

FIRST DRAFT as of September 05

**INDIGENOUS FODDER TREES AND SHRUBS AS FEED RESOURCES
FOR INTENSIVE GOAT PRODUCTION IN UGANDA**

FARMERS' HANDBOOK

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PREFACE

This handbook has been prepared for use by farmers and extension staff in Uganda. It is intended as a practical guide to cover some aspects of the basic principles of goat feeding and health management based on indigenous fodder trees and shrubs (IFTS). Much of the information in this handbook has been taken from a study report on “Research and Development on indigenous fodder trees and shrubs in Uganda”. This was part of a regional consultancy study that was carried out in Uganda, Tanzania, Kenya and Ethiopia and funded by the Regional Land Management Unit (RELMA) and The International Centre for Research in Agroforestry (ICRAF).

Due to enormous variation in production systems in Uganda, not all of the recommendations will apply to every situation. Users should use the general principles to develop their own recommendations which are best for their particular areas.

ACKNOWLEDGEMENTS

We are acknowledge the financial and technical support of The Livestock Production Programme (LPP), U.K for production of this manual.

We thank Dr. Aichi Kityali, Animal Husbandry Officer, RELMA/ICRAF, Nairobi and Dr David Mutetikka, Head, Animal Science Department, Faculty of Agriculture, Makerere University for their comments and criticisms on the manuscript. Special thanks to the Director, Namulonge Agricultural and Animal Production Research Institute (NAARI) and Dr. Cyprian Ebong, the National Coordinator, Agricultural Research Component (ARC) under the DANIDA supported Agricultural Systems Programme Support (ASPS) for the technical support.

CONTENTS

CHAPTER ONE

INTRODUCTION

Animal agriculture is one of the most important economic sub-sectors of Uganda's agriculture and is currently among the most rapidly developing industries. The livestock sector in Uganda contributes about 30% of the national Agriculture Gross Domestic Product (GDP) in the form of milk and meat. According to the 2004 Population Census, the livestock population in Uganda comprises of 6,100,000 cattle, 1,150,000 sheep, 6,852,000 goats, 1,719,000 million pigs and 33.000,000 chickens. Both high and low-income farmers can afford to keep goats. Goats, therefore, play an important role in food security, providing both food and cash, as there is a ready market for meat and they are also exchangeable.

The off-take of this sector has been gradually increasing, and this is thought to be enhanced by market forces and to some extent the awareness of many people on the importance of goats. Another reason is the increasing pressure on land being enhanced by the high feeding costs for larger ruminants (cattle) and non-ruminants (pigs and improved chickens) when compared to that of goats. Other factors include their low capital investment per unit area and the land holdings are usually very small, Indicated their reproductive turnover is also high, and both poor and rich farmers can easily manage them.

CHAPTER TWO

BREEDS AND BREEDING OF GOATS

2.1 Breeds of Goats

A breed is a group of animals of the same species having similar appearance and qualities and is usually developed by selection. A cross bred animal is a result of mating of two breeds of different species. Very often the crossbred has qualities which are better than either of the parents. When selecting goats, it is important to consider the environment that they will have to live in, and if they are suited to such environment.

There is a high demand for the supply of goat meat and milk in Uganda but the major constraints to adequate supply of these two products are the scarcity of suitable breeds and poor nutrition.

2.1.1 Major breeds of goats in Uganda

i) Indigenous goats

Indigenous goats are small and very hardy. The adult female weighs approximately 10 to 25 kg. They are mainly kept for meat production, but sometimes milked especially by pastoralists.

Indigenous goat (photo)

ii) Mubende

Mubende goats are black or grey long-haired weighing 20-90 kg.

Mubende goat (photo)

iii) Toggenburg

Toggenburg goats are imported from South Africa, Kenya and other countries. They are mainly white and fawn with cream stripes, erect, forward-pointing ears. Usually polled; the female weighs 40-50 kg and give 2-3 litres of milk per day.

Toggenburg (photo)

iv) Crosses

Many local goats are being crossed with exotic goats to improve growth rate and overall performance of the goats.

Cross bred goats (photo)

2.2. Goat breeding

If a female is mated when she is not physically fit, she will not come on heat; she will abort or she will reabsorb the foetus at an early age. Those which are mated and carry their kid, will be unable to rear it satisfactorily. Any female with deformities e.g bad feet, hard udders, blind eyes, should be taken out of the breeding stock. Old bucks (male goats) and those with deformities should be culled.

2.2.1 Time of mating

Females should have at least 2 hard teeth i.e. 10 months of age. Females mated younger and with a low body weight. The kid's growth will be very poor and the kid will be of little value. It is important that females are mated when there is plenty of good quality grass and leguminous forages. Mating during the rain season will also ensure that the goats are in good body condition. If females are in good condition, they will readily come into heat and repeat services will not happen. Thus mating period of 45 days should be sufficient.

