

# Feed resource utilization in intensive dairy goat production systems

Dr. Jolly Kabirizi  
 Livestock Consultant  
 Small-scale dairy and goat farmer

## Introduction

Goats provide a major source of protein in form of milk and meat. In areas where cow milk is scarce, particularly where land holdings are small like in Uganda, goat milk could be a solution to home milk demands. Goat milk is closer in composition to human milk than milk from the cows and, therefore, an excellent baby food. In many peasant societies in Uganda, goats form a major investment and contribute a big percentage of the home's income. Often poor families invest their small savings into goats and these multiply fast. The accumulated goats besides providing food can be sold to generate cash to solve various home demands such as medical bills at any time of the year, particularly when cash crops are not yet ready and can be exchanged or sold to acquire bigger assets such as cows or land. Goats are essential in various ceremonies and festivals. Due to their relatively low value compared to cows, goats are frequently used as gifts. In some societies, they form part of the bride wealth or dowry. Goat manure is an important source of fertilizer. It contributes to soil fertility thus improving crop yields. Goats utilize the often-wasted crop residues and increase the overall farm income.

## Locally available feed resources and their chemical composition

Major feed resources and their seasonal availability are shown in Table 3. The major feed resources are: planted fodder, crop residues, natural pastures, agro-industrial by-products and water. The chemical composition (dry matter content and crude protein content) of available feeds is shown in Table 4. Table 5 shows estimated proportions of overall dry matter intake at household level.

**Table 3: Seasonal calendar of major local feed resources in the highlands of Eastern Uganda**

Source	Month											
	J	F	M	A	M	J	J	A	S	O	N	D
Crop residues	■	■	■	■	■	■	■	■	■	■	■	■
Planted fodder	■	■	■	■	■	■	■	■	■	■	■	■
Indigenous fodder trees	■	■	■	■	■	■	■	■	■	■	■	■
Weeds	□	□	□	□	■	■	■	■	■	■	■	■
Agro-industrial by-products	■	■	■	■	■	■	■	■	■	■	■	■
Natural pastures	■	■	■	■	■	■	■	■	■	■	■	■
Water	■	■	■	■	■	■	■	■	■	■	■	■

Not available  Very low quantity  high quantity

The contribution of planted forages such as elephant grass, forage legumes and fodder trees to the diet of goats is very high. Elephant grass (*Pennisetum purpureum*) also known as Napier grass is grown widely throughout the district. However, the average acreage of planted elephant grass is too low (less than 0.2 ha) to sustain goat production throughout the year. Majority of the households planted elephant grass around their banana fields. The number of plants ranged between 50-100 per household. It was also observed that where elephant grass was planted as a fodder bank, management (spacing, weeding, fertilizer application, harvesting) was not done as recommended. Plants were being harvested at about 30 cm above ground level resulting in poor regrowth and low fodder yields. Many of the fields visited showed symptoms of nitrogen deficiency and all of them had been attacked by the Napier stunt disease causing a reduction in fodder yield.

The quantity and quality of elephant grass depends on the season (Table 5).

**Table 4: Dry matter and crude protein concentration of major available feed resources in the highland areas of Eastern Uganda**

<b>Feed resource</b>	<b>DM (%)</b>	<b>CP (%)</b>
Elephant grass	25.1	7.5
Other grasses from roadsides	58.1	6.8
Maize stover	59.9	4.1
Banana peels	18.4	6.5
Sweetpotato vines	45.4	16.7
Mango leaves	61.13	9.6
Cassava leaves	25.4	25.4
Jack fruit leaves	55.4	13.8
Banana leaves	28.9	8.5
Bean haulms	22.4	13.5
Banana stems	5.3	5.2
Fresh lablab herbage	24.9	22.7
Fresh calliandra	40.9	28.3
<i>Vernonia amygdalena</i>	48.7	16.3
Ficus leaves	38.3	16.5
Dairy meal	89.5	16.0
Maize bran	88.0	10.8
Cotton seed cake	87.0	41.2

