual rainfall is 750–1 000 mm. Further east, under rainfalls of 350–500 mm, are the *Chrysopogon* clay steppes of Karamoja which provide moderate grazing. Bush and thickets occur at altitudes of 1 200–2 000 metres on shallow soils with 300–850 mm rainfall. These communities, which contain a great variety of species, provide a lot of browse, but the grass cover is sparse.

5.6 Montane grassland

Grass savannahs with abundant *Andropogon distachyus, Cenchrus validus, Exotheca abyssinica* and *Hyparrhenia cymbaria* have developed at altitudes of 2 000–3 000 m. The most productive grasses are *Pennisetum clandestinum* and *P. purpureum* followed by *Setaria sphacelata* found on Mt. Elgon, in the East and Southern Kigezi and on the foothills of the Ruwenzori Mountain. The *P. clandestinum* grasslands have a natural clover *Trifolium semipilosum* (Kenya white clover) which is very compatible with the grass.

6. PASTURE SEED PRODUCTION

Development of sown pastures depends on a viable seed industry. From 1950–1970, pasture seed production was based at Serere Research Station in Eastern Uganda where grass and legume seeds were harvested opportunistically, sold to the Department of Agriculture and later sold to livestock farmers. This was followed by farmers in Serere and Central Uganda getting involved in producing pasture seed. The grasses grown were *Chloris gayana, Panicum maximum* and the legumes were *Desmodium intortum, Stylosanthes guianensis* and *Centrosema pubescens*. Substantial amounts of seed were produced at Serere (Table 5). Yields per hectare are not available and the quality of the seed, particularly grass, was very low.

The ODA-funded Uganda Seed Multiplication Project (USMP) enhanced seed production activities at Serere and opened new sites in Mbarara, Kigumba and Ngetta. Research on pasture seed production was begun but was not successful because more emphasis was put on crop seeds.

During and after the USMP, the pasture seed industry was hit by shortage of funds to pay the pickers, and this hampered rapid progress; by 1977 most farmers and pickers were discouraged. This led to lack of pasture seeds in the country. The situation was saved by the Department of Veterinary Services and Animal Industry (DVS&AI) working with Uganda Central Co-operative Union to import seed from Kenya from 1974 to 1983. The seeds imported were different varieties of *Chloris gayana* and *Panicum maximum,Brachiaria* spp. Nasiwa Setaria; *Macroptilium atropurpureum, Desmodium uncinatum, Centrosema pubescens* and *Stylosanthes guianensis*. Between 1984–1988, no seed was imported. In 1989, the African Development Fund (ADF) gave DVS&AI a grant that was used to import 3 800 kg of grass seed (*Chloris gayana and Panicum coloratum*) and 600 kg of legume seed (*Centrosema pubescens and Pueraria phaseolides*).

In 1989, the UNDP/FAO Dairy Industry Development Programme imported some seeds and in conjunction with DVS&AI, Makerere University and Namulonge Research Institute began pasture seed production; 26 ha of an assortment of pasture crops was established which included grasses namely, *C. gayana* and *P. maximum*; and legumes *M. atropurpureum, C. pubescens, D. intortum, Lablab purpureus, Leucaena leucocephala* and *Cajanus cajan*. Through the work done at Namulonge, the cost of production of seed for each of those varieties was established. The seeds produced under this programme were used in the UNDP/FAO programme area and the rest was given to DVS&AI for bulking. This was done through farmers who were contracted to multiply the pasture seeds. From 1990–1992, UNDP/FAO purchased pasture seeds from the contracted farmers in Mpigi, Mukono and Mbarara Districts and sold them to livestock farmers nation-wide.

The World Bank, through the Livestock Services Project (LSP) in the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF), carried on with pasture seed production activities began under UNDP/FAO as well as training both staff and farmers in various technologies of forage production and utilization. Over the period 1992–1997, over 50 farmers had been contracted and produced about 58 000 kg of grass and legume seeds (see Table 6)

Table 5. Pasture seed produced at Serere: 1972–1980

	1972	1973	1974	1975	1976	1977	1978	1979	1980
Grasses (kg)	4 280	4 238	10 583	9 743	520	6 607	1 078	3 535	-
Legumes (kg)	1 720	4 515	16 355	3 903	4 211	7 636	12 598	7 659	7 789
Total (kg)	6 000	8 753	26 938	13 646	4 731	14 243	13 676	11 194	7 789

Source: S.A. Bureau Courtoy NV & European Development Fund (1981)

Table 6. Seed production from contract farmers under the Livestock Services Project (kg): 1992–1997

Seed type	1992 (imported)	1993	1994	1995	1996	1997
M. atropurpureum	100	3 132	3 190	5 892	-	1 284
C. pubescens	100	374	2 238	2 243	-	691
L. purpureus	-	11 179	9 252	15 892	-	2 263
S. guianensis	-	2	-	-	-	15.5
Verano Stylo	120	-	-	-	-	-
Seca Stylo	100	-	-	-	-	-
D. intortum	100	-	-	-	-	-
D. uncinatum *C. rotundifolia*	100 120	- -	- -	- -	- -	- -
L. leucocephala	400	-	-	-	-	-
C. gayana	40	-	-	-	-	656
P. maximum	-	-	-	-	-	209
TOTAL	1 180	14 687	14 680	24 027	--	5 118.5

Source: LSP Internal Completion Report, June 1997.

from an average area of about 0.75 acres each. The main crops produced were *C. gayana* and *P. maximum* (grasses) and *M. atropurpureum, C. pubescens, S. guianensis* and *L. purpureus* (legumes). Under this project, a study for the privatisation of the pasture seed industry was conducted. Unfortunately, before it was concluded, the project came to an end (June, 1997). There is now no clear way-forward for pasture seed production in MAAIF. Field extension staff responsible for pasture improvement in the districts have managed to keep a few farmers involved in seed production as they find a market for the seed from amongst livestock owners.