2.2.2 Signs of heat

When on heat, the females become restless, bleat frequently and wag their tails. The vulva is swollen and discharges a clear mucus. Females in heat will also mount other females. The duration of a cycle is from 19-24 days.

2.2.3 Care of a pregnant doe

As pregnancy progresses, the nutritional requirements of the female goat increases. It is important to get a cheap source but high quality feed. On average a goat will kid 150 days after she has been mated. Females carrying twins will kid a few days earlier. It is wise to be ready for kidding 145 days after the introduction of the buck in the breeding stock.

2.2.4 Signs of kidding

The udder will become firm and the teats will enlarge. The female will become restless on the day of kidding, often pawing on the ground. She will have a discharge from the vulva.

2.2.5 Care of the doe

The female should be left alone and not harassed during labour time. If a female has not kidded within 3 hours after the start of labour, professional help should be sought. The placenta or afterbirth will normally be expelled within a few hours after birth. If this does not happen, do not attempt to remove it because it can result in excessive bleeding.

2.2.6 Care of the kid

As soon as the umbilical cord breaks, the kid has to breathe on its own. The mucus in the nostrils should be removed to prevent the kid from suffocating. Usually the mother will remove the mucus. The navel should be cleaned with an anti-bacteriostat such as iodine, spirit or diluted dettol immediately after birth. The kid will start suckling its mother immediately. If it is too weak to suckle, it should be fed using a feeding bottle. The first milk which a kid receives from its

mother is called colostrums and it contains antibodies, vitamins which protects the kid from diseases.

2.2.7 Rearing the kid

The most important period in a kid's life is the first 6 weeks of life because during this time the kid depends on milk from its mother's. It is therefore important to provide the mother with good quality feed and plenty of water and keep the mother free from diseases. Male kids should be weaned at 4 months by which they are beginning to become sexually active and could cause a lot of harassment to females. Female kids should be left with their mother for another month..

CHAPTER THREE

FEEDS AND FEED MANAGEMENT

3.1 Introduction

Goats will not eat or drink anything which is dirty. It is therefore important to design the water, fodder and feed boxes outside as shown in the picture below to prevent soiling. Goats should be allowed to see around and should be allowed outside daily for exercise and to browse whatever is available. No goats will perform satisfactory living in a prison cell atmosphere.

3.2 Major types of feed for goats in Uganda

3.2.1. Natural pastures

Natural pastures consist of grasses such as elephant grass, Rhodes grass, setaria, guinea grass, couch grass, grasses from swamps and public land. These are harvested from public land and their availability varies across seasons. Natural pastures in most parts of Uganda are inadequately nutritious. Such pastures cannot sustain satisfactory levels of production and health of improved goats for most of the year. Grasses grow rapidly during the rains and set seed before the dry season. Consequently, goats gain body weight in the rains and lose it in the dry season. The seasonal gain and loss in weight of animals results in poor growth pattern accompanied by low reproductive performance. In many instances the goats have to rely heavily on crop by-products for survival until the next rainy season. In order to ensure better performance of goats, the use of high nutritive planted pastures are required.

Natural pastures such elephant grass found in public land are low in feeding value and could be a source of ticks (photo)

3.2.2. Planted grasses

The quantity and quality of feed available to goats can be improved substantially by planting improved forages such as fodder trees, elephant grass/legume mixtures and forage legumes. The potential for pasture cultivation is determined by the agro-ecological zone, especially the amount and distribution of rainfall, soil fertility, fertilizer application, irrigation, the species involved and, to a lesser extent, by land tenure and land use rights.

Elephant grass (*Pennisetum purpureum*) fodder is the most popular forage for stall-fed goats in Uganda. With rapid growth, and re-growth after harvesting, the quantity of fodder is not a limiting factor to fodder production. However, the quick maturing of elephant grass during the dry season leads to a decline in its nutritive quality (less than 7 per cent crude protein). Intercropping elephant grass with forage legumes improves the quality and quantity of fodder. Other grasses include: setaria, Rhodes grass (*Chloris gayana*); guinea grass (*Panicum maximum*) and others.

Elephant grass, a major feed resource base for intensive goat production (photo)

Grass/legume mixtures have higher feeding values compared to sole grasses (photo) Rhodes grass planted to produce seed

The amount of fodder a goat will consume will depend on a number of factors namely: the quality (stage of growth) of the grass. The goats will eat less when the grass is very mature. If good quality forage is available, the goat will eat more and refuse very little, but if the feed is of low quality, the refusal rate will be high as will the wastage. For dairy goats, if the forage quality is low, milk production will be reduced drastically. This has a negative impact on the performance of the goat and its offspring. Zero grazed goats eat more fodder than goats on free range. It is always advisable to chop fodder to reduce waste and make it more palatable. A 45 kg dairy goat in milk should consume up to 7% of its body weight in dry matter daily and plenty of clean water.

