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**Research article**

# Farmers' Knowledge on Forage Production in Smallholder Dairy Systems of Uganda

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## Abstract

The aim of the study was to assess dairy farmers' knowledge on forage production and utilization in the Lake Victoria crescent and Eastern Highlands Agro Ecological Zones (AEZs) of Uganda. Semi-structured questionnaires were administered to a total of 208 small holder dairy farmers in Masaka (100) and Mbale (108) districts. Data was analyzed using Statistical Package for Social Scientists. While the main source of forage is on farm (67.2%), forage growing is not taken as a tradition among small holder dairy farmers. The most prominent forage species used for feeding livestock are *Pennisetum purpureum*, *Calliandra calothyrsus*, *Musa paradisiacal* (peelings and stems), and *Leucaena leucocephala.* Milk production increases during months of forage abundance (March to May and September to November) and the observed trends are generally comparable to the seasonal rainfall patterns in Uganda. Forage production among dairy farmers is significantly ($P < 0.05$) influenced by location, household size, land ownership, forage source and livestock feeding system. Apart from chopping before feeding the animals, minimal processing is done to forage. The study provides a basis for designing interventions for improving fodder production and utilization among Uganda's smallholder dairy farmers.

**Key words:** Forage, seasonality, milk production, farmers' knowledge

## INTRODUCTION

Dairy farming is an important contributor to Uganda's agriculture Gross Domestic Product (GDP), accounting for an estimated 9% of total agriculture GDP and about 3% of the national GDP[1]. Milk consumption is estimated at 25 litres per person per year[2, 3]. Improved livestock breeds are mostly kept under intensive management on small and medium sized farms under zero grazing, tethering and paddock feeding systems. The indigenous breeds are kept under a less labour and investment intensive but lower yielding extensive free ranging system. Although exotic and cross breed cattle constitute less than 20% of the cattle population, they are estimated to produce 60% of all the milk in Uganda[4]. Extensive grazing can yield as low as 1-2 liters of milk per day per cow, while semi-intensive grazing yields vary from an average of 5 to 20 liters per day per cow and zero-grazing yields can go up to 30 liters[5]. This is partly due to quality and quantity of feeds accorded to the zero grazing livestock.

The need for cultivating cattle feed in Uganda has become urgent due to the rapidly declining natural grazing areas. According to Cheema *et al.,* [6], provision of forage of adequate nutritional quality is fundamental in ensuring increased livestock production in the developing countries. Tree fodders are richer in protein and mineral contents than natural grasses and thus can be supplemented to low quality grasses[7]. Planted grasses, forage legumes and improved fodder trees and shrubs can enhance forage availability and subsequently milk production. Forage trees and shrubs can also withstand extended periods of water stress as their deep root systems enable tapping of water and nutrients from deep into the soil profile[8]. In spite of these attributes, use of improved forage in Uganda's livestock systems is limited, and animal feed supplies remain largely dependent on wildly existing stands, which limits livestock productivity[5]. Seasonal shortage of such feeds, especially during dry spells, further impedes growth of the dairy sector in Uganda. Understanding farmers' knowledge on forage production and utilization is key to their promotion for enhanced smallholder dairy development.

## MATERIALS AND METHODS

### Study population

The study was conducted in L. Victoria Crescent and Eastern Highlands agro ecological zones (AEZs) between October and December 2013. Masaka and Mbale districts were purposively selected from L. Victoria Crescent and Eastern Highlands AEZs respectively. These districts are renowned for dairy farming interventions by institutions such as National Agriculture Research Organization [9, 10, 11], Masaka Diocesan Developemtn Organization[12] and VI Agroforestry Project Masaka [13, 14], working with small holder dairy farmers. In each district, respondents were selected for interviews using simple random sampling from a list of small holder dairy farmers obtained from the extension, forestry and agriculture officers, Non Government Organizations (NGOs) and Community Based Organizations (CBOs). Semi-structured questionnaires were administered to the small holder dairy farmers to generate information on existing forage sources, seasonality, post-harvest handling and farmers' perception on their

contribution to milk production. A total of 208 respondents were interviewed for the entire study in Masaka (100) and Mbale (108) districts.