Planting material of vegetatively propagated grasses such as Elephant Grass, Guatemala, Giant Setaria and leguminous tree seedlings (multi-purpose trees) Calliandra, Gliricidia and Leucaena, is produced by research institutions and some NGOs.

7. OPPORTUNITIES FOR IMPROVING PASTURE RESOURCES

Uganda has a number of opportunities for the improvement of pasture resources. These include:-

7.1 Modernisation of Agriculture is an integrated programme approach where the livestock development strategy focuses on:-

- **Achieving self-sufficiency in meat, milk, poultry and other livestock products.** Pastures are the cheapest source of feed for ruminants. Given the well distributed rainfall and fertile soils, Uganda has abundant of green forage available for most of the year. Proper use of this forage will ensure that the plan is implemented.
- **Provision of planting materials and genitors.** This is an indication of Government commitment to buying planting materials. Farmers can exploit this opportunity to produce more seed and planting material. Farmers will be encouraged to improve their stock through AI, or selection of good traits within existing herds.
- **Targeting commercial agricultural production.** Pasture seed production will expand as farmers diversify cash crops from the traditional ones. The sale price for pasture seeds is good compared to all other agricultural crops. The knowledge that livestock production can be profitable has created a willingness amongst farmers to take up new technologies aimed at increasing livestock productivity; pasture improvement is just one of them.
- **Improving and strengthening of agricultural research and extension.** The National Agricultural Research Organisation (NARO) was established by an act of parliament with the mandate of nation-wide research, training and extension. New technologies for all categories of farmers in pasture improvement are developed on-station and tested on-farm to suit the different farming systems. Through MAAIF, NARO and its research institutions, and Makerere University, Uganda has established networks with a large number of international research organisations interested in livestock nutrition.

7.2 The agricultural extension system is well developed with staff at district, sub-county and parish level; the staff have degrees or diplomas. They are responsible for training farmers according to their needs. There is on-going in-service training of all front-line livestock extension workers in pasture improvement and seed production. Uganda has several universities and agricultural colleges which train agricultural personnel with specialisations, namely; crop production, animal husbandry, pasture resource management and many others.

7.3 Peri-urban commercial dairying depends on fodder. The farmers involved in dairying have had a lot of exposure to training and know the importance of good pastures for livestock production. They will form a good group for promoting development and improvement of pasture and fodder production. In periurban dairy farming milk is the most important product because of the favourable market and, in order to realise maximum profits, the cost of production has to be kept low. One way of reducing the cost of production is for the farmer to grow fodder to provide all-year round feed.

7.4 NGO, community-based organizations and producer associations involved in livestock production are growing rapidly. They organize training programmes and focuse extension advice for the farmers with whom they are involved; feeding on pasture is given a lot of emphasis in their training programmes. As a matter of policy with all these NGOs, recipient farmers must have one hectare of well established fodder crops, that is, grasses and fodder trees; with back-yard vegetable gardens for the family.

7.5 The fertile soils and favourable climate of Uganda are a good potential that will favour all pasture and fodder development efforts in the country.

7.6 The pasture seed production industry is being revived and is catching up well. Government efforts to privatise the industry locally will go a long way in stimulating local production and create a demand for pasture seeds from livestock farmers.

8. RESEARCH AND DEVELOPMENT ORGANIZATIONS AND PERSONNEL

The National Agricultural Research Organisation (NARO) was created by a statute of parliament with a mission to improve the welfare of the people of Uganda through generating improved technologies (including policy recommendations), transferring them to clients and beneficiaries, and maintaining an agricultural research institution that is relevant to national development and capable of producing the above outputs in an efficient, effective and sustainable manner. The primary target beneficiaries of NARO´s outputs are small-scale producers in the agricultural sector. The mandate of the organization is to undertake, promote and co-ordinate research in all aspects of crops, fisheries, forestry and livestock. The immediate objectives for NARO´s technology generation and transfer focuses on increasing and sustaining food production, sustaining natural resources, improving agricultural techniques, commercialisation and optimal land use.

Namulonge and Serere Agricultural and Animal Production Research Institutes (NAARI and SAARI in Central and Eastern Uganda respectively) are mandated to undertake research in, amongst others, livestock production systems, pastures, range management and general livestock husbandry. These institutions (NAARI and SAARI) collaborate locally with Makerere University, the Government extension services of Ministry of Agriculture, Animal Industry and Fisheries (MAAIF); NGOs and CBOs (HPI, YWCA, Farm Africa, UNFA and several women groups) interested in pasture and livestock development. At the regional and international level, they collaborate with International Livestock Research Institute (ILRI), USAID, ICRAF and GTZ. NAARI and SAARI receive their largest funding from the Government of Uganda, World Bank, DANIDA, USAID and Rockefeller Foundation.

The following personnel are involved in pasture and fodder research and extension:

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Mr. J. Beyunga - Forage Agronomist; Dr. S. Ossiya - Forage Agronomist/ Animal Nutritionist.

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