The effectiveness of the volunteer farmer trainer approach vis-à-vis other information sources in dissemination of livestock feed technologies in Uganda

*Joan Kimaiyo, Evelyn Kiptot, Mercy Mwambi,
Jane Kugonza and Steven Franzel*

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Table of contents

About the authors	iii
List of tables.....	v
List of figures.....	vi
Acknowledgements.....	vii
Abbreviations and Acronyms	viii
Summary	ix
1.0 Introduction.....	1
1.1 Farmer access to extension information	1
1.2 East Africa Dairy Development project overview.....	3
1.3 Volunteer farmer trainers	4
2.0 Methodology	6
2.1 Study site.....	6
2.2 Sample selection	6
2.3 Data collection	8
2.4 Data analysis	8
3.0 Results.....	10
3.1 Demographics and socio-economic characteristics of interviewed farmers.....	10
3.2 Livelihood sources	12
3.3 Farmers' participation in farmer groups	14
3.3.1 Benefits derived from belonging to groups	16
3.3.2 Benefits derived from groups between females in male-headed households and female heads	17
3.4 Livestock ownership	17
3.5 Ownership, access and usage of information and communication technology	20
3.6 Farmer access to livestock feed information	21
3.6.1 Farmers' access to information on livestock feed technologies	26
3.6.2 Preferred sources of livestock feed information	28
3.7 Trainings on livestock feed technologies offered to farmers.....	33
3.8 Livestock feed technologies practised	36
3.8.1 Feed practices across different livestock feeding systems.....	39
3.9 Livestock feed technology preferences.....	43
3.10 Multiplier effect of information sharing by farmers to other farmers	47
3.11 Level of understanding of livestock feed technologies.....	49
4.0 Discussion.....	52
4.1 Comparison of volunteer farmer trainers to other information sources.....	52
4.2 Training in livestock feed technologies	54
4.3 Livestock feed technology preference, practices and sharing by farmers	55
Conclusion	57
References.....	58

List of tables

Table 1: Characteristics of sampled POs	8
Table 2: Demographic characteristics of interviewed farmers	10
Table 3: Comparison between female heads and females in male-headed households.....	11
Table 4: Characteristics of respondents in different livestock feeding systems	12
Table 5: Livelihood sources across male- and female-headed households	14
Table 6: Proportion of farmers participating in different group enterprises	14
Table 7: Male and female farmers' membership in farmer group enterprises.....	15
Table 8: Proportion of male and female farmers belonging to groups that engage in specific agricultural enterprises	16
Table 9: Benefits derived from participating in farmer groups by female heads and women in male-headed households	17
Table 10: Livestock ownership by household	18
Table 11: Livestock ownership between male-headed and female-headed households.....	18
Table 12: Average number of livestock owned between male- and female-headed households	19
Table 13: Livestock ownership across feeding systems	19
Table 14: Information technology ownership and access between male and female farmers.....	20
Table 15: Information technology ownership and access between male- and female-headed households	21
Table 16: Proportion of farmers accessing livestock feed information from each source.....	22
Table 17: Sources of information on livestock feeds.....	22
Table 18: Information sources between men and women in different household types.....	23
Table 19: Feed information sources by POs	25
Table 20: Access to livestock feed information sources by the different POs	26
Table 21: Farmer access to information on livestock feed technologies	27
Table 22: Types of livestock feed technologies accessed by females in male-headed households and female heads.....	28
Table 23: Preferred information sources defined by number of farmers.....	29
Table 24: Preferred information sources defined by weighted scores and ranking	30
Table 25: Information source preference across gender	31
Table 26: Effectiveness of information sources vs VFT by use of weighted scores	33
Table 27: Sources of livestock feed technology training.....	33
Table 28: Training frequency of different sources of training over a six-month period	34
Table 29: Training offered to farmers on different feed technologies.....	35
Table 30: Training offered on different feed technologies to female household heads and females in male-headed households	36
Table 31: Number of feed technologies practised	37
Table 32: Feed technologies practised by male-headed and female-headed households	38
Table 33: Feed technologies practised by female heads and females in male-headed households	39
Table 34: Number of feed technologies practised across feeding systems.....	40
Table 35: Feed technologies practised in different feeding systems	41
Table 36: Feed technologies practised across sites.....	42
Table 37: Livestock feed technology preferences by use of farmer frequencies.....	44
Table 38: Preferred feed technologies practised by gender through the use of weighted scores	46

Table 39: Feed technologies shared by farmers.....	47
Table 40: Number of technologies shared by farmers	48
Table 41: Proportion of farmers trained, practising and sharing feed technologies	49
Table 42: Farmers' level of understanding of livestock feed technologies	51

List of figures

Figure 1: Map of study area	6
Figure 2: Livelihood sources and strategies.....	13
Figure 3: Preferred information sources across age groups.....	32

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Abbreviations and Acronyms

ABS TCM LTD	African Breeders Service Total Cattle Management Limited
CGIAR	Consultative Group on International Agricultural Research
DADO	District Agriculture Development Office
EADD	East Africa Dairy Development
FTA	Forests, Trees and Agroforestry
HH	Household
ICRAF	World Agroforestry Centre
ICTs	Information communication technologies
IFPRI	International Food Policy Research Institute
ILRI	International Livestock Research Institute
MAAIF	Ministry of Agriculture, Animal Industry and Fisheries
NAADS	National Agricultural Advisory Services
NGOs	Non-governmental organizations
PIM	Policies, Institutions and Markets
PMA	Plan for Modernization of Agriculture
PO	Producer organization
SSA	Sub-Saharan Africa
T&V	Training and visit
TV	Television
UCC	Uganda Communications Commission
UNNF	Uganda National NGO Forum
VFT	Volunteer farmer trainer
WTO	World Trade Organization

Summary

Agricultural extension in developing countries has evolved from the traditional top-down approach to a more demand-driven farmer-centred approach. These changes have also led to improved involvement of non-governmental organizations (NGOs) and research institutions. Inadequacies displayed by the public extension in Uganda has led to the emergence of farmer-led extension delivery whose main mandate goes beyond technology transfer but also towards farmer-driven agricultural technologies and enhanced farmer capacities. One such approach is the use of farmer-to-farmer extension that targets farmers as the core instigators of change.