## Statistical analysis

Questionnaire responses were coded and entered into the Statistical Package for Social Scientists (SPSS Version 16). Descriptive statistics were used to summarize farmers' responses on existing forage sources, livestock feeding systems and forage species. Data on forage use and availability, and milk production throughout the year was analyzed and presented in form of line graphs. A flow chart was used to show the major stages involved in forage post harvest handling and utilization based on farmers' knowledge. Logistic regression analysis was used to identify socio demographic characteristics influencing forage use and production among smallholder dairy farmers. All statistical tests were conducted at a 5% level of significance.

# RESULTS AND DISCUSSION

## Characteristics of smallholder dairy farmers

Results indicate that less than 50% of smallholder dairy farmers take forage growing as a tradition in Lake Victoria Crescent and Eastern Highlands Agro ecological zones of Uganda (Table 1). The farm is the main source of forage with a wide range of forage species and feed types being used by dairy farmers. The most prominent forage species are *Pennisetum purpureum*, *Calliandra calothyrsus*, *Musa paradisiacal*, and *Leucaena leucocephala* (Table 2). Most small holder dairy farmers in Uganda graze exotics and crossbred cattle in the wet season and introduce stall feeding, with cut fodder, in the dry season[15]. Indigenous cattle kept under the traditional extensive management system rely on grazing natural pastures for their entire nutritional requirements and often have limited pastures during the dry season. This is often accompanied by widespread invasion of unpalatable species, mainly *Brachiaria brizantha* and *Themeda triandra* [16]. The high potential for pasture and fodder productivity, and subsequent animal production in Uganda has not been fully exploited by dairy farmers.

**Table 1.** Characteristics of the forage situation on smallholder dairy farms

| Variables | District | | Overall |
|---|---|---|---|
| | Masaka | Mbale | |
| Number of farms sampled (N) | 100 | 108 | 208 |
| Forage growing as a tradition (%) | 47.9 | 45.3 | 46.8 |
| All year use of forage (%) | 85.0 | 94.4 | 89.4 |
| **Main sources of forage (%)** | | | |
| *On farm* | 74.0 | 60.0 | 67.2 |
| *Off farm (Gathered)* | 54.0 | 70.5 | 62.1 |
| *Off farm (Purchased)* | 14.0 | 18.9 | 16.4 |
| **Feeding systems (%)** | | | |
| *Zero grazing* | 77.1 | 49.0 | 63.0 |
| *Tethering* | 33.3 | 68.8 | 51.0 |
| *Paddocking* | 3.1 | 1.0 | 2.1 |

| | | | |
|---|---|---|---|
| **Type of Dairy cattle owned (%)** | | | |
| *Exotic cows* | 55.0 | 56.0 | 50.5 |
| *Cross breed cows* | 44.0 | 20.0 | 33.0 |
| *Local cows* | 27.0 | 74.0 | 49.5 |

Zero grazing is the most practiced livestock feeding system and more predominant in Masaka while tethering is most commonly practiced in Mbale district. Dairy farmers are also more inclined to deliberate planting of exotic fodder species like *Calliandra calothyrsus* and *Sesbania sesban* (Table 2) while indigenous species are mainly retained on farms. Only a small number of households keeping dairy cattle make effort to plant improved pastures[17], and consequently, very few farms produce enough fodder to meet the needs of their herds throughout the year[18].

**Table 2.** Major forage types used by small holder dairy farmers

| **Scientific name** | **Local/ Common Names** | **District** | | **Overall (%)** |
|---|---|---|---|---|
| | | **Masaka (%)** | **Mbale (%)** | |
| *Pennisetum purpureum* Schumach. | Elephant grass/ Bisagazi/Napier | 53.4 | 41.8 | 48.4 |
| *Calliandra calothyrsus* Meissn. | Calliandra/kaliandra/kaliyandra | 35.6 | 14.1 | 25.9 |
| *Musa paradisiacal* L. | Banana peels, leaves and stems | 24.8 | 25.1 | 25.1 |
| *Leucaena leucocephala* (Lam.) de Wit | Lusena | 10.8 | 22.5 | 16.8 |
| *Zea mays* L. | Maize stalks/ebisorisori | 9.2 | 19.9 | 14.8 |
| *Ipomoea batatas* (L.) Lam. | Sweet potato leaves / vines | 9.2 | 16.1 | 12.7 |
| *Vernonia amygdalina* Delile. | Mululuza/omululuza | 14.6 | 7.7 | 11.8 |
| *Lablab purpureus* (L.) Sweet. | Lablab/labu labu | 15.1 | 6.4 | 11.2 |
| *Ficus natalensis* Hochst. | Emituba | 12.4 | 9.6 | 11.2 |
| *Sesbania sesban* (L.) Merr. | Sesbania | 4.3 | 17.4 | 10.9 |
| *Persea americana* Mill. | Avocado leaves | 4.9 | 12.9 | 9.1 |
| *Artocarpus heterophyllus* Lam. | Ffene/Jack fruit | 5.9 | 6.4 | 6.3 |

