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Identification of indigenous tree and shrub fodder species in the Lake Victoria shore region of Uganda

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Abstract

A study to investigate livestock farmers' experiences with indigenous tree fodder in the Lake Victoria shore region of Uganda was carried out in Mukono, Wakiso and Mpigi districts, in 2003. It identified potential indigenous fodder species, their propagation, management and utilization. A formal survey approach was used. Multi-stage stratified sampling method was used to select farmers for individual interviews, using a semi-structured questionnaire. Each of the 3 districts constituted a stratum. Initial sampling purposively selected 2 sub-counties with high livestock population from each district. In subsequent stages, the selection of units (parishes, villages, farming households) was random. Results showed all livestock farmers sampled use indigenous tree fodder. Seasonal variations in the use of indigenous tree fodder exhibited a bi-modal pattern, with peaks between January - March and June - July. The increased dependency on tree fodder during these periods is mainly attributed to drought conditions resulting in scarcity of pasture. Farmers' preferences among indigenous tree fodder species were determined considering palatability, medicinal value, ability to increase milk production and coppicing ability. The priority species identified were *Vernonia amygdalina, Ficus natalensis, Sapium ellipticum, Artocarpus heterophyllus* and *Persea americana*. Others include *Securinega virosa, Acalypha bipartia, Sesbania sesban, Carica papaya* and *Manihot esculenta.* These trees and shrubs are used to feed livestock as well as serving other purposes like provision of firewood, medicines and for improving soil fertility. Several of these species have been domesticated on-farm, while the contribution of others to livestock production is still limited by their location off-farm. The study has identified indigenous tree fodder species with potential for supporting intensive livestock systems in the Lake Victoria shore region of Uganda. It recommends further research into their nutritive value, effect on livestock, adoption potential and economic viability.

Key words: Coppicing, livestock trees, fodder, livestock, management pastures

Introduction

In Uganda, smallholder dairy development can be a major catalyst in agriculture-led economic development if it can generate significant and regular income for producers, create employment and improve diets to rural and urban consumers. However, most smallholder farmers realise a rather low milk production due to poor composition of the fodder used. Cultivated grasses, banana stems and leaves as well as vines from sweet potatoes are the common source of fodder. Although these provide roughage, their nutritive value is low (Gerrits, 1999).

Fodder bank technology is an agroforestry intervention in which indigenous and exotic trees and shrubs are used to feed livestock. Local and exotic fodder trees potentially play an important role in livestock diet. Feeding protein-rich tree leaves to dairy animals can be profitable as these substitute expensive diary feed and increase production and fat content of milk. Generally, fodder trees play an important part in farming systems as they are more resistant to mismanagement than herbaceous legumes and can retain high quality foliage under stress conditions. Their deep-rooted nature enables fodder trees to tap water and nutrients deep in the soil profile (Gerrits, 1999; Kabirizi, 2003).

Indigenous fodder systems involve the use of locally growing trees and shrubs mostly growing in the wild with minimal or no management. For many years, these trees and shrubs have been used to feed livestock as well as serving other purposes like provision of firewood, medicines and for improving soil fertility. Indigenous fodder species have an advantage over exotic ones; they are well adapted to the local environment, farmers know how to use them and planting material is abundant. However, their contribution to livestock production is limited by their location away from the farm (Roothaert and Franzel, 2001; Gerrits, 1999).

Despite the importance attached to these fodder species by farmers, the focus of research and extension has largely been on exotic tree fodder species. The potential for indigenous species to support intensive livestock systems

remains to be assessed. This necessitates an understanding of farmers' evaluations of existing species: their attributes, utilization and effects on livestock production. A study, carried out in March 2003 identified indigenous tree and shrub species used as fodder in the three districts of the Lake Victoria shore region in Uganda. The purpose of this study was to provide an entry point for the management and utilization of indigenous fodder trees and shrubs on-farm to support intensive livestock production systems in central Uganda.