This study aimed to assess the effectiveness of the volunteer farmer trainer (VFT) approach, a form of farmer-to-farmer extension promoted by the East Africa Dairy Development (EADD) project, in dissemination of livestock feed technologies and practices in comparison to other information sources. This was done through a survey of 11 producer organizations (POs) in Eastern and Central Uganda. The POs represented different feeding systems: intensive, characterized by small land size and few cattle mainly focused on zero grazing; extensive, characterized by free grazing and a larger number of cattle; and semi-intensive which has characteristics of both intensive and extensive feeding systems.

In the study sites, most farmers accessed information on livestock feeds from PO extension assistants, followed by radio and VFTs. VFTs were found to be a preferred information source for female farmers both in male-headed and female-headed households. However, male farmers did not consider VFTs among the top three most preferred information sources. Male farmers often accessed information on feed technologies from PO extension assistants and radio, while female farmers accessed information from PO extension assistants and VFTs. Female heads of households accessed information from PO extension assistants followed by radio and VFTs while females in male-headed households accessed information from PO extension assistants followed by VFTs and National Agricultural Advisory Services (NAADS). Even though farmers interviewed were from POs, not all PO members sought information from PO extension assistants. The farmers interviewed in this study were all members of POs and, therefore, the results could be skewed towards POs extension assistants.

In terms of information source preference, POs extension assistants were most preferred, followed by NGOs and NAADS. VFTs came in fourth. When comparing VFTs' effectiveness and other most preferred information sources, VFTs were ranked second by male and female farmers. Effectiveness was measured with regard to accessibility, affordability, reliability and frequency of contact with farmers. PO extension assistants were ranked first while NAADS and NGOs were ranked third by male and female farmers.

Female farmers, both in male- and female-headed households accessed approximately similar feed technologies from the different sources with the exception of mucuna and setaria species. However, females in male-headed households accessed most feed technologies at a higher rate than female household heads. The most accessed feed technologies by females were Napier grass, sweet potato vines, Rhodes grass, lablab, utilization of crop residues and fodder shrubs. Male farmers, on the other hand, significantly accessed information on water harvesting, paddocking, bush clearing and perimeter fencing at a higher rate than female farmers ($p < 0.05$).

With regard to trainings offered to the PO members, the majority of farmers were trained by PO extension assistants (78%), 64% by NGOs and 58.2% by NAADS, while 53.5% received training from VFTs. Most of the trainers, including VFTs, only trained once or twice in a six-month period and most farmers (81.2%) often resorted to self-training. More than 50% of farmers were trained on Napier grass, fodder shrubs, silage making, hay making and mineral supplementation. A higher number of female farmers received training than male farmers. Furthermore, female farmers received training on Napier grass, mucuna, fodder shrubs, sweet potato vines, lablab, silage-making, utilization of crop residues and mineral supplementation at a higher rate than male farmers who received training mostly on management of dairy stock, perimeter fencing, bush clearing, weed control and paddocking. There was no significant difference between training received by females in both male- and female-headed households.

All farmers practised 3-10 technologies, with most farmers practising an average of eight technologies. The most practised technologies were Napier grass planting, mineral supplementation and utilization of sweet potato vines by 73.3%, 72.6% and 62.1% of farmers respectively. Male-headed households practised more of the feed technologies than female-headed households. Females in male-headed households were also found to practise more technologies than female heads. Across feeding systems, farmers in extensive systems practised bush clearing, perimeter fencing, paddocking, water harvesting and the management of dairy stock more than both intensive and semi-intensive systems. In intensive and semi-intensive systems, farmers practised Napier grass planting, utilization of crop residues, planting of fodder shrubs, use of lablab and sweet potato vines. The three most practised and preferred feed technologies were Napier grass, sweet potato vines and mineral supplementation, practised by 66.5%, 36.8% and 31.3% of farmers respectively. In terms of preferences by use of weighted scores, mucuna, Napier/elephant grass and paddocking were ranked first, second and third respectively. Mucuna was however practised by only 16 farmers.

Approximately 83.5% of farmers who had received training had trained other farmers. Training shared by farmers was similar to training received and practised. A higher percentage of farmers were trained but this proportion decreased with practice and the sharing of feed technologies. This study found that there is an average 9.9% decrease with farmers trained to farmers who practise, and a further 6.9% decrease with farmers sharing information from those who practise.

These findings therefore suggest that the VFT approach is an effective model for the delivery of information, especially to female farmers. The approach is considered less costly, accessible and reliable, and can reach farmers more frequently. Effectiveness of the VFTs can be enhanced by finding low-cost ways of motivating them to perform better.

1.0 Introduction

Food insecurity, extreme poverty and associated poor nutrition among the rural poor in sub-Saharan Africa (SSA), underline the need for extension to contribute to agricultural productivity and rural development (Kroma, 2003). Extension as defined by Christopolos (2010) is “...all the different activities that provide the information and advisory services that are needed and demanded by farmers and other actors...”. Various extension approaches have been adopted by SSA countries, for improved rural livelihoods and farm-related incomes. The currently adopted variety of extension approaches in SSA range from the training and visit (T&V) approach, participatory demonstration and training extension system in Ethiopia, decentralized market-oriented extension in Uganda, Kenya’s stakeholder inclusion, bottom-up planning and farmer common interest groups and farmer field schools in Rwanda, Senegal and Mozambique (Davis, 2009).