Improved dairy cattle are still unaffordable among the poor farmers. According to MAAIF/UBOS[19], only 10% of the cattle rearing households in Uganda keep improved dairy breeds which produce 30.2% of the national total milk while production by indigenous cattle accounts for 69.8%. A milk production rate of 30.2% by 10% of the cattle rearing households is far much economical than the latter and this provides substantial evidence on the contribution of small holder dairy farmers to milk production as majority of them keep improved (exotic and cross) dairy breeds. However, there is need for promotion of commercial milk production systems such as small-holder intensive and medium-holder intensive dairy production systems among dairy farmers rearing indigenous cattle breeds. In addition to exotic breeds, supporting research in improving forage production and utilization among dairy farmers with indigenous cattle breeds can be a worthwhile intervention.

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## Seasonality of forage use and milk yield among smallholder dairy farmers

This study sought smallholder dairy farmers' perception and knowledge on variation in forage use and availability, and milk production in the different months of the year. Although dairy farmers generally use forage throughout the year, there are variations in forage availability to farmers and levels of milk production at different periods. For example, merged datasets from Mbale and Masaka districts show two distinct periods of acute forage shortage (i) from June to September and (ii) November to February, with correspondingly low milk production (Figure 1). Conversely, the months of abundant forage (March to May and September to November) are the corresponding months of high milk production based on farmers' knowledge (Figure 1). Apparently, milk production increases during months of forage abundance and vice versa. The observed trends are comparable to the seasonal rainfall patterns in Uganda. Balikowa[18] also acknowledged that the scarcity of milk in Uganda during the dry season was severe during the months of August and September of 2009 and 2010.