3.2.3 Forage legumes

Protein is the most limiting element in smallholder goat production and its deficiency reduces the productivity of the goats. The role of forage legumes as the cheapest potential source of soil, crop and animal protein in different farming systems in Uganda include enhancement of high protein supply, increase crop productivity and maintaining the productivity of farmland.

Forage legumes such as lablab have higher protein content and are easy to establish

Green leaf desmodium

Biologically fixed nitrogen is transformed into leguminous protein and this may be consumed directly by animals in the forages to meet their protein requirements. The excess is returned to the soil via animal manure and urine.

3.2.4 Crop residues

Mixed crop/livestock production occurs virtually throughout the farming systems in Uganda. Declining crop yield/unit area accompanied by progressively increasing requirement for food is forcing farmers to cultivate more land at the expense of grazing pasture and browses. The other aspect of this process is the increase in the production of crop residues. There is already a heavy reliance on the use of the by-products as feed during the long dry season immediately after harvest, and yet farmers still face a number of constraints on their efficient utilization. Major crop residues fed to animals include sweetpotato vines, maize stover, cassava peels and leaves, banana

peels, banana leaves etc. Most crop residues are low in protein and high in fibre content, which leads to their poor utilization by livestock. Crop residues must therefore be supplemented with a source of protein such as lablab. Intercropping cereal crops such as maize with forage legumes improves the quality of maize stover and maize grain yield.

Intercropping maize with lablab improves maize stover quality and maize grain yield (photo)

3.2.5 Agro-industrial by products

Agro-industrial by products such as cotton seed cake, sunflower cake and brewer's grain, molasses, cotton seed cake and cereal milling by-products (maize and rice bran) supply energy and protein to the goats. The major problems facing the use of agro industrial by-products for animal feeding are their bulkiness and availability; high cost of transport; the general lack of understanding among livestock owners about the feeding value and the relatively poor nutritive value of most agro-industrial by-products

3.2.6 Conserved forages

The supply of nutrients from grasslands and harvested forages in Uganda is seasonal because of the rainfall pattern. During the rain season, there is luxuriant growth of pastures and during the dry season, pasture is very scarce with resultant decline in animal performance. The goats therefore loose weight and become susceptible to diseases. In severe cases, goats die due to underfeeding. Hence the need to conserve forage to bridge the nutrient gap during periods of scarcity. Forage conservation in form of hay or silage allows for intensive goat farming with a higher stocking rate than would otherwise be possible.

Goats feeding on grass hay

lablab hay (photos)

Maize/lablab stover

calliandra leaf hay kept in polythene bags (photos)

Conserved forages should be stored in well ventilated places (photos)

A number of factors affecting utilization of conserved forages in smallholder production systems include inadequate land to produce sufficient quantities, losses due to weather, lack of technical knowledge and skills, shortage of labour and capital. In addition, at the end of the rainy season, most crops are ready for harvest so fodder conservation competes with crop harvests for labour.

3.2.7 Concentrates

Energy has been identified as the most limiting nutrient for milk production in dairy goats. Concentrate feeds are valued for their energy and protein levels and their protein quality, which result in improved goat productivity. Small quantities (0.5-2 kg/goat/day) of concentrates lead to an increase in the intake of low quality forages containing which in turn increases milk yield of dairy goats. A small quantity should be fed to the goat before kidding in order to build up the body reserves and help in the development of the unborn kids. Table 1 shows suggested dairy meal rations to be fed daily. Crushed maize grain and dairy meal are good supplements. Forage legumes are rich in protein and have high digestibility.

Table 1: Suggested dairy meal rations to be fed daily (1/2 in the morning and 1/2 in the evening)

Type	Quantity
Dry female	0.5 kg
Female milking 1 litre	1.0 kg
Female milking 2 litre	1.5 kg
Female milking 3 litre	2.0 kg
Female milking 4 litre	2.5 kg
Female milking 5 litre	3.0

3.2.8 Mineral supplements

Minerals are required for proper growth of the goats. Milking goats require minerals such as calcium for milk production. A high yielding goat will draw considerably on her own body. Minerals such as mineral lick must be available all the time. Lack of minerals in goats can result in weight loss, poor reproduction, anaemia, still births, low yields, malformation of bones etc.