In Uganda, agriculture is the backbone of the national economy, and supports up to 65% of the country’s population (Wagubi, 2003). Agricultural output primarily comes from about three million smallholder subsistence farmers, who own an average farmland area of 2.5ha. The agricultural sector is dominated by the production of food crops, livestock, fishery and forestry (Wagubi, 2003). Among the challenges facing Uganda’s agricultural sector is limited access to extension and advisory services and weak public agriculture institutions. The sector also faces inadequacy in staff numbers, skills of staff and high transaction costs due to the isolated locations of the Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) and its departments (MAAIF, 2010).

According to MAAIF’s strategic plan, the achievement of increased productivity is dependent on effective and efficient extension and advisory services that facilitate improved farmer access to relevant information, knowledge and technology (MAAIF, 2010). Access to effective extension has been shown to improve farmer yields and productivity (Evenson and Mwabu, 1998; Betz, 2009). In Uganda, as in any other sub-Saharan African country, extension is often considered ineffective.

1.1 Farmer access to extension information

Access to information and innovative technologies by farmers is paramount to improved agricultural productivity. Information is accorded weight as one of the major factors of production (Ikoja-Odongo and Ocholla, 2003). Farmer information needs is often based on their survival and basic day-to-day activities (Dutta, 2009). Information needs among farmers are constantly changing due to environment changes, agricultural transformations (i.e. from subsistence to modern agriculture), and influence from government and development partners who introduce various projects or schemes for smallholder farmers’ transformations (Elly and Silayo, 2013). In rural Uganda, as in any other developing country, farmers still rely on traditional ways to access information.

According to studies in Uganda, Nigeria and India, farmers obtain information from radio, other traders/farmers, family, neighbours, friends, newspapers, extension offices, churches, political persons, bill boards/posters, farmer groups, NGOs, input dealers and local government representatives (Kleih et al., 2004; Ofuoku et al., 2008; Babu et al., 2012). Preferred information sources is largely dependent on the type of information and authority of the source with regard to the type of information (Nobelius et al., 2010). The choice of information is also dependent on its reliability, affordability, accessibility, timeliness, and awareness (Babu et al., 2012). Farm information needs as found by Kleih et al. (2004) were crop and livestock production, market information, health matters, funding opportunities and value addition.

Extension will be more efficient in meeting the farmer's information needs if designed with an understanding of the farmer's decision-making processes and information search behaviour in mind. In Babu et al. (2012), farmers' social economic characteristics such as age, land size and education level affect their information searches. Farmers' main information sources were interpersonal: input dealer, state department, family and progressive farmer. Initiatives such as encouraging farmers to join or form farmer groups increases the likelihood of farmer information-seeking behaviour (Babu et al., 2012).

Extension in Uganda has undergone major transformations from the pre-colonial, colonial to post-colonial eras. As highlighted by Semena (1999), extension evolved from: i) zero research stations (1898-1907) to provision of extension services by local chiefs (1920-1956); ii) extension through progressive farmers, where technical advice and support were offered to selected progressive farmers (1956-1963); iii) an extension methods' phase through provision of training and use of appropriate methods (1964-1972); iv) a dormant phase (1972-1980); v) a recovery period that aimed at rehabilitation of infrastructure and restoration of basic services (1981-1991); and vi) agricultural extension education to farmers with radical reforms that led to demoralization of extension staff and a considerable reduction in the provision of extension services to farmers (1992-1997). The 1998-2002 period involved a mixture of conflicting ideas and activities concerning extension, increased support by donors to the government's development of extension and reform policies, and development of long-term extension delivery systems. From the year 2000, the Ugandan government implemented a plan for modernization of agriculture (PMA), a policy initiative aimed at reducing poverty based on the seven pillars of development (Benin et al., 2007). One of the pillars was improved extension and advisory services to farmers that led to the creation of the National Agricultural Advisory Services (NAADS) in 2001.

Efforts to revitalize the agricultural sector have not been forthcoming. Such attempts and initiatives include the creation of NAADS for increased market-orientated agricultural production and empowering farmers to demand and control agricultural and advisory services. Although NAADS in the beginning showed favourable evaluations in farmer-level adoption of improved technologies and practices, and improved access to extension by vulnerable groups, there was no significant difference between NAADS sub-counties and non-NAADS sub-counties

in terms of adoption of technologies (Benin et al., 2007). NAADS, as cited by Okoboi et al. (2013), still lacked quality in the extension services provided. A system for supporting service providers to access up-to-date quality information was also lacking in the NAADS programme as described by Davis (2009), hence necessitating adoption of other innovative ways to improve the quality of extension services to farmers.

A review of extension in SSA by Davis (2009), concluded that extension in the future would involve pluralism with greater emphasis on demand-driven participatory programmes. Extension is foreseen to have a greater focus on facilitation and access to markets through farmer groups and ICTs. Reforms on extension delivery will be required for instance privatization, decentralization, outsourcing and participatory demand-driven aspects. Ineffectiveness of the public extension services, as outlined above, led to the emergence and promotion of farmer-led extension service models promoted by research and NGOs. The farmer-to-farmer extension approach aims at making farmers principle agents of change in their communities and targets the marginalized and women (Kiptot et al., 2011). Farmer-to-farmer extension models as defined by Kiptot and Franzel (2015) complement formal extension services through provision of farmer-driven agricultural technologies and enhanced farmer capacities. The effectiveness of farmer-to-farmer extension depends on the facilitators or trainers. An effective farmer-to-farmer model is where its facilitators have similar socio-economic status as their beneficiaries, have multiple roles in the community, better interaction and information-sharing among beneficiaries and mostly use demonstration facilities for experimental learning (Ssemakula and Mutimba, 2011). Farmer trainers are individuals with limited formal education who, through a process of training and experimentation, increase their knowledge and are capable of sharing it with others (Kiptot and Franzel, 2014). Farmer trainers as characterized by trainees in Western Kenya are keen, outgoing and early adopters (Lukuyu et al., 2012). One such model is the volunteer farmer-trainer (VFT) approach used by the East Africa Dairy Development (EADD) project to disseminate livestock feed technologies to dairy farmers in Kenya, Uganda, Rwanda and Tanzania.