Methodology

The study area

The Lake Victoria shore region is situated in the southern part of Uganda. It covers the districts of Mukono, Wakiso, Mpigi, Masaka, Nakasongola, Luwero, Kiboga and Mubende, with a population of about 4,011,320 people, increasing at an average annual growth rate of 2.8 (UBOS 2003). The farming system is characterized by growing of bananas and robusta coffee. Other crops include maize, beans, tea, vanilla and horticultural crops. The livestock production includes rearing of dairy cattle, piggery, poultry, fish farming (NARO, 2001). However, livestock is kept in small numbers as a supplement for food and financial security (Nielsen *et al*., 1995; Mrema *et al*., 2001).

The Lake Victoria shore region receives lots of rain and is generally warm and humid. Rainfall is bi-modal, with the "first rains" falling between March and May. The second rainy season extends from August to November. Mean annual rainfall ranges from 1000mm to 2250mm. Average annual maximum temperatures range between 22.5°C and 27°C and average minimum temperatures vary from 18°C to 23°C. Average relative humidity ranges between 80 – 95 percent. The area is characterized by undulating terrain with flat-topped hills, large papyrus valleys and extensive river system. Cultivation is mainly done on the gentle slopes. Soils are deep but low in nutrients. Upland soils are deep-red, drain easily and have lost a lot of nutrients due to leaching. Poorly drained dark soils occur in the lowlands, mainly on the northern shores of the lake.

Tropical high forests, forest plantations, wood lots, bush land, grassland and wetlands comprise the main vegetation types. Medium altitude moist evergreen forests occur in well watered areas, while medium altitude, moist, semi-deciduous and secondary forests occur in the areas that were originally forested but have undergone repeated cultivation. Elephant grass (*Pennisetum purpureum*) and other grasses are dominant. Wetlands, comprising seasonally and permanent swamps mainly of papyrus and palms occupy the low-lying areas.

The region is characterized by intensive smallholder production of subsistence and cash crops. Robusta coffee is the main cash crop. Individual households are densely scattered over the zone, averaging 1-3 ha of land. The households grow crops in a variety of mixtures. Crops commonly grown in mixed cropping patterns include beans, cassava, sweet potatoes, yams, soya beans, maize, pumpkins, groundnuts and various indigenous and exotic vegetables. Isolated fruit trees are also common around homesteads and within banana – coffee gardens. Cattle are basically for milk, meat and occasionally cash. Many farmers have adopted zero grazing as a viable enterprise. Cattle are also increasingly kept to provide manure, which in some cases is sold. Goats and pigs are kept for sale and home consumption (Oluka-Akileng *et al*., 2000).

Sample selection

A multi-stage stratified sampling method was used to select farmers for individual interviews, which followed a non-formal approach using semi-structured questionnaires. At the initial stage of sampling, the three districts were randomly selected from the Lake Victoria shore region. In each of the three districts, two (2) sub-counties with high livestock populations were purposively selected. During subsequent stages, selection of units was random. A parish was selected from each sub-county of study. In each parish, two (2) villages were selected. Within each selected village, ten (10) farmers were randomly chosen with the assistance of the Local Council 1 Chairperson using the village register as the sampling frame. A total of 123 farmers were selected for the survey, with 42 selected from Mukono, 39 from Mpigi and 42 from Wakiso (Table 1).

Preparatory visits were made by 2 members of the research team to all 24 selected villages to establish contact with the Local Councils, introduce the study and explain its objectives. It also served to ascertain the presence of village registers and where unavailable, arrange for compilation of a sampling frame. During these visits, the study instrument was pre-tested and appointments for the main survey made.

Data collection, entry and analysis

Data were collected from the field using questionnaires and coded in the office. Data entry using Ms-Excel, was done in two stages. First, frequencies were used to determine most widely used species. More data was entered on the 20 most frequently used species. For some variables, ratings and rankings were converted to rating / ranking points. Analysis was done using SPSS for Windows 9.0. It mainly involved use of descriptive statistics to derive frequencies and averages. The results are presented in summary tables and graphs.