3.2.9 Water

Many farmers do not offer water to goats. Although, goats can get some little water from the forages they consume, they should be given clean water all the time. Water is very important in the digestion of the feeds consumed and in milk production. The watering bucket can be located outside the pen with a hole in the wall for the goat to put its head through to drink. This prevents the goat upsetting the water container or fouling the water.

3.2.10 Exotic fodder trees

The last two decades have seen vigorous promotion of exotic or foreign species of fodder trees and shrubs, e.g. *Calliandra calothyrsus* (*calliandra*), *Leucaena leucocephala* (*leucaena*) and *Gliricidia sepium* (*gliricidia*) for fodder.

Sesbania sesban (sesbania)

Gliricidia sepium (gliricidia)- photos

Calliandra calothyrsus tree

Figure 1: Common exotic fodder trees

These trees are easy to propagate, are ready for harvest within one year after planting and, unlike grasses, maintain their green foliage and protein content during the dry season. However, there are two important issues to consider. Firstly, farmers need to diversify the tree species they use, both to enrich livestock diets and to reduce the risk of a tree species succumbing to pests or disease. For example, *Leucaena* succumbed to the *physillid* (*Heteropsylla cuban*) pest while *calliandra*, now being widely promoted in Uganda, is being threatened by a die-back disease that has reduced biomass yields. Secondly, there is a need to use the many indigenous fodder species that are now being promoted as livestock feed.

CHAPTER 4

INDIGENOUS FODDER TREES

Indigenous fodder trees and shrubs (IFTS) provide livestock feed and play critical role especially during the dry season and droughts. The potential of indigenous fodder of trees and shrubs to produce considerable amounts of high protein biomass during the dry season and their adaptation to the natural environment make them suitable candidates for further development as feed resources. They contribute significantly to sustainable agriculture by providing high value fodder to livestock. Indigenous fodder has been important dietary component and especially energy and protein supplement to the low quality basal feeds. They have also played an important role as medicines against many diseases facing both livestock and human being. On the other hand, high population in the highlands has resulted in miniaturization of farmlands thus reducing the fodder niches and availability. As a result farmers reduced the number of livestock and tried to domesticate some of the indigenous fodder materials.

Indigenous fodder trees and shrubs have advantages over exotic species because they are well adapted to the local environment and planting material is abundant. But to be successfully produced on small farms, suitable tree and shrub species need certain characteristics including being nutritious, palatable, persistent and compatible with other crops.

4.1 Indigenous fodder trees and shrubs as feed resources

Season is has an effect on the feeding value of IFTS. Although nutritive value of IFTS is generally higher in the forages during the rainy season than during the dry season, it is still high enough during the dry season to provide high quality fodder supplements, with a large scope for selection of superior species. IFTS play an important role in bridging the gap in fodder supply during the critical dry months in Uganda. Being perennials, IFTS are better able to withstand prolonged periods of moisture stress than grasses and herbaceous forage legumes. In many parts of Uganda, IFTS are the only source of green forage available during the dry season. In addition, many fodder trees and shrubs have high feeding value that supplement the often poor quality elephant grass and crop residues, the normal dry season feeds. The protein content (CP) of most IFTS is higher (over 18% CP) than that of grasses (less than 10% CP) and most forage legumes (less than 20% CP). When compared to the recommended rations of minerals, calcium and phosphorus, majority of the species sufficiently provide these minerals.

Goats owe their continuing good health, or indeed survival, to IFTS supplements. Many IFTS are valuable feed resources for goats (Appendix 1). In Masaka district, a non-government organization (NGO) Joy Children's Centre has contracted farmers to supply IFTS to the farm. The main aim of the founders is to assist orphans in the area using a rural and agricultural approach, whereby children being assisted would remain in their homes but assist in gathering fodder and managing the project. Using "learn and earn scheme", the project takes on orphans whom they teach simple goat husbandry skills for stall-grazed goats. There are more than 100 farmers and orphans in Masaka district who have benefited from the project through sale of fodder and/or have received a goat.

Joy Children's Home- (a goat rearing project for orphans in Masaka district), 3 km, Kalungu road is a NGO belonging to Mr. & Mrs David Dawdy. They have 300 crossbred and pure goats (milk and meat) and 3 crossbred dairy cows, which are all stall-fed. The home takes care of orphans who manage these goats and in return the project pays their fees. IFTS contribute over 75% of the fodder used on the farm. A mixture of about 4 ton/day of fodder comprising of [1 ton of forage legumes (centro, siratro, desmodium or/and glycine spp) and fodder trees [callandra, gliricidia, leucaena] ; 1 ton IFTS and 2 tons of fodder grasses (elephant grass, Panicum maximum, Chloris gayana or/and setaria spp) is fed to the goats. Each goat gets about 10 kg/day of fresh material. The milking goats are supplemented with maize bran and cotton seed cake and are given plenty of

Due to shortages of other feeds, lopping is done during the dry season, thus providing a source of green supplement. It is estimated that IFTS contribute over 15 per cent of the total goat diet during the dry season. However, very little IFTS is fed to goats during the wet season because there is plenty of green fodder. IFTS are normally fed to goats once a day in the afternoon. For the rest of the day, the goats can feed on other grasses such as *Setaria* spp; giant *Panicum* (guinea grass), *Chloris gayana* (Rhodes grass), *Pennisetum purpureum* (elephant grass), crop residues such as banana, sweetpotato and cassava peels.