1.2 East Africa Dairy Development project overview

The East Africa Dairy Development project¹ is a programme designed to boost milk yields and incomes of small-scale farmers in East Africa. The project is led by Heifer International in partnership with the International Livestock Research Institute (ILRI), Technoserve, the World Agroforestry Centre and the African Breeders Service Total Cattle Management Limited (ABS TCM LTD). The EADD project aims to improve on-farm productivity through increased milk production, improve the quality of milk produced and reduce loss of milk through spoilage. It also aims to improve market access through the development of local business hubs for service

¹<http://www.heifer.org/eadd/index.html>

delivery and enhance dairy farmers' understanding of fundamental business practices and the possibilities of accessing finances (EADD, 2008).

Phase 1 (2008-2012) was implemented in 13 districts in Uganda: Mukono, Jinja, Kayunga, Nakaseke, Kiryandongo, Luwero, Masindi, Masaka, Sembabule, Mayuge, Kamuli, Mpigi and Wakiso. The project targeted 45,000 families, and developed 10 milk collection hubs where farmers bring raw milk for bulking and chilling before pick-up by processors and traders.

1.3 Volunteer farmer trainers

Volunteer farmer trainers (VFTs) are usually trained by external agents who in turn share their knowledge and skills with other farmers. The VFT approach is based on the assumption that farmers reside in the community, have the trust of their community members and can effectively disseminate information and innovations due to their deep understanding and knowledge of the community.

VFTs are selected through a participatory process involving farmers, locational representatives and a management committee of producer organizations (POs) (Kiptot et al., 2012). The criteria for selection of VFTs in Uganda as described in Kiptot et al. (2012) are farmers who are:

- good communicators;
- have networks within and beyond the community;
- active and skilled in dairy farming;
- active members of a dairy group;
- willing to donate a piece of their land for demonstration; and
- permanently domiciled in the area of jurisdiction.

The VFT approach, as a form of farmer-to-farmer extension, has been proven effective in reaching many farmers within the shortest period of time with minimum resources, efficiently attending to farmers' problems, and being reliable and innovative. Effectiveness of the VFT has been measured by using indicators such as the number of farmers trained, perspectives of farmer trainees, reliability of the VFTs to disseminate information to farmers, level of uptake of technologies of the farmers trained and the multiplier effect of the information shared (Kiptot and Franzel, 2012).

This study aims to assess the effectiveness of the VFT approach in dissemination of livestock feed practices vis-à-vis other information sources. The specific objectives are to:

1. Determine dairy farmers' information sources and evaluate farmer preference on different sources in comparison to VFTs;
2. Identify the number and type of livestock feed technologies accessed by farmers through VFTs in comparison to other sources;
3. Determine the number of farmers trained by VFTs on specific feed technologies in comparison to other trainers;

4. Determine uptake and sharing of feed technologies by men and women farmers;
5. Assess the level of understanding of livestock feed technologies between men and women members of POs; and
6. Assess the association between training offered, uptake of technologies and sharing of information on livestock feed technologies.

2.0 Methodology

2.1 Study site

Data was collected from farmers in Central and Eastern Uganda, across 10 districts: Buikwe, Kampala, Kayunga, Luweero, Lyantonde, Mukono, Nakaseke, Sembambule and Wakiso in Central and Kamuli in Eastern Uganda. Interviewed PO members were drawn from both EADD Phase 1 districts and other neighbouring districts. All farmers interviewed are members of selected POs. Central Uganda is the second largest milk producer after Western Uganda with 34.2% milked cows and the highest average milk yield per cow (Balikowa, 2011). The region sells about 39.1% of the milk produced. Eastern Uganda comes in third with 33.9% of milked cows.

Figure 1: Map of study area

2.2 Sample selection

A total of 310 farmers were sampled and interviewed. This represented 5% of PO members in the first phase of the EADD project. All these farmers were members of 11 POs selected for the study which covered a total of 26 operational dairy POs situated in 13 districts. For this study, the selection of POs was based on the identified feeding systems practised in the area (intensive, semi-intensive and extensive) and the years when the POs were formed.

An intensive farming system is characterized by higher use of inputs such as capital and labour per unit land area. It involves either large numbers of animals raised on limited land, or managed under intensive rotational grazing. Feed is brought to the animals or the animals are repeatedly moved to fresh forage, for instance, cattle kept on zero-grazing/stall feeding. This system is characterized by innovations designed to increase yield of food and fibre, such as planting multiple crops per year, increased use of fertilizers, reduced frequency of fallow and improved cultivars (Marlon, 2015).

Extensive farming is an agricultural production system that uses small amounts of inputs and has relatively more acreage. Livestock production in extensive systems is characterized by free-range in part or all of their production cycles and have low agricultural productivity. Nomadic herding is an extreme example of extensive farming, where herders move their animals to use feed from occasional rainfall (Marlon, 2015). Semi-intensive systems are production systems with characteristics of both intensive and extensive systems.

To select POs from a total of 26 in Phase 1, the locations of the POs, their year of formation and the type of livestock production system practised by its members were determined. POs were eliminated based on replications so that only one PO was randomly selected from a list of POs from the same district which were formed in the same year. Others with similar characteristics were eliminated.

A systematic sampling design was carried out to select households for the study. Farmers to be interviewed in each PO were selected proportionate to the total number of members in each PO. The lists of farmers who were members of POs were obtained from a database of PO members during Phase 1. The farmers selected for the interviews comprised both men and women. A replacement list was obtained using the above procedure to replace farmers who were not available during the interview period. The number of farmers selected from each PO and PO basic characteristics are presented in Table 1. A total of 189 male and 121 female farmers were selected for the survey.