Results

Characterization of farmers

Out of the 123 livestock farmers interviewed, 51% were males with average age of 52 years while 49% were females aged 45 years. Overall, land size averaged 5.6 acres though there were significant variations between farms (Table 2). About 73% of the livestock farmers interviewed had less

Table 2. Farmer characteristics in the study area

Districts	Farmer characteristics				
	Males (%)	Females (%)	Age (yrs)	Land size (acres)	Family size
Mukono	59.5	40.5	49.0	3.4	8.2
Wakiso	38.1	61.9	49.2	6.9	8.7
Mpigi	56.4	43.6	46.8	6.2	7.8
Overall	**51.0**	**49.0**	**48.4**	**5.6**	**8.3**

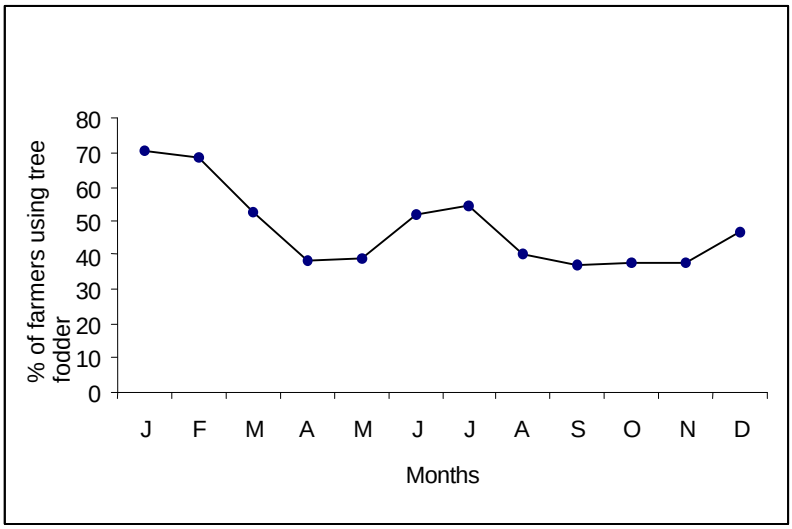

Figure 1. Seasonal use of indigenous tree fodder in the Lake Victoria shore region.

than 6 acres of land. Male respondents owned relatively larger farms on average (6.2 acres) than females (4.8 acres). Family size averaged about 8 persons, though slightly higher in Wakiso district. Most (88%) respondents were married, while 7% and 5% were widowed and single respectively.

Use of indigenous tree fodder by farmers

About 40% of respondents use indigenous tree fodder throughout the year. Livestock farmers in rural areas tended to fall in this category more than their peri-urban counterparts. The majority of livestock farmers indicated 3 to 6 peak months during the year when dependency on tree fodder is high. Seasonal variations in the use of indigenous tree fodder exhibited a bi-modal pattern. The major peak periods are January to March and around June to July (Figure 1). The increased dependency on tree fodder in these months was mainly attributed to dry weather conditions resulting in scarcity of pasture.

Farmers' criteria for selection of priority fodder species

The purpose of identifying fodder selection criteria was to establish what farmers value when selecting and rating indigenous tree fodder species. Palatability of fodder to livestock was described as the ease with which livestock consumed the edible parts of the tree / shrub. This was said to vary widely between livestock types. For instance, young stems of many indigenous fodder trees / shrubs are quite palatable to goats and sheep, but not cattle. The medicinal importance of a tree / shrub was highly considered by farmers. It was indicated that the health of livestock is a crucial concern to livestock farmers and they incur huge expenses on veterinary care. Fodder species that treat or prevent livestock diseases were rated quite highly, especially those that treat multiple diseases. *Vernonia amygdalina* is widely used to treat fever and worms in livestock.

The ability of a fodder species to increase milk production, both in quantity and quality, was a strong attribute farmers considered. However, farmers found difficulty in attributing the increase in milk to a particular indigenous fodder species, given the feeding regimes used (i.e. wild browse or cut and carry in various combinations). Similarly, increase in meat production (or rate of animal growth) was not easily attributable to particular indigenous tree / shrub fodder species. Farmers also seemed to strongly relate weight gain with the health status of the animals, rather than the fodder types *per se*. Other factors considered included the ability to re-grow after cutting back or browsing. Those that regain foliage rapidly are a more reliable source of fodder compared to those that do not re-sprout. Much as this attribute is recognized to be important by livestock farmers, it is not closely monitored in wild browse systems. Scanty information was available though on some on-farm fodder trees / shrubs like *Ficus natalensis, Sapium ellipticum* and *Vernonia amygdalina* that have for long been domesticated.