The frequency of harvesting from the trees depends on the species and the season. Most trees are harvested every 90 days during the wet season and every 4-6 months during the dry season. Freely grazing or browsing livestock will eat twigs, leaves, young shoots, and fruits of these plants. In most areas intensification of production systems means forage is brought to confined animals. In these systems, farmers harvest the edible parts (soft branches or top twigs pillared or pruned) of IFTS and feed them to animals along with grass and other forages. Tree fruits and seeds e.g. avocados, jack fruits and mangoes are also fed to goats. The fruits should be or crushed to avoid chocking the goats.

(*Persea americana*-Avocado pear)

Jack fruit tree

4.2 Fodder treatment, value adding and conservation of IFTS

Although fodder from IFTS is always fed fresh without treatment, some IFTS such as bitter leaf tree (*Vernonia amygdalina*), cassava leaves and peels are bitter and could be poisonous because of anti-nutritional compounds. The effects can be reduced by wilting or drying the leaves before offering them to the animals. Wilting also improves their palatability and intake. It is clear that goats have developed a mechanism of feeding on IFTS forage without treatment. This is an advantage, when forage is left to be browsed without close supervision of the animals or the forage has to be harvested and quickly brought to animals. Feeding IFTS in mixtures helps to overcome possible side effects that could result from feeding species, known to be poisonous, such as *Lantana camara* in large quantities.

Vernonia amygdalina (Bitter leaf tree)

Lantana camara

The major parts of IFTS that are fed to animals are the leaves and twigs but feeding immature fruits, seeds of jackfruits, avocado and mangoes to goats is very common. These are chopped or crushed before they are offered to the animals since they can choke the animals.

Acacia tortillas is very suitable feed for goats. The goats only digest the outer shell while the seed passes out through the faeces. These pods are high in protein having a value of about 17% crude protein. Their mineral content is also high. These pods can be sun dried and stored. A daily ration of ½ kg is adequate supplementation.

In eastern Uganda, farmers remove seeds and fruits from *Lantana camara* before feeding them to animals. Farmers reported *Lantana camara* to be toxic to animals if fed with seeds. It is also not a very good feed if fed frequently and in large amounts as it causes blisters on the lining of the intestines and the leaves and twigs do damage the animal's teeth. It is best if mixed with other IFTS. The bark of some IFTS such as *Ficus* and *Morus alba* (mulberry) is also very palatable to the animals.

CHAPTER 5

GOAT HEALTH

5.1 Diseases of goats

5.2 IFTS as medicine for goats

The importance of traditional medicine for humans, as well as goats, is difficult to ascertain in most parts of Uganda. Traditional medicine plays a significant role in the health care system, since this is the only affordable and accessible health care available. Some IFTS have medicinal uses, with leaves, roots and bark providing the raw materials for medicinal and veterinary products (Appendix 1). IFTS do not offer a 100 per cent solution but it is a means of administering first aid to animals and family members, especially in rural areas where veterinary and medical services are either not easily accessible or are very expensive.

Mrs Tereza Nakirya, a widow with 30 orphans in Buyikuuuzi village, Bukulula sub-county, Masaka district said “I have been able to reduce veterinary costs by using IFTS such as Vernonia spp. The goats like the fodder very much. It is also used to treat fever in goats and human beings.

Plant material is used either singly or in combination. Farmers reported that the combination of several IFTS increases the chance of recovery. Moreover, a disease can be cured by one or more medicinal formulae and one formula can be used for the treatment of several diseases.

5.3 Other uses of IFTS in the farming systems

IFTS are sources of income through sale of firewood, poles, fruits, seeds, fibres and medicine. Shade and shelter, for people and animals, environmental protection, and enhancement of rural and scenic surroundings are other reasons cited by farmers for leaving trees such as *Ficus spp.* and *Mimusops bagshawei* standing in their fields. Bushy, thorny hedgerows are planted to mark boundaries and channel herd access and movements in Mbarara district. *Ficus* trees are planted very close together to form living fences, and their clippings are used as fodder. Territorial boundaries, a first stage in land appropriation, can be demarcated by IFTS.