Table 1: Characteristics of sampled POs

No .	Producer organization	District	Year mobilized by EADD	Type of feeding system	Number of farmers
1	Bugerere Dairy Cooperative	Kayunga	2008	Extensive	32
2	Buikwe Dairy Farmers Cooperative Limited	Buikwe	2009	Intensive	32
3	Dindo Kasawo Creameries Cooperative Society Ltd	Mukono	2009	Semi-intensive	20
4	Kinyogoga Livestock Farmers Cooperative Society	Nakaseke	2011	Extensive	25
5	Kirimya Dairy Farmers Group	Wakiso	2011	Intensive	16
6	Luweero Dairy Development Cooperative Society	Luweero	2008	Semi-intensive	48
7	Mperewe St. Stephen HPI Women's group	Wakiso	2008	Intensive	20
8	Nabitanga Dairy Farmers Cooperative Limited	Sembabule	2010	Extensive	25
9	Namante Dairy Farmers Society	Mukono	2010	Semi-intensive	32
10	Nawanyago Dairy Farmers Cooperative Society	Kamuli	2010	Intensive	40
11	Sembabule TC SALL cooler	Sembabule	2012	Extensive	20
	Total number of farmers				310

2.3 Data collection

A structured survey questionnaire was administered to farmers who were members of 11 POs. The POs represent different feeding systems (extensive, intensive and semi-intensive) and were formed in different years. Each PO has a membership of up to 1500 smallholder farmers (Balikowa, 2011). The questionnaire captured information based on the specified objectives which included: access to information by different farmers in the POs, sources of information other than the VFTs, preferred information sources by gender and POs, training on technologies received by farmers and technologies practised by both men and women, sharing of information among farmers, and understanding of the different feed technologies. The questionnaire collected socio-economic characteristics of the interviewed farmers such as household demography, livelihood sources, ages and education levels.

2.4 Data analysis

Data entry and analysis was done using the software, SPSS version 22. Data cleaning was performed through outlier detection and summary statistics to eliminate errors. Descriptive statistics were performed to address each of the highlighted objectives. T-tests and Pearson chi-square tests were used to evaluate the likelihood of association between variables.

The majority of the questions asked in the survey required respondents to select more than one response; this, therefore, led to multiple response variables. Multiple response analysis was thus

applied to variables with multiple responses such as farmer group activities, farmer group enterprises, sources of livestock feed information and feed technology trainings offered to interviewed PO members.

3.0 Results

3.1 Demographics and socio-economic characteristics of interviewed farmers

A total of 310 farmers comprising 61.2% males and 38.6% females were interviewed in 10 districts from Central and Eastern Uganda. An average of 27 members was drawn from each of the 11 selected POs. From Table 2, male respondents were slightly older than female members with an average of 51 years compared to female respondents with an average of 50 years. There was, however, no statistical difference between the age of males and females. Most of the dairy farmers were middle-aged between 35 and 59 years old. Male respondents had significantly more schooling (8.8 years) on average compared to their female counterparts with an average of 7.3 years. The number of years of schooling was statistically significant at $p < 0.01$. Male respondents had significantly more experience (18 years) in dairy farming than female respondents (13 years), despite the fact the farmer's average ages in years were not significantly different. Half (50%) of the farmers had some primary education (18.5% complete and 31.5% incomplete) while 41% of the farmers had secondary school education. Only 9% had undergone tertiary level education. A person is said to have completed a given education level if the number of school years are equal to the number of years required to complete that level of education, otherwise it is considered incomplete. A higher female percentage (95%) had a basic secondary school education compared to 87.8% of men who had a secondary education and below.

Table 2: Demographic characteristics of interviewed farmers

Demography		Male (N=188)	Female (N=121)	Significance tests
Age of the farmer		51.0	50.0	0.329
Education (no. of years of formal schooling)		8.8	7.3	0.003**
Years of experience in dairy farming		17.0	13.4	0.001***
Distance to nearest sub-county extension office (km)		6.4	5.24	0.052
Distance to nearest VFT (km)		2.6	2.6	0.988
Distance to nearest milk buyer		3.9	3.8	0.846
Distance to main road		1.5	0.70	0.003**
Sale of milk	Yes (%)	92.0	89.3	0.409
Employees on farm	Yes (%)	54.3	43.0	0.053*

p value: *** (1%), ** (5%), * (10%)

About 80.3% of respondents were married while 10% were widowed, the majority of whom were females (29 out of 31), 6.8% were single and only 2.8% divorced. About 54.3% of male respondents had employees on their farm, compared to 43% of females. The majority of farmers sold the milk produced. The nearest milk buyers were about 3.8km away.

About 14% of the households are headed by females. A comparison between female heads and females in male-headed households show they significantly differ in terms of age, education levels and years of experience in dairy farming (Table 3). Female heads were found to be

significantly older than females in male-headed households ($p < 0.001$) and had more experience in dairy farming ($p < 0.05$). Females in male-headed households were, however, found to be more educated than female heads ($p < 0.05$).

Table 3: Comparison between female heads and females in male-headed households

Demography		Female heads (N=43)	Females in male-headed households (N=76)	Significance tests
Age of the farmer		56.4	45.8	0.000***
Education (no. of years of formal schooling)		6.4	7.8	0.031**
Years of experience in dairy farming		16.5	11.7	0.005**
Distance to nearest sub-county extension office (km)		6.1	4.8	0.193
Distance to nearest VFT (km)		3.3	2.3	0.066*
Distance to nearest milk buyer		4.3	3.5	0.589
Distance to main road		0.7	0.7	0.927
Sale of milk	Yes (%)	91.0	88.2	0.640
Employees on farm	Yes (%)	61.4	31.6	0.001***

p value: *** (1%), ** (5%), * (10%)

Socio-economic characteristics of the respondents in the three feeding systems also differed. Analysis of variance (ANOVA) was used to test the difference between the three feeding systems: extensive, intensive and semi-intensive. The three systems varied in all demographic characteristics of the respondents except age. Extensive feeding systems had larger land sizes, and the respondents had more experience in dairy farming and travelled longer distances to the nearest extension service provider, whether offered by the sub-county or VFTs. They travelled further to get to the main road (Table 4).