Table2. Indigenous tree and shrub species commonly used as fodder in the Lakeshore region

Scientific name	Local name	% of livestock farmers using species			
		Lakeshore (N=123)	Mukono (n=42)	Wakiso (n=42)	Mpigi (n=39)
Vernonia amygdalina	Mululuza	87.0	85.7	90.5	82.1
Ficus natalensis	Mutuba	65.9	52.4	64.3	61.5
Sapium ellipticum	Musasa	62.6	61.9	61.9	38.5
Artocarpus heterophyllus	Fene	51.2	54.8	45.2	30.8
Persea Americana	Ovakedo	29.3	31.0	28.6	12.8
Securinega virosa	Lukandwa	19.5	0.0	23.8	18.0
Acalypha bipartia	Gerengeza	15.4	4.8	2.4	20.5
Sesbania sesban	Muzimbandegeya	13.8	2.4	19.1	0.0
Carica papaya	Mupapali	13.0	7.1	4.8	7.7
Manihot esculanta	Muwogo	9.8	4.8	2.4	5.1
-	Nkomakoma	8.1	0.0	0.0	25.6
Mangifera indica	Muyembe	6.5	4.8	4.8	7.7
Acacia hockii	Kasaana	6.5	2.4	2.4	10.3
Albizia zygia	Nongo	5.7	0.0	4.8	12.3

Table 3. Ranking indigenous tree / shrub fodder species according to use and preference

Scientific Name	Local Name	*% of farmers ranking spp. among top three (n=123)*		*Overall ranking from top 3 spp.*	
		Used	*Preferred*	*Used*	*Preferred*
Vernonia amygdalina	Mululuza	85.4	85	1	1
Sapium ellipticum	Musasa	81.3	78.5	2	2
Ficus natalensis	Mutuba	75.0	71.6	3	3
Artocarpus heterophyllus	Fene	54.7	61.2	4	4
Securinega virosa	Lukandwa	43.8	46.2	5	5
Persea americana	Ovakedo	26.7	27.6	6	6
Acalypha bipartia	Gerengeza	6.5	4.9	7	7
	Nkomakoma	5.7	3.2	8	9
Sesbania sesban	Muzimbandegeya	3.3	4.1	9	8
Mangifera indica	Muyembe	3.3	1.6	9	11
Carica papaya	Mupapali	1.6	2.4	11	10
Manihot esculanta	Muwogo	1.6	1.6	11	11
Bridelia micrantha	Katazamiti	1.6	0.8	11	14
Lantana camara	Kayukiyuki	1.6	0.8	11	14
Albizia zygia	Nongo	1.6	0.0	11	18

Indigenous tree and shrub species used as fodder

Individual farmers were requested to mention any indigenous tree or shrub fodder species commonly used. On average about 5 indigenous tree / shrub species used as fodder were given by a farmer. The most common were *Vernonia amygdalina, Ficus natalensis, Sapium ellipticum,* Artocarpus heterophyllus,* *and Persea americana*. Others* include *Securinega virosa, Acalypha bipartia, Sesbania sesban, Carica papaya, Manihot esculenta, "Nkomakoma" and Mangifera indica.* Table 3 gives a summary of the indigenous tree and shrub species commonly used as fodder in the Lake Victoria shore region by districts while Table 3 presents a ranking of the trees and shrubs according to use and preference.

The parts of trees or shrubs fed and the feeding methods vary between species and livestock types. The leaves and twigs of most indigenous tree / shrub fodder species, except *F. natalensis, M. indica* and *A. hockii* are fed to animals. The bark of *S. ellipticum* and fruit of *A. heterophyrus* are also eaten by goats and pigs respectively. The feeding method for taller species like *F. natalensis, A. heterophyllus, P. americana,* and *S. ellipticum* is mainly cut-and-carry. Farmers also graze their livestock on wild stands of *V. amygdalina, S. ellipticum, S. virosa, A. bipartia* and other low growing species. *V. amygdalina, S. ellipticum* and *S. virosa* are commonly used both as wild browse and cut-and-curry feeding methods. Table 4 gives the feeding methods used for indigenous tree fodder.