**Table 5: Estimated proportion (%) of overall dry matter intake of major sources of goat feeds in Eastern Uganda**

Source of feed	*Estimated proportion (%) of dry matter of various feeds	
	Wet season	Dry season
Elephant grass fodder	58	35
Maize stover	0	5
Natural grasses	16	4
Weeds from cropped land	4	0
Green maize thinnings	1	0
Banana residues	17	55
Indigenous fodder trees and shrubs	5	15
Leguminous forages	4	1
Mineral supplements	0	0
Concentrate	0	0

\*It is estimated that a dairy goat eats 3-4% of its liveweight

The low quantity and quality of elephant grass during the wet and dry seasons has a negative impact on dry matter intake (Table 5). Reports from farmers showed that elephant grass dry matter intake declined by about 50% during the dry season. This was mainly due to a decline in forage yields. Farmers are therefore forced to harvest young plants resulting in poor regrowth.

Major fodder trees planted are *Calliandra calothyrsus* (calliandra), *Leucaena leucocephala* (leucaena) and *Gliricidia sepium* (gliricidia). Although a few (5-10) gliricidia trees were found on over 50% of the households visited, farmers were not using it to feed their goats. They claimed that gliricidia is not palatable to goats. Gliricidia contains anti-nutritional factors that make it unpalatable. It can, however, be improved by wilting or drying it (leaf hay) before offering it to the goats.

*Lablab purpureus* (lablab) is one of the major herbaceous forage legumes fed to goats. The legume produces high biomass yield and is tolerant to drought but majority of farmers had planted a few (less than 30) plants scattered in banana plantation. Poor cutting management of lablab forage resulted in low yields. For proper regrowth, lablab plants should be cut when about 30% of the plants have flowered. The plants should be cut at about 30 cm above the ground and above the branches (Kabirizi, 1996). With decreasing availability of feed from natural sources and increasing reliance on crop residues, the production of supplementary forage legumes and fodder trees that are compatible with the existing cropping systems would be one of the most viable options of improving feed supply on these smallholder farms.

Over 80% of the land is under food crops. Crop production provides a range of residues and agro-industrial by-products that can be utilized by goats. Major field crops, produce large quantities of crop residues such as banana based residues (peels, pseudostems and leaves); cereal by-products (straws, stovers and haulms) in addition to grain, the main product; grain legume haulms (e.g. beans, groundnut, peas), sugar cane tops and root crop tops and vines (cassava and sweet potato) (Table 2). Food/feed crops can simultaneously meet the food needs of the farm families and the feed needs of their goats. The most important components of the crop residues are the leaves and stems that remain after the edible parts (grain, roots and fruits) are harvested. Other parts such as the stems are less palatable to the goats because of the high fibre content.

Sweetpotatoes are planted in March and July/August and are harvested for roots in June and November. Sweet potato vines are therefore fed to goats during drought (June to October). In addition to the vines, damaged tubers that are unfit for human consumption are fed to goats. This enables the transformation of a product that would otherwise be wasted into a more useful product and enhance the efficiency of resource utilization. In general, in densely populated and land scarce areas such as the Highland areas of Eastern Uganda, sweet potato vines and tubers have a promising potential for use as goat feed because of their relatively short vegetative cycle and high yield potential with minimal horticultural practices. Sweet potato has a vegetative cycle of 4-5 months fitting into tight cropping systems. The principal nutritive value of the sweet potato vines is as a source of protein which is about 18% CP). The dry matter yield of sweet potato vines can be as high as 4-6 tones/ha with a crude protein content of over 20% and digestibility of about 70% (Kabirizi, 2006). Sweet potato vines particularly from the new varieties e.g. “yellow orange fresh variety” have good palatability because of higher CP and vitamin A content. However, because of very high water content (83-88%), sweet potato vines are more important for growing than for lactating goats. When offered to lactating goats, they can only support sub-optimal levels of production because of dry matter (DM) intake limitations.