Table 4: Characteristics of respondents in different livestock feeding systems

Demography	Extensive	Semi-intensive	Intensive	Significance levels
	Mean			
Age of the farmer	49.1	50.5	51.6	0.29
Distance to main road	2.7	0.4	0.40	0.00***
Distance to nearest milk buyer (km)	4.9	5.6	1.2	0.00***
Distance to nearest sub-county extension office (km)	9.4	4.5	4.0	0.00***
Distance to nearest volunteer farmer (km)	3.5	2.2	2.2	0.00***
Education (no. of years of formal schooling)	7.0	8.8	9.0	0.00***
Land size (acres)	164.2	6.7	3.6	0.00***
Years of experience in dairy farming	22.9	13.8	12.1	0.00***

p value: *** (1%), ** (5%), * (10%)

3.2 Livelihood sources

Farmers in Uganda engage in diverse livelihood strategies. Almost all respondents (98%) practise dairy farming (Figure 2), followed by subsistence characterized by annual crops such as maize and beans. Farmer involvement in dairy farming in the study sites justifies the need for promotion of dairy farming techniques in the region. Both male-headed and female-headed households participated almost equally in all livelihood strategies. More male-headed households participated in goat rearing and bee keeping when compared to female-headed households (Table 5). Male respondents participated in 12 of the 19 livelihood sources. Livelihood sources with a higher percentage of women include: small-scale trading, receipt of remittances, off-farm income and horticulture (Table 5).

Figure 2: Livelihood sources and strategies

Photo 1: Stall feeding

The most commonly practised livelihood sources (over 60%) among both male-headed and female-headed households were dairy farming, subsistence farming, poultry keeping and cash-crop farming (Table 5).

Table 5: Livelihood sources across male- and female-headed households

Livelihood sources	Male-headed HH (N=267)	Female-headed HH (N=43)	Chi square
Dairy farming	98.5	97.7	0.541
Subsistence farming	94.3	95.5	0.552
Cash-crop farming	63.6	63.6	1.000
Poultry	74.2	63.6	0.144
Goat rearing	71.6	55.8	0.037**
Sheep rearing	21.2	13.6	0.246
Beef farming	10.6	7.0	0.464
Horticulture	30.7	37.2	0.393
Pig farming	33.3	30.2	0.688
Off-farm income	12.9	9.3	0.509
Pension	4.5	2.3	0.503
Formal employment	7.6	2.3	0.206
Remittances	8.0	14.0	0.198
Sale of timber	3.4	0.0	0.219
Small-scale trade	16.7	20.9	0.493
Fish farming	1.1	0.0	0.635
Bee keeping	7.6	0.0	0.043**
Brick making	4.2	2.5	0.423

p value: *** (1%), ** (5%), * (10%)

3.3 Farmers' participation in farmer groups

The majority of farmers in Uganda belong to farmer groups; 95% belong to three or fewer farmer groups. A higher percentage of women belonged to groups compared to men (83.5% vs 72.5%). The most common group types in the sites were agriculture (livestock keeping, crop farming/horticulture, agroforestry, beekeeping and fish farming), savings and credit and welfare groups.

Table 6: Proportion of farmers participating in different group enterprises

Group enterprises	% of farmers (N=237)
Savings and credit	95.8
Agricultural	79.7
Welfare	41.4
Community	16.0
Religious	15.2
Education	12.2
Clan	2.1
Others	2.1

The majority of farmers (95.8%) participated in savings and credit groups, while 79.7% were involved in agricultural groups (Table 6). On disaggregating data by gender, 72.5% male and 83.6% female respondents participate in farmer groups (Table 7). A higher percentage of men participate in savings and credit and agricultural groups than other group types, while women farmers participate more in savings and credit groups (Table 7).

Table 7: Male and female farmers' membership in farmer group enterprises

Group typology	Male	Female	Total
	% of farmers (N=137)	% of farmers (N=100)	% of farmers (N=237)
Agricultural	60.6	58.0	59.5
Savings and credit	64.2	83.0	72.2**
Education	8.0	15.0	11.0*
Community	13.1	15.0	13.9
Religious	12.4	15.0	13.5
Welfare	29.9	42.0	35.0*
Clan	2.9	1.0	2.1

p value: *** (1%), ** (5%), * (10%)

Only about 35% of farmers were members of welfare groups. Welfare groups focus on wellness of its members and provide social support. Farmer groups engaged in differing enterprises and specific activities that could enhance the farmer's welfare and farm-level incomes. Such enterprises relate to objectives of the farmer groups and individual member's needs. Some of the activities farmer groups participated in include poultry keeping, dairy goat keeping, dairy cattle rearing, subsistence farming, cash-crop farming and savings and credit. Fifty-one percent of the respondents were involved in dairy cattle followed by subsistence farming at 37.2%, then savings and credit at 29.0%, cash crop farming at 27.6%, and poultry at 25.5%. These activities differed between male and female members of groups (Table 8).

Table 8: Proportion of male and female farmers belonging to groups that engage in specific agricultural enterprises

Group enterprises	Male	Female	Total
	% of farmers (N=87)	% of farmers (N=58)	% of respondents
Poultry	13.8	43.1	25.5**
Dairy goat	9.2	19	13.1
Dairy cattle	51.7	50	51.0
Sheep	0	0	1.4
Pig	4.6	8.6	6.2
Production of livestock feed	4.6	5.2	4.8
Subsistence farming	39.1	34.5	37.2
Cash crop	35.6	15.5	27.6**
Horticulture	9.2	1.7	6.2
Bee keeping	3.4	1.7	2.8
Fish farming	1.1	0	1.4
Agroforestry	5.7	10.3	7.6
Savings and credit	23	37.9	29.0
Welfare support	6.9	1.7	4.8
Other specify	11.5	6.9	9.7

p value significance: *** (1%), ** (5%), * (10%)

About half of the farmers (both male and female) are engaged in groups dealing with dairy cattle farming. This implies that they are interested in dairy farming and would be more open to information regarding dairy management and production. From Table 8, women were significantly more involved in groups with poultry ($p < 0.05$). Men, on the other hand, were significantly involved in groups that deal with cash crops ($p < 0.05$). All other group activities were not significantly different between men and women.