Table 4. Use of various indigenous tree fodder species

Species	*Livestock fed*	*Parts commonly fed*	*Feeding Methods*[1]
Vernonia amygdalina	Cattle, Goats	Leaves, twig	CC, WB
Ficus natalensis	Cattle, Goats	Leaves	CC
Sapium ellipticum	Cattle, Goats	Leaves, twig, bark	CC, WB
Artocarpus heterophyllus	Cattle, Goats, Pigs	Leaves, twig, fruits	CC
Persea Americana	Cattle, Goats	Leaves, twig	CC
Securinega virosa	Goats, Cattle	Leaves, twig	CC, WB
Acalypha bipartia	Goats	Leaves, twig	WB
Sesbania sesban	Cattle	Leaves, twig	CC
Carica papaya	Cattle	Leaves, fruits	CC
Manihot esculanta	Goats, Cattle, Pigs	Leaves, twig	CC
"NKOMAKOMA"	Local cattle, goats	Leaves, twig	WB
Mangifera indica	Crossed cattle, goats	Leaves	CC
Acacia hockii	Goats, local cattle	Leaves	WB
Albizia zygia	Crossed cattle, goats	Leaves, twig	WB
Bridelia micrantha	Crossed cattle, goats	Leaves, twig	CC
Lantana camara	Goats, local cattle	Leaves, twig	WB

[1] *CC= Cut and carry, WB= Wild browse*

Table 5 Locations for indigenous tree and shrub fodder species

Species	**Frequency of farmers mentioning location**							
	On-farm				**Off-farm**			
	Home-stead	*Farm boundary*	*Crop garden*	*Fallow land*	*Road-sides*	*Swamps*	*Forests*	*Range lands*
Vernonia amygdalina	10	15	24	48	21	6	13	33
Ficus natalensis	21	26	44	6	16	-	10	3
Sapium ellipticum	5	19	20	19	9	1	20	12
A. heterophyllus	37	1	16	1	5	-	11	1
Persea Americana	18	-	11	-	-	-	-	-
Securinega virosa	-	3	1	8	1	1	2	7
Acalypha bipartia	-	1	-	6	1	-	1	5
Sesbania sesban	1	3	2	-	-	1	-	1
Carica papaya	4	1	-	-	-	-	-	-
Manihot esculanta	-	-	5	-	-	-	-	-

Table 6. Propagation and management of indigenous tree and shrub fodder species

Species	**Frequency of farmers mentioning**							
	Propagation methods				**Management Practices**			
	Seed	*Seedling*	*Stem cutting*	*Wildlings*	*None*	*Pruning*	*Coppicing*	*Weeding*
Vernonia amygdalina	11	1	12	43	67	5	22	-
Ficus natalensis	1	-	66	2	11	43	14	7
Sapium ellipticum	6	1	2	31	46	15	4	2
A. heterophyllus	32	14	1	3	11	30	3	6
Persea Americana	16	8	2	3	6	16	1	4
Securinega virosa	-	-	-	7	13	-	4	-
Acalypha bipartia	2	-	-	3	6	1	3	-
Sesbania sesban	5	1	-	1	3	-	4	-
Carica papaya	3	2	-	1	4	-	1	1
Manihot esculanta	-	-	5	-	-	1	2	2

Most indigenous tree fodder species exist both on-farm and off-farm. Naturalized species like *P. Americana, C. papaya* and *M. esculanta* only occur on-farm, grown in homesteads and on croplands. *V. amygdalina* most commonly grows on fallow land and rangelands. *F. natalensis* grows mainly on cropland, though boundary, homestead and roadside stands also occur widely. *S. ellipticum* and *A. heterophyllus* both exist on crop gardens and in forested areas. *A. heterophyllus* is, however, more common in homesteads while *S. ellipticum* also occurs on fallow land and farm boundaries. *S. virosa* and *A. bipartia* are common in fallow lands and rangelands. Table 5 summarizes the locations of the various species.