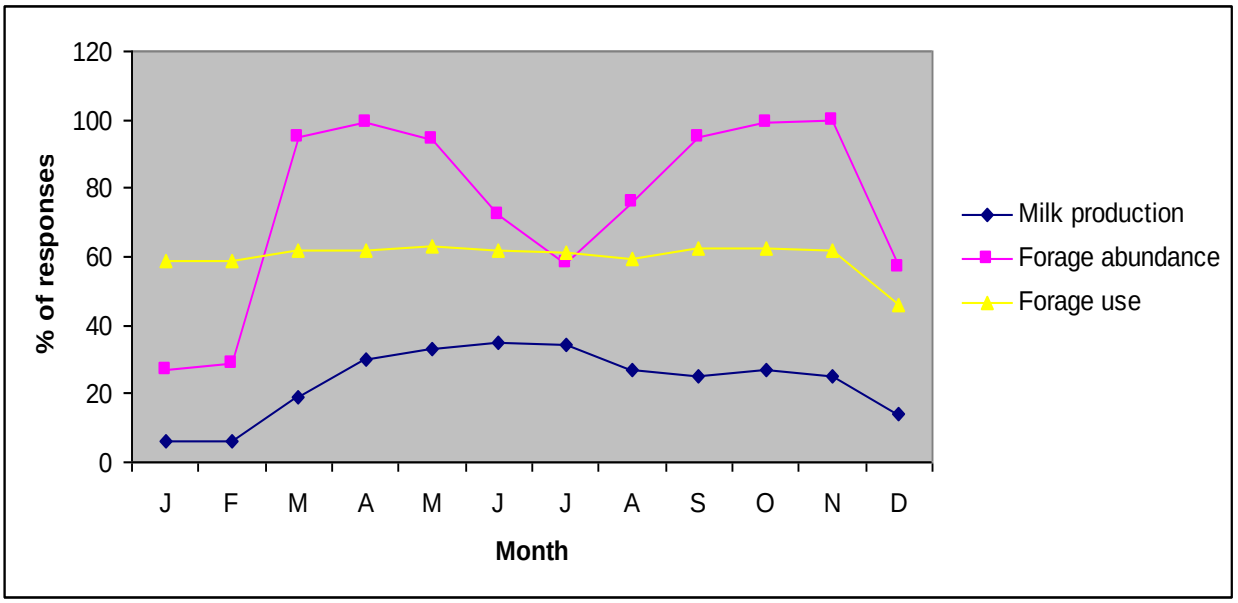


**Figure 1.** Seasonality of forage use and milk production

However, disaggregated data from the two study sites show different observable trends in forage use and availability, and milk production during different months of the year. In Masaka (Figure 2), a similar trend to the merged data can be observed in all the three indicators used, while Mbale depicts a different scenario (Figure 3). Mbale data shows one short period of forage shortage stretching from December to February, with the rest of the months having abundant forage and corresponding high milk production (Figure 3). Although rainfall in the Elgon region is generally known to be bimodal, with the first and second rains occurring in March - May and August–October respectively, bimodality is not very marked as some rain still occurs between the two peaks[20]. Similarly, the 2013 Vulnerability Impact Assessment (VIA) report for the Mt Elgon Ecosystem indicated that Mount Elgon

experiences intense dry spells from December to February. The local communities also reported a drastic change in rainfall pattern, timing and amount of rain, with erratic rains sometimes beginning as early as February. Local communities also reported that during some years, such as 2012, there was rainfall throughout the year and were notably heavier in 2013 compared to previous years.