Mimusops bagshawei (Mimusops kummel)

Fig tree

Many IFTS such as mangoes, guavas provide products that enhance food security and also help to promote dietary balance, diversity and good health. Trees such as paw paws, avocados,

mangos and guavas are rich in Vitamin C. They also provide simple snacks during work or travel. The IFTS also play a key environmental role. Firewood is the main source of energy for rural households, especially for cooking in rural areas of Uganda. In urban areas charcoal from IFTS, such as *Acacia* spp., is used extensively for household cooking and also in restaurants and hotels.

Mango leaves are very palatable to goats Mulberry leaves

In most rural and urban areas, IFTS are still the main source of materials for constructing houses, fences etc. Raw materials from IFTS are used to make a wide range of products that can broadly be classified as household utensils, tools, and equipment. Many different species, such as *Sapium allipticum*, are used to make tools and utensils.

Sapium allipticum tree

Sapium leaves

Traditional beekeepers make their living from IFTS, by placing hives in carefully selected trees such as *Moringa oliefera* and *Acacia gerradai*. Honey is a unique product in that it does not compete with other land uses or cause land degradation, although burning has been mentioned as an adverse effect of traditional bee-keeping practices.

Many IFTS have been, and are still, an integral aspect of the social structure, religion, art, history, medicine, and politics of a community. In Masaka District, *Ficus* spp. is used to make bark cloth used in cultural functions, including witchcraft, death and funerals. In rural areas, the cloth is used to make bed sheets and traditional costumes. Some IFTS are viewed as both sources of, and protectors against, evil and as providers of fortune and power. In Masaka District, certain trees, such as *Ficus ovata* and *Commiphora* spp., are used to link the living with their ancestors. Sometimes gifts are given as a means of showing ancestors that they have not been forgotten. Gifts such as flowers or alcohol are placed at the foot of the tree as an offering which is symbolic of giving food to the ancestors through the tree. *Dracaena afromontana* is known as a “peace” plant and mostly used to mark graveyards, begging for forgiveness and for decorations during public ceremonies.

Ficus natalensis (Fig tree)

Dr. Kitayli of RELMA/ICRAF holding a piece
of a bark cloth made out of the bark of a Fig tree

CHAPTER 6

TREE ESTABLISHMENT, SOURCES OF PLANTING MATERIALS, PROPAGATION, FARM NICHES AND DISEASE AND PEST CONTROL

6.1 Tree establishment

IFTS are established and propagated either by natural regeneration, by cuttings or direct sowing on site. The seeds are sometimes carried out by birds to the host trees where they germinate. However, the seeds also germinate in the ground. The main reason given for giving little attention or no effort at all to plant IFTS is their slow growth and sometimes lack of planting materials. Other IFTS such as cassava and *Cajanus cajana* are planted for food while leaves and peels are fed to livestock after harvesting the tubers.

A few cases of deliberate planting using seeds for trees such as *S. ellipticum*, *G. robusta*, and *Ficus* spp, and roots and/or stem cuttings for *T. diversifolia*, *Manihot* spp (cassava), *M. alba*, *Sesbania sesban* and *Milletia tanaensis*.

6.2 Sources of planting materials

Major source of planting materials for IFTS are from the wilderness. Other sources are from fellow farmers and research institutes such as The Forestry Resources Research Institute at Kifu, Mukono district.

6.3 Niches

Niche is defined as “a place or position adapted or suited for the proper growth of the tree “. The main niches are farm boundaries, edges of terraces to control soil erosion e.g in Kabale district, live fences, hedgerows or scattered in the fields. External boundaries are mainly for *Lantana camara*, *T diversifolia*, *Commiphora zimmermanii* and *Acalypha fruticosa*. Trees like *Ficus* spp are highly valued but the plants are large, occupy space and were preferably maintained in open pasture or in external boundaries. *Ficus* is planted at the edges of terraces to control soil erosion e.g in Kabale district, live fences, hedgerows or scattered in the fields. Some times IFTS are scattered among crops e.g. *Ficus* spp. and *moringa* is left scattered in the cassava and banana fields.

Moringa tree planted in banana plantation

Calliandra trees between banana plant rows to control soil erosion

calliandra trees planted as hedge rows around the compound

This is a form of mixed intercropping. Major IFTS used in live fences are *Ficus natalensis*, and *Acacias*. *Ficus* poles are used in fencing where they regenerate easily thus forming permanent fencing poles that are cheaper than Eucalyptus poles. The trees are also planted in paddocks or compounds to provide shade to livestock and humans. Some trees such as *Acacia senegal* and *Ficus* spp are planted at the boundary of the houses, fields and demarcating land.