Indigenous fodder trees and shrubs (IFTS) play an important role in bridging the gap in fodder supply during the critical dry months. Being perennials, IFTS are better able to withstand prolonged periods of moisture stress than grasses and herbaceous forage legumes. Before the rains, IFTS are the only source of green forage available. Many IFTS, including cassava, *Vernonia* spp, mango and jackfruit leaves, and twigs are valuable feed resources for livestock. Fresh cassava roots, sliced, chopped or finely ground are consumed by goats. . Farmers estimated that IFTS contribute over 30 per cent of the total diet during the dry season. However, very little (less than 10%) of the IFTS is fed to goats during the wet season because there is plenty of green fodder.

### **Constraints for promoting and adopting improved feed resource technologies in intensive dairy goat production systems in Eastern region**

From field observations and information from the farmers, land shortage, unavailability/high cost of forage legume seed, and lack of knowledge and skills on forage establishment, management and utilization were identified as the major socio-economic constraints for promoting and adopting improved feed resource technologies.

Land scarcity and land fragmentation have direct implications on the quantity and quality of feed or level of feed investment smallholder farmers can make for improved goat production. Farmers own small pieces of land to support both fodder and food crop production. Land fragmentation is a serious issue in the highlands of Eastern Uganda and limits productivity and yet the population is high in all the sub-counties.

Field observations showed that the varieties of elephant grass that were planted had become susceptible to a new stunting disease. This disease has been reported to reduce fodder yields by 20-60% (Alicai *et al.*, 2004). Another factor that could have contributed to low dry matter yields

was the improper utilization of manure. Majority of the households prefer to use manure in banana plantations instead of the fodder fields.

A decline in soil fertility is the main cause of low fodder production in the district. Continuous cultivation of the same pieces of land without replenishment of soil organic matter and nutrients is one of the major causes of decline in soil fertility. Use of manure and planting of legumes are some of the appropriate soil fertility maintenance practices.

During discussion, the majority of farmers lamented to have inadequate knowledge on alternative feed resources such as the use of stover from maize/lablab intercrop, cassava leaf hay etc. Inadequate knowledge seemed to be, inter-connected and acted as a multiplier of other problems. Knowledge on types of feeds fed to goats, amount fed, regimes of feeding, quality of rations were identified as major constraints hindering goat productivity. Farmers do not have enough knowledge on both the nutritional requirement for the different classes of goats and knowledge on ration formulation for goats.

Fodder production and conservation require a lot of labour and capital. The most demanding activities are planting, weeding, manure application, harvesting, transporting, chopping, drying and conserving forages. It is also at this time when the same labour is required to plant or weed food crops. High capital requirements for establishing and managing fodder fields is a major constraint because farmers do not have enough capital to purchase the required inputs and later meet the labour costs for managing the forages.

### **Opportunities for adapting, promoting and adopting improved feed resource technologies**

#### **a) Improvement in feed supply, animal productivity and household income**

Improvement in feed supply (quality and quantity) results in better animal body condition and body weight. This in turn reduces incidences of animal diseases and lowers veterinary costs. The dry season coincides with the time of the year when maize grain is harvested. The farmers could therefore make use of crop residues such as stover from maize/lablab intercropping systems to fill the feed gap. Increased milk yield, maize and meat due to improved forage technologies has resulted in improved household income and welfare (Kabirizi, 2005).

#### **b) Supply of firewood from fodder trees**

Planting fodder trees such as calliandra and gliricidia improves feed quality by supplying the protein required by the animals. Fodder trees also improve supply of firewood. Women and children (after school) are in charge of searching for firewood, food and fodder. Using foliage from fodder tree to feed goats and the dry stems as a source of fuel enables the women and children to save time that would otherwise be used to search for firewood and/or feed to do other household tasks. It also protects the environment.

#### **c) Maximizes land utilization**

Intercropping forage legumes with elephant grass or/and maize maximizes land utilization because land shortage is a major constraint in the highland areas in Eastern Uganda. Farmers

observed that they could not accommodate any flexibility in the present cropping system due to very small land holdings; therefore forage cultivation technologies had not been popular. However, where land was available, it is often unproductive and of low quality.

**d) Weed control, soil moisture conservation and soil fertility improvement**

Intercropping food and forage crops (such as maize/lablab intercropping) reduces labour requirements for weeding. Although the initial establishment of lablab is very poor, once established, lablab plants are fairly drought and shade tolerant. With its spreading habit, fast early growth, and ability to grow with little soil moisture; lablab plants are effective in smothering couch grass weeds and quickly provide an effective ground cover to protect the soil from erosion.