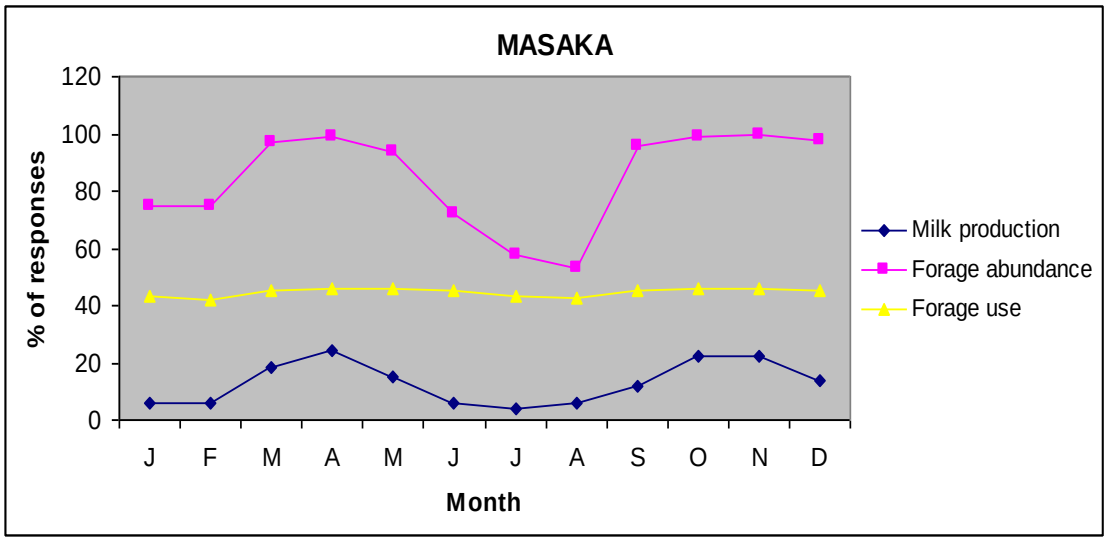


**Figure 2.** Seasonality of forage use and milk production in Masaka district

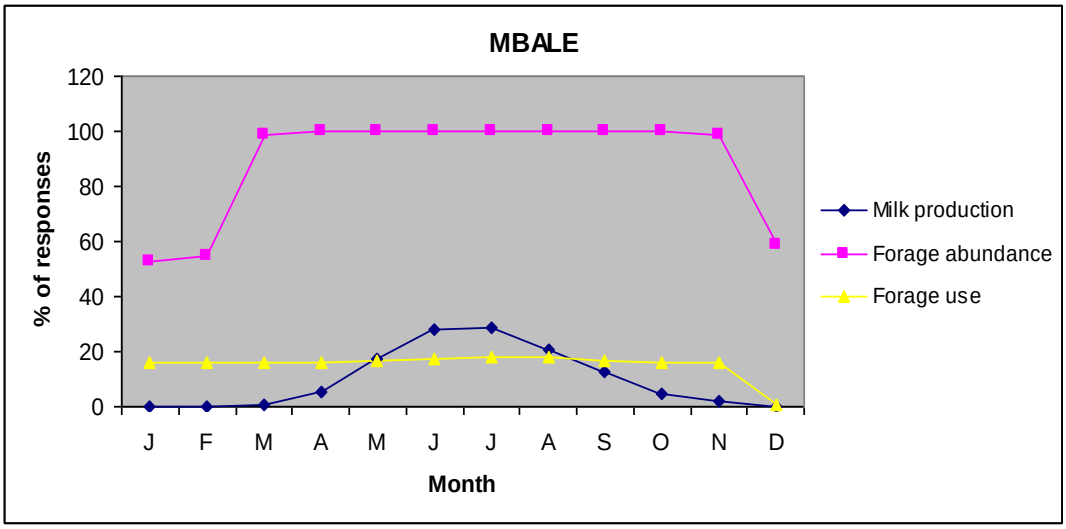


**Figure 3.** Seasonality of forage use and milk production in Mbale district

Although this study could not quantify the amount of milk produced during periods of forage shortage and abundance based on farmers' knowledge, the graphical trends show variations in farmers' perception on forage availability and milk production throughout the year. A study by DDA[21] shows that total national annual milk production has been gradually increasing, for example from 365 million litres in 1991 to over 1.5 billion in 2008.

However, the observed growth in milk production is mainly attributed to growth in the cattle population rather than increased milk productivity per cow[22]. Higher milk productivity per cow is still hindered by low adoption of improved livestock management practices and technologies such as fodder growing and utilization.

## Factors influencing on-farm production and utilization of forage

The logistic regression analysis of the socio-demographic characteristics of the farmers influencing on-farm forage production and utilization is shown in Table 3. Results indicate forage production and utilization was significantly ($P<0.05$) influenced by farmers' geographical location (district), household size, land ownership, source of forage and livestock feeding system. However, the influence of gender, education level, land size and duration in dairy farming was not significant ($P>0.05$). Studies by Fufa and Hassan[23] and Salasya *et al.*[24] also found out that factors including household size and land tenure influence farmers' adoption of new agricultural technologies

**Table 3.** Logistic regression of factors influencing forage use and production among small dairy farmers

| Variable | R | Odd ratio | Probability level | Sig. |
|---|---|---|---|---|
| District | 2.311 | 1.099 | 0.036 | ** |
| Gender of household head | 0.862 | 0.854 | 0.313 | ns |
| Age of household head | -0.099 | 0.500 | 0.844 | ns |
| Household size | 1.647 | 0.589 | 0.005 | ** |
| Highest Education level | 0.035 | 0.367 | 0.924 | ns |
| Main source of income | 0.336 | 0.416 | 0.419 | ns |
| Land size | -0.301 | 0.431 | 0.484 | ns |
| Landownership | 1.269 | 0.557 | 0.023 | ** |
| Years of dairy farming | -0.080 | 0.081 | 0.321 | ns |
| Feeding system being used | 3.499 | 0.719 | 0.000 | ** |
| Source of forage for livestock | 1.768 | 1.071 | 0.039 | ** |

*ns = not significant ** = significant at P≤0.01*

Household level characteristics such as household size, land ownership and access to extension services have always been considered as fundamental variables that can influence adoption of agricultural technologies. For example, Mugisha *et al.* [25] found that the farmer's family size, size of cultivatable land and household income influenced adoption of Integrated Pest Management technologies in Eastern Uganda. Similarly, Turinawe *et al.*[26] indicated that the demand for labor has direct implications for the adoption of agricultural technologies, with larger families more likely to adopt. Therefore, any interventions among smallholder dairy farmers should put in consideration factors such as household size, land ownership, forage sources and feeding system if the project is to be successful

## Forage post-harvest handling and Utilization

Majority of the dairy farmers cut forage and directly feed their cattle without any post harvest processing (Figure 4). In fact, apart from chopping before feeding to the animals, minimal processing is done to the forage. Forage preservation by sun drying, mixing with other grasses and tying to make hay only occur in isolated instances. According to Ekou [17], about 25% of the households in south western Uganda plant forage crops, mainly Napier and various legume species. However, only a small proportion (5%) of the farms, preserved fodder for dry season

feeding[18]. This could explain why most farms frequently experience severe shortage of forage during the dry season. Nonetheless, natural pastures which are nutritionally deficient[26] are the major component in the diet of both indigenous and improved dairy cattle in Uganda. Therefore most dairy farmers have not yet perceived the value of preserving naturally growing pastures with a presumption that they will always be at their disposal.