3.3.1 Benefits derived from belonging to groups

Farmers join groups for different reasons but one of the major reasons for joining a group is to derive the benefits from that group. From Table 9, the major benefits derived by farmers in participating in farmer groups include information access (95.9%), collective marketing (71.0%), input access (56.6%), credit/loans (51.7%), and welfare support (40.7%). Farmers receive information at a high rate from groups: 95.5% for males and 96.5% for females. Female members appreciated benefits from groups more than the males as more than 50% of females mentioned having received all outlined benefits from the groups. Significantly higher proportions of female than male members received welfare support from groups ($p < 0.05$).

3.3.2 Benefits derived from groups between females in male-headed households and female heads

A farmer's ability to engage in farmer groups and implement group activities depends on the farmer's decision-making ability. Women farmers, whether married or heads of their own households, will engage in group activities depending on their ability to access assets and resources. An analysis to determine the difference in female farmers' participation in different group types revealed that female heads of households are as equally involved in the different group types as are females in male-headed households. Results from the analysis showed no significant differences between these two groups (Table 9).

Table 9: Benefits derived from participating in farmer groups by female heads and women in male-headed households

Benefits derived from farmer groups	Household type	
	% of female household heads N=22)	% of females in male-headed households % (N=34)
Information	90.9	100.0
Collective marketing	72.7	76.5
Credit/loan	45.5	61.8
Ready market	68.2	41.2
Input	63.6	55.9
Welfare	50.0	52.9
Other specify	9.1	11.8

In terms of enterprises and group activities, women in male-headed households (wives) were significantly more involved in cash-crop farming than female-heads. This could perhaps be due to the influence of male decisions or collective decision-making and interests in the activities of the households. Another explanation could be that women in male-headed households are supported financially by their spouses to engage in activities that require a high level of capital such as cash crops.

3.4 Livestock ownership

All households in the interviewed sites owned livestock. The main types of livestock owned by farmers were cattle (96.5%), sheep (19.7%), goats (68.1%), pigs (29.0%) and poultry (77.0%). Most farmers owned cross breeds of cows, calves, heifers and bulls (Table 10). Very few farmers owned pure breeds of livestock.

Table 10: Livestock ownership by household

Livestock owned (N=310)	Number of HH (pure breed)	Pure breed (means)	% of HH (cross breed)	Cross breed (means)	% of HH (local breed)	Local breed (means)
Cows	10	2 (0.35)	88.3	11 (1.08)	29	17 (2.07)
Calves	5	2 (0.97)	56.5	7 (0.7)	20	9 (0.87)
Heifers	4	1 (0.25)	42.6	8 (1.21)	12.3	12 (2.14)
Bulls	0		36.5	4 (0.5)	12.9	5 (0.85)
Sheep	0		4.2	17 (5.71)	16.8	5 (0.67)
Pigs	2	3 (2)	14.5	9 (3.47)	15.5	3 (0.28)
	Number of HH	Exotic (mean)		Number of HH		Local (mean)
Goats	29	27 (9.28)		194		11 (1.28)
Rabbits	2	4 (2.5)		2		7(6)

Note: Figures in parenthesis are standard errors

A comparison between male and female-headed households showed that a higher proportion of male-headed households owned livestock than female-headed households (Table 11). Male-headed households owned a significantly higher number of cross breeds of cows ($p<0.05$), heifers ($p<0.001$), calves ($p<0.001$) and bulls ($p<0.001$) than female-headed households.

Table 11: Livestock ownership between male-headed and female-headed households

Livestock owned	Pure Breed		Cross breed (%)		Local Breed (%)	
	No. of male-headed HH (N=264)	No. of female-headed (N=44)	Male-headed (N=264)	Female-headed (N=44)	Male-headed (N=264)	Female-headed (N=44)
Cows	3.0	6.8	88.6	88.6	29.9	22.7
Calves	1.9	0.0	58.7	47.7	20.8	15.9
Heifers	1.1	2.3	44.7	34.1	13.3	6.8
Bulls	0.0	0.0	38.6	25.0	14.4	4.5
Sheep	0.0	0.0	4.5	2.3	17.8	9.1
Pigs	0.0	4.5	15.2	11.4	15.5	13.6
			Exotic Breed		Local Breed	
Goats			10.6	2.3	64.8	50.0
Rabbits			0.8	0.0	4.5	0.0

Male- and female-headed households owned a higher number of local breeds, followed by cross breeds. Few households owned pure breeds (Table -12). All households owned a higher number of cattle than any other livestock type. The households also owned sheep and goats in larger numbers.

Table 12: Average number of livestock owned between male- and female-headed households

Livestock owned	Pure Breed (mean)		Cross Breed (mean)		Local Breed (mean)	
	Male-headed (N=264)	Female-headed (N=44)	Male-headed (N=264)	Female-headed (N=44)	Male-headed (N=264)	Female-headed (N=44)
Cow	2 (1.19)	2 (0.7)	12 (18.87)	6 (11.2)	18 (20.6)	13(0.7)
Calves	2 (2.17)	0	8 (9.7)	4 (3.2)	9 (7.02)	5 (3.3)
Heifer	1(0.58)	1(.)	9 (14.51)	3 (3.9)	13(13.4)	1(0.6)
Bulls	0	0	4 (5.7)	2 (1.2)	5 (5.4)	1(0)
Sheep	0	0	16 (21.5)	20 (.)	6 (5.051)	5 (3.0)
Pigs	0	3 (2.8)	10 (24.6)	3 (0.9)	3(3.5)	3 (1.5)
			Exotic breed (mean)		Local breed (mean)	
			Male-headed	Female-headed	Male-headed	Female-headed
Goats			28 (50.7)	1 (.)	12(18.3)	8 (14.3)
Rabbits			4 (3.5)	0	7(8.5)	0

Note: Figures in parenthesis are standard deviations

Households in extensive feeding systems own more cross and local breed livestock than other feeding systems; however, they do not own any pure breeds (Table 13). On average, households in intensive and semi-intensive feeding systems own few livestock.