**e) Improved nutrition**

With improved milk yield, farmers are able to improve nutrition of the families and maintain a small cash income. The availability of milk for families substantially improves the family nutrition especially of the children.

**Recommended feeding strategies for dairy goats for optimal productivity**

In order to improve feed supply, nutrient balance and content, and quantity of feed consumed throughout the year in smallholder goat production systems in the highlands of Eastern Uganda, there is a need to improve the nutritional value of low quality forages and crop residues. This can be achieved through supplementation. There is also a need to optimally exploit other feed resources available in the area and wide adoption of appropriate fodder conservation strategies.

Low quality feed resources such as crop residues and low quality forages cannot sustain effective goat production or even maintenance when fed alone because of their inherent nutrient deficiencies (Table 4), low digestibility and limited intake capacity of animals. Thus, provision of supplementary feedstuffs such as leguminous forages and concentrates is necessary to enhance the productivity of goats. Diets formulated from locally available protein and energy ingredients are cost-effective and have a potential for use as replacement to the conventional dairy meal in maintaining high milk production in the dry season.

**Proposed feeding calendar guidelines for dairy goats in the highlands of Eastern Uganda**

Using information collected during the study period and from literature review, the feeding calendar guidelines below were proposed (Table 6). The guidelines were intended to provide the nutrient requirements of the dairy goats during the wet and dry season. It is important to note that the feeding calendar will depend on the resources (land, labour and capital) available on the individual households.



**Table 6: Proposed Crop-fodder-labour calendar guidelines for dairy goats in Sironko, Manafwa and Mbale districts**

	March to May	June to August	September to October	November to February
	First rains	Short dry season	Second rains	Long dry season
<b>A. Major food crops available on farms</b>				
	Bananas Cassava Fresh Beans Fresh Groundnuts Fresh maize	Bananas Sweet potatoes Cassava Dry Beans Dry maize Dry Groundnuts Millet Sorghum	Bananas Cassava Fresh Beans Fresh Groundnuts Fresh maize	Sweet potatoes Cassava Dry Beans Dry maize Dry Groundnuts Millet Sorghum
<b>B: Fodder and Feed available on farms</b>				
<b>Basal diet</b>	Napier grass Banana leaves Indigenous fodder trees Crop residues (sweetpotato vines, cassava leaves etc) Natural pastures Conserved forages	Napier grass Banana leaves Indigenous fodder trees Crop residues (sweetpotato vines, cassava leaves etc) Natural pastures Conserved forages	Napier grass Banana leaves Indigenous fodder trees Crop residues (sweetpotato vines, cassava leaves etc) Natural pastures Conserved forages	Napier grass Banana leaves Indigenous fodder trees Crop residues (sweetpotato vines, cassava leaves etc) Natural pastures Conserved forages
<b>Protein supplement</b>	Calliandra fresh foliage Calliandra/gliricidia leaf hay	Calliandra fresh foliage Calliandra/gliricidia leaf hay	Calliandra fresh foliage Calliandra/gliricidia leaf hay	Calliandra fresh foliage Calliandra/gliricidia leaf hay
<b>Mineral supplement</b>	Urea Molasses Multinutrient Blocks Macklick mineral block or powder	Urea Molasses Multinutrient Blocks Macklick mineral block or powder	Urea Molasses Multinutrient Blocks Macklick mineral block or powder	Urea Molasses Multinutrient Blocks Macklick mineral block or powder
<b>Homemade concentrates (for milking goats)</b>	0.5-1 kg/goat/day	0.5-1 kg/goat/day	0.5-1 kg/goat/day	0.5-1 kg/goat/day
<b>Water</b>	Available throughout	Available throughout	Available throughout	Available throughout
<b>C: Labour availability</b>				
	Labour is available for planting and weeding food and fodder crops and goat management	Labour is available for land preparation and tethering goats	Labour is available for planting and weeding food and fodder crops and goat management	Labour is available for land preparation and tethering goats

**NOTE**

Protein supplements must constitute 30% of the basal diet; Water must be offered throughout the day/season

It is recommended that goats should be given an opportunity to reject the lower quality material (such as stems) offered, so that the ratio of utilization (feed consumed/feed offered) may be quite low if milk production is to be maintained. Forage allowance is further modified by the size of the animal and the daily intake as a fraction of body weight (3-3.5 % body weight) according to Nutrient Requirements of Dairy Cattle (NRC, 2001).