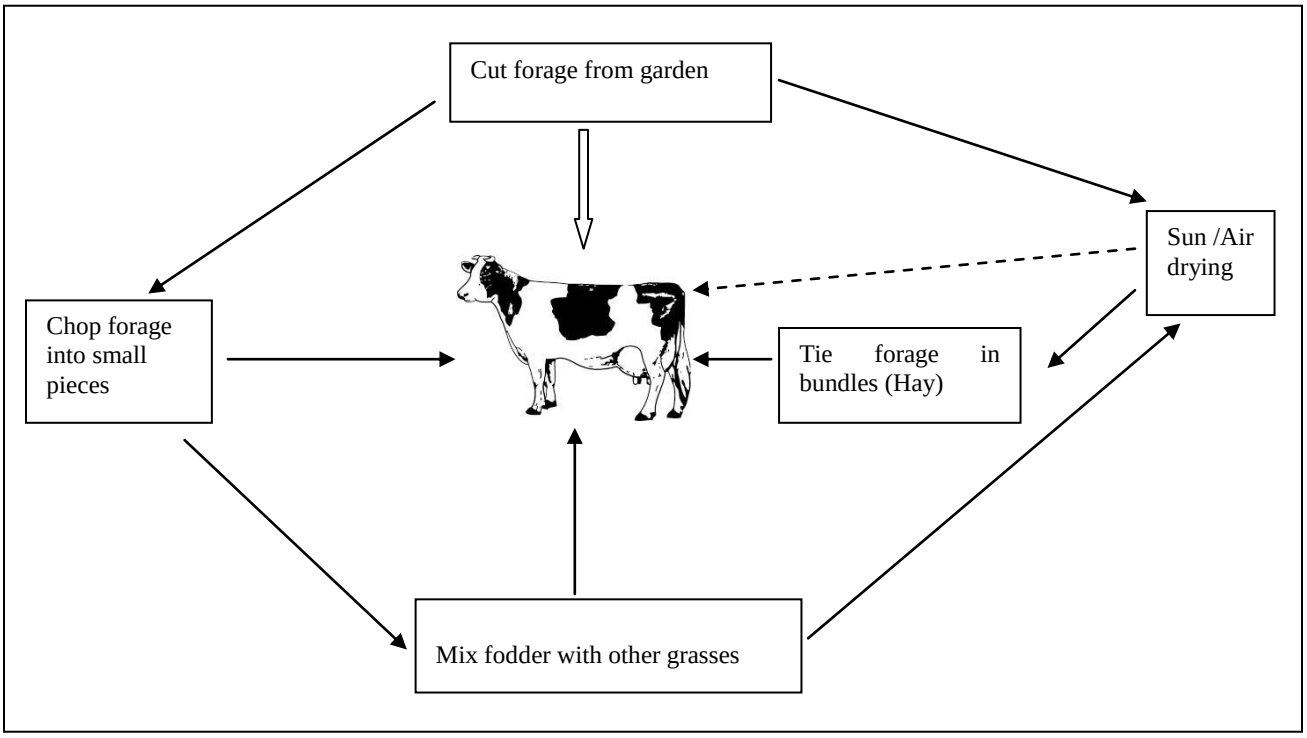


**Figure 4.** Farmers' knowledge on existing forage post-harvest handling options

## CONCLUSION

Most of the milk in Uganda is produced by smallholder dairy farmers who heavily rely on rain-fed natural pastures. Most dairy farmers have not yet perceived the value of growing and preserving forage with a presumption that they will always be at their disposal. A severe decline in the quantity and quality of pasture occurs during the dry season and consequently affect milk production. Research that can generate sustainable interventions should build on already existing indigenous traditional knowledge among target groups. This is because most local communities are hesitant to adopt entirely new interventions introduced to them. However, provision of tree/shrub fodder of adequate nutritional quality is fundamental in ensuring increased livestock production in Uganda's smallholder dairy systems.

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