6.4 Availability seasonality and abundance

Most of the IFTS are deciduous, with their forage abundantly available and best used during rainy seasons when their the twigs are soft and edible; if left un-used leaves dry and shed soon into the dry season. Such IFTS are useful because when harvested and added to grass they improve the quantity of the available forage, and sometimes used in order to preserve the grass for longer use.

Some other shrubs are evergreen or do not lose leaves extensively and are valuable forage resources for the animals during the dry period. These included *B micrantha*, *T diversifolia*, *Oriobota japonica* and *Manihot glaziovii*. Other plants such as *C macrostachyus* and *G robusta* are not quite palatable but since they do not lose their foliage, farmers greatly appreciate their availability during the dry season.

Thus the forage of IFTS is available and used throughout the year with proportions in the livestock's diet varying depending on availability of all varieties the farmer has access to offering the advantage of provision of forage in all seasons.

6.5 Management of IFTS

Though valued as IFTS, some trees grow too big for easy harvesting because the primary purpose of these trees is for use as timber and construction. When in farm compounds shrubs and creeper and climber herbs such as *Ipomoea* spp are harvested as weeds and fed to animals or left to stay and maintained, with occasional harvesting as need arises. A rather wide range of herbaceous creepers and shrubs are collected as weeds singly or in mixtures, with or without grass types, for feeding livestock. For bigger woody trees kept primarily for other purposes such as *S. ellipticum*, forage can be obtained by coppicing and pollarding branches and using the pruned leaves/twigs.

6.6 Pests and diseases

Some IFTS like *B. micrantha* and *S. ellipticum* are attacked by insect pests but the plants and their foliage largely remain unaffected. Moles are said to be serious pests of *M. alba*.

CHAPTER 7

POSITIVE AND NEGATIVE ASPECTS OF IFTS AND FARMERS' SUGGESTIONS TO ENHANCE USE OF IFTS

Big trees like *Ficus* spp could grow beyond the normal reach making their forage difficult to harvest. This limitation is observed with exotics (*Sesbania* spp) but is managed by maintaining coppicing height to manageable levels. Also noted is the danger of creeping and climbing herbs like the *Ipomoea* spp rapidly growing and overwhelming other crops.

7.1 Positive aspects of indigenous fodder trees and shrubs

Major positive aspects of IFTS are:

- a) Fodder from IFTS improves feed availability
- b) Leguminous IFTS such as *Cajanus cajana* improves soil fertility
- c) Some IFTS have fast growth rate
- d) Most IFTS are drought resistant
- e) Highly palatable
- f) Fruit trees improve food security and nutrition

7.2 Negative aspects of IFTS

Major negative aspects connected with IFTSs are:

- a) Big trees, like *Ficus* spp. grow to a great height, making their forage difficult to harvest.
- b) Slow growth
- c) There is a danger of creeping and climbing trees and shrubs smothering other crops.
- d) Variation in fodder availability (quantity) across seasons Difficulty of integrating most of the IFTS into the cropping system Bitter taste (e.g. *Vernonia* spp.)
- g) Competition between humans and animals
- h) Difficulty in propagating planting material Thorns and spines (e.g. *Acacia*) affecting intake
- j) Pests and diseases
- k) Low fodder yields
- l) Some IFTS are poisonous (e.g. *Phytolaca* and *Lantana* spp.).

CHAPTER EIGHT

CONCLUSION

The multiple uses of IFTS in different agro-ecological zones of Uganda has led to both negative and positive effects. The negative effects are related to the disappearance of IFTS that are palatable to livestock or used for medicinal purposes, firewood, poles and charcoal. The positive effect is the need to explore farmers' knowledge on the use of IFTS and incorporating this knowledge into research projects to improve the availability of IFTS (quality and quantity). It is, therefore, recommended that research-extension institutions and farmers work collectively to build a sustainable livestock production system through efficient utilization of IFTS. There is also a need to intensify use of promising IFTS because of their multiple roles across farming systems. Many species are endowed with high levels of protein and hence are suitable as animal feed supplements, especially for dry season feeding. Further analysis of feeding value is required.