## **Conclusions and recommendations**

The local feed resource base for goat production in almost all villages visited was substantial to support the growing interest in dairy goat keeping in the highlands of Eastern Uganda. However the level and techniques of utilization of the feed resource base to sustain high productivity from the goat sector is still very low. Crop residues from banana are a valuable feed resource in the area and are available throughout the year. It should be used but not to constitute more than 30% of the daily ration. This should then be fed with other sources like legume tree foliage. Stripping of maize after tasseling should be a standard practice. The leaves should be dried under shade and tied in bundles for feeding during periods of scarcity. Haulms from beans should continue to be fed fresh because they do not dry easily. However groundnut haulms should be dried under shade and baled while avoiding excessive loss of leaves. All available space (as long as food crop production is not compromised) should be used to plant fodder tree legumes and elephant grass to maximize amount of forage produced on the farms. Farmers should plant high yielding and stunt resistant varieties of elephant grass to maximize yield per stool. As much as possible manure should be returned to the elephant grass stools to maintain soil nutrient status. Trees should be managed in such a way as to obtain maximum benefit. Recommended cutting heights and intervals should be observed.

To obtain the maximum amount of dry matter for conservation, the legume fodder trees should be given a longer growing period (without harvesting) in the months of June to September; then harvested in October and dried to make hay. In the first rains they should be harvested regularly and fed fresh. While the legume trees on the edge of the gardens should be cut at a height of 1-2 feet from the ground, those intercropped within the banana garden should just be stripped of the leaves, leaving the growing shoots. This allows them to compete with the bananas and the farmer obtains more wood for use as fuel. When harvesting fresh maize for use in the home, cut the whole plant. Either feed the whole plant to the goats or conserve. In the second rains plant legume forages which are resistant to draught like lablab. Sweet potato should also be planted in the second rains as it withstands draught and will supply feeding materials well into the dry season.

Cassava leaves should be harvested and dried for use as a protein supplement. They should never be fed fresh.

## **Acknowledgement**

We acknowledge the financial support from FARM Africa. We thank the National Coordinator, Agricultural Research Component of the Agricultural Sector Programme Support (ASPS), a DANIDA funded programme, for the technical and material (transport, computer and office facilities) support. Special thanks to the local leaders and farmers in Manafwa district for their cooperation.

## REFERENCES

1. Alicai, T.; Kabirizi, J.; Byenkya, S.; Kayiwa, S. and Ebong, C. 2004. Assessment of the magnitude and farmers' management practices of the elephant grass stunting disorder in Masaka district. Survey Report.
2. Kabirizi, J. 1996. Productivity and feeding value of *Lablab purpureus* cv. Rongai for lactating dairy goats fed elephant grass based diet. MSc Thesis. Makerere University.
3. Kabirizi, 2006. Effect of integrating forage legumes in intensive smallholder farming systems on feed availability and animal performance. PhD Thesis, Makerere University.
4. LSRP (Livestock Systems Research Programme) Report, 2000. District Diagnostic Survey Reports. Livestock Systems Research Programme (NARO/DANIDA/LSRP).
5. Mutetikka, D. and Kabirizi, J. 2006. Feeding Calendar Guidelines for Dairy Goats in Soroti, Manafwa and Sironko districts Uganda. FARM Africa/NARO/Makerere University Consultancy work.
6. NRC (Nutrient Requirements of Dairy Cattle) 2001. 7th edition. National Academy Press. Washington DC.
7. Odedo, R. 2003. Baseline survey of Mbale and Sironko districts covering Busano, Kaato, Bulegeni and Buteza sub-countries commissioned by Farm Africa. Final Report. October 2003.