Few farmers carry out deliberate propagation and management of indigenous tree fodder. Species like *V. amygdalina, S. ellipticum* and *S. virosa* are propagated by use of wildlings. Naturalized species that are also grown for fruits are commonly propagated by seeds and seedlings. Stem cuttings are widely used to propagate *F. natalensis* and *M. esculanta*. *V. amygdalina* is also occasionally propagated using this method. Management mainly includes coppicing for species like *V. amygdalina, F. natalensis* and *S. virosa* and pruning for *F. natalensis, A. heterophyllus, P. americana* and *S. ellipticum*. Table 6 shows the propagation methods and management practices for various species.

Discussion

Livestock production in the Lake Victoria shore region is intensive due to small land holdings limiting the number of livestock kept and feeding methods. Livestock is largely kept in small numbers as a supplement for food and financial security (Nielsen *et al*., 1995; Mrema *et al*., 2001). In these intensive systems livestock production is predominantly home based and the role of women is significant even though land and livestock ownership is controlled by men.

These findings agree with Boffa *et al.* (unpublished) and Nielsen *et al.* (1995) that *Ficus natalensis, Sapium ellipticum, Vernonia amygdalina* and *Albizia zygia* are important fodder species in the lakeshore region. They note that although farmers observed livestock eating leaves from a few indigenous species, these trees are not deliberately used as fodder. The extent and frequency of use of tree fodder was found to vary between farmers. Although all livestock farmers surveyed use indigenous tree fodder, it was mainly used in the dry season when grass pastures are scarce. Trees, being deeper rooted than grasses, produce greener fodder during the dry season (Roothaert *et al*., 1997). With increasing intensification of dairy farming in the Lake Victoria shore region and others, the need for reliable supplies of fodder throughout the year is indisputable. The systematic growing of indigenous species will diversify the few exotic species currently in use. The study also showed that when alternative sources of forage are available, indigenous tree fodder is only used for medicinal purposes both as a preventive and curative measure. Thus, medicinal species are highly preferred given that veterinary services are unaffordable to resource-constrained farmers and are also unavailable in many rural areas.

Improved cows on most smallholder farms realize low milk production due to poor composition of the fodder. Palatability of a fodder is an important attribute to the farmers as their main concern is to feed and satisfy the animals since most of them are unaware about the basic requirements for normal growth and production in livestock. They do not realize the importance of balancing the diet of the animals. Although the species ranked as highly palatable have common characteristics (high protein and mineral concentration mainly found in the leaves and twigs), farmers found difficulty in attributing increase in milk production or change in animal welfare to particular fodder species. In wild browse methods, livestock feed on various grasses and shrubs. Even in cut and carry systems, a mixture of shrubs and grasses are often fed and it requires deliberate monitoring to determine their effect on livestock productivity.

The study has identified different types of indigenous fodder tree species. What remains to be done is a more deliberate domestication of the preferable species, and their screening for intensive fodder production. In particular, knowledge needs to be generated on their, genetic variability, propagation, biomass yields, ability to withstand intensive pruning, and nutritive value, including anti-nutritional factors. *Vernonia*, for example, contains anti-nutritional factors such as alkaloids, saponins, tannins and glycosides (Buttler and Bailey, 1973; Ologunde *et al*., 1992), which affect its intake. Studies by Bonsi *et al*. (1995) reported that boiling Vernonia for 30 minutes enhanced its acceptability in sheep. Similar studies need to be carried out on the other indigenous fodder trees.

Conclusion

Many tree and shrub species commonly used as fodder have been domesticated on-farm mainly for other purposes, other than fodder production. The contribution of indigenous fodder trees to livestock production is still limited by their location off-farm. The study has identified the indigenous tree fodder species with potential for supporting intensive livestock systems like the Lake Victoria shore region in central Uganda. Since most of the indigenous tree fodder species are multipurpose, (*V. amygdalina, Ficus natalensis, Sapium ellipticum, Artocarpus heterophyllus* and *Persea Americana)* research is needed to determine management techniques that optimize multiple products rather than maximize one product.

The information obtained from the suggested future studies will ensure proper integration of these species in intensive livestock production systems in other regions of Uganda.

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