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Appendix 1: Most promising Indigenous Fodder Trees and Shrubs in crop/livestock farming systems in Uganda

Scientific name	Common name	Part used as fodder	Other uses	Major constraints	Propagation	Farm niches
	(Uganda local name)					
<i>Vernonia amygdalina</i>	Bitter leaf (mululuza)	Leaves and twigs	The leaves are used as: medicine to treat fevers in humans and livestock; vegetables and to stimulate digestive system;	Low fodder yields; Pests and diseases; Bitter probably due to anti-nutritional compounds	Cuttings	Scattered
<i>Ficus natalensis</i>	Fig tree, Back-cloth fig (mutuba)	Leaves and twigs	Bark cloth, live fence, shade	Slow growth and low fodder yield, High content of lignin	Cuttings and seedlings	Boundary
<i>Mangifera indica</i>	Mango tree (muyembe)	Leaves	Leaves and bark used to treat cough, fruits are source of vitamin C, mangoes are used in preservatives	Slow growth and low fodder yield	Grafting and from seedlings	Scattered
<i>Manihot spp</i>	Cassava (muwogo)	Leaves and peels	Tubers are used as food and leaves used as vegetables	Cassava mosaic, low fodder yield and high content of cyanide	Cuttings and seed	Scattered
<i>Sepium ellipticum</i>	(Musasa)	Leaves	Poles, timber, anti-viral properties, roots are used to treat chronic coughs and colds, the tree provides shade, firewood and charcoal	Slow growth, low fodder yield and competes with other crops	Seed	Scattered
<i>Sesbania sesban</i>	Sesbania, Riverbean	Leaves and twigs	Roots are used to treat fever and contraceptive	Slow growth and low fodder yield	Seed	Scattered
<i>Artocarpus heterophyllus</i>	Jackfruit (ffene)	Leaves, twigs and seeds	The roots are used to treat fever, the seeds can be roasted and eaten as groundnuts	Slow growth and low fodder yield	Seed	Scattered
<i>Mimusops bagshawei</i>	Mimusops, Red milkwood (musaali)	Leaves	The wood is used for timber, firewood, charcoal and carvings. The tree provides good shade. The fruits provide vitamin C	Slow growth and low fodder yield	Seed	Scattered
24						

Scientific name	Common name (Luganda local name)	Part used as fodder	Other uses	Major constraints	Propagation	Niche
<i>Persea americana</i>	Avocado pear (<i>ovakedo</i>)	Leaves and seeds	Boiled leaves are used to treat dehydration in humans and livestock. Avocado oil is used for hair and skin care	Slow growth, low fodder yields and many seedlings never produce fruits and sometimes the quality of fruits is very low	Seed and commercially propagated by cleft or grafting or budding	Scattered
<i>Moringa oleifera</i>	Horse-raddish tree	Leaves	Treats high blood pressure in humans. Used as firewood, poles, charcoal, shade, bee forage, live stakes, seeds are used to purify water	Competes with humans for medicinal purposes	Direct seedlings, seed and cuttings	Scattered
<i>Entada abyssinica</i>		Leaves	Prevents abortion in cows	Low fodder yields and slow growth	Wildings	Scattered
<i>Cajanus cajana</i>	Pigeon peas (<i>nkolimbo</i>)	Leaves, twigs and seed	Food and fodder	Low fodder yields and slow growth	Seed	Scattered
<i>Securinega virosa</i>		Leaves and twigs	Prevents abortion in cows, the slender branches are used to make fish traps while an infusion of various parts of the plant is used to relieve malaria,	Low fodder yields and slow growth	Wildings	Scattered
<i>Psidium guajava</i>	Guava (<i>mupeera</i>)	Leaves and fruits	Leaves are used to treat cough. The wood makes excellent firewood and charcoal. The fruits are very good source of vitamin C. Guava fruits are used in preserves, jam, jerry etc.	Low fodder yields and slow growth	Seed, wildings	Scattered
<i>Morus alba</i>	Mulberry (<i>Nkenene</i>)	Leaves and fruits	Juice is made from fruits. An antidotal, astringent and bactericide	Low fodder yields and slow growth	Seed and cuttings	Scattered
<i>Ficus ovata</i>	Ficus	Leaves	Poles, shade, soil conservation, live fence, boundary demarcation, white barkcloth, latex is used to treat ringworms	Low fodder yields and slow growth	Seed, wildings	Scattered

Scientific name	Common name	Part used as fodder	Other uses	Major constraints	Propagation	Farm niches
<i>Albizia coriaria</i>	Albizia	Leaves	Firewood, charcoal, poles, posts, medicine and soil fertility improvement	Low fodder yields and slow growth	Seed, wildings	Scattered
<i>Senna occidentalis</i>	Coffee senna, septicweed	Leaves	Used to treat constipation, worms, edema, asthma high blood pressure and a substitute for coffee	Low fodder yields and slow growth	Seed, wildings	Scattered
<i>Acacia spp.</i>	Acacia	Leaves and pods	Firewood, charcoal, poles and medicine	Low fodder yields and slow growth	Seed, direct sowing, wildings	Scattered
<i>Lantana camara</i>		Leaves		Harbours snakes, seeds are poisonous	Wildings	Scattered

NOTES