Table 13: Livestock ownership across feeding systems

Livestock owned (N=310)	Pure Breed (Mean)			Cross Breed			Local Breed		
	Extensive	Semi-intensive	Intensive	Extensive	Semi-intensive	Intensive	Extensive	Semi-intensive	Intensive
Cows	0	3 (0.7)	2 (1.2)	27 (22.6)	3 (3.2)	2 (1.4)	24 (20.7)	4 (6.1)	2 (1.4)
Calves	0	4 (2.8)	1(0.0)	13 (10.4)	2 (1.8)	2 (0.9)	11(6.5)	2 (2.5)	1(0.0)
Heifer	0	2 (1.2)	1(0.0)	14 (16.6)	1(1.0)	2 (1.2)	13 (13.4)	1(0.0)	1(0.0)
Bulls	0	0	0	5 (6.2)	1(0.5)	2 (1.1)	5 (5.7)	1(0.5)	3 (2.1)
Sheep	0	0	0	21(21.9)	14 (35.6)	3 (1.2)	8 (5.6)	3 (1.2)	3 (2.8)
Pigs	0	0	3 (2.8)	5 (2.5)	14 (35.6)	5 (3.5)	4 (1.049)	3 (1.7)	4 (2.5)
				Exotic (Mean)			Local (mean)		
Goats				37 (57.8)	3 (1.5)	10 (13.1)	23 (23.4)	4 (3.0)	3 (2.1)
Rabbits				0	1(.)	6 (.)	0	7 (8.5)	0

Note: Figures in parenthesis are standard deviations

Photo 2: Cattle, goats and sheep

3.5 Ownership, access and usage of information and communication technology

Information and communication technology (ICT) provides a platform for effective access to information to a wide variety of farmers. It can be a medium for sharing new agricultural ideas, innovative solutions for improved farming and information sharing between peers. ICT is quite accessible in rural Uganda. In Table 14, both male and female farmers own mobile phones and radios. A few own television sets and computers.

A small number of farmers can access TV all the time, although 40.6% of the men have access to TV compared to 16.5% of women (Table 14). Men could most likely access TV at social gatherings (local pubs and restaurants).

Table 14: Information technology ownership and access between male and female farmers

Assets	Owned		Access	
	Male (%)	Female (%)	Male (%)	Female (%)
Mobile phone	98.4	96.7	99.9	99.9
Television	0	0	40.6	16.5
How often do you access the asset	TV		Internet	
	Male	Female	Male	Female
All the time	5.7	7.7	0	0
Once a day	24.5	15.4	15.8	0
Not often	69.8	76.9	78.9	100

A comparison between female-headed households and male-headed households reveal that most households own a radio with a few households owning TV sets (Table 15). More farmers in male-headed households have access to radios compared to female-headed households. TV, although owned by more than 30% of the households, is fairly inaccessible. Only 8.4% of male-headed households own a computer and it was generally considered inaccessible by farmers in both male- and female-headed households.

Table 15: Information technology ownership and access between male- and female-headed households

Assets	Own		Access	
	Male-headed households (%)	Female-headed households (%)	Male-headed households (%)	Female-headed households (%)
Radio	95.4	93.2	86.7	25
Television	32.3	34.1	33.9	17.2
Internet	8.4		7.9	4.5
How often do you access the asset	TV		Internet	
	Male-headed households (%)	Female-headed households (%)	Male-headed households (%)	Female-headed households (%)
All the time	4.9	20	0	0
Once a day	23	20	15	0
Not often	72.1	60	80	100

3.6 Farmer access to livestock feed information

Access to information is a major factor for smallholder farmers in their quest for improved livelihoods and poverty reduction. There exist numerous information sources for livestock feeds. Access to information depends on accessibility and convenience of the mentioned ICT devices, whether owned or borrowed. In the study site, 76.5% of farmers receive livestock feed information from PO extension assistants. Table 16 shows livestock feed information sources for farmers. Radio was the second most frequently accessed information source. Unlike the internet, radio is fairly affordable and accessible to most farmers. Although 94.5% of the farmers interviewed owned a radio, only 68.1% accessed information on livestock feeds through it. Other frequently-used information sources include VFTs, NAADS, NGOs and exchange visits. Male and female farmers did not significantly differ in terms of sources of information. However, PO extension assistants and VFTs top the list for female farmers while PO extension assistants and radio tops the list for male farmers. More men reported making more use of posters, input dealers and religious institutions than did women (Table 17).

Photo 3: Farmers during a training session

Table 16: Proportion of farmers accessing livestock feed information from each source

Sources of information	Proportion of farmers % (N=310)
PO extension assistants	76.5
Radio	68.1
VFTs	67.4
NAADS	63.5
NGO	63.5
Exchange visit	51.6
Private service providers	46.8
Other farmers	42.9
Posters	38.7
Farmers organizations	36.5
Field days	31.9
District agricultural officers	24.5
Television	20.3
Written materials	18.4
Input dealers	18.1
Mobile phone	14.8
Religious institutions	8.1
Research institutions	6.8
Internet	3.9

Table 17: Sources of information on livestock feeds

Sources of information on livestock feeds	Male (%) (N=189)	Female (%) (N=121)	Total (%) (N=310)
PO extension assistants	74.1	80.2	76.5
Radio	70.4	64.5	68.1
VFTs	66.1	69.4	67.4
NGOs	64	62.8	63.5
NAADS	63.5	63.6	63.5
Exchange visits to skilled farmers	55.6	45.5	51.6
Private service providers	48.7	43.8	46.8
Posters	45.5	28.1	42.9**
Other farmers (neighbours, friends)	44.4	40.5	38.7
Field days	33.3	29.8	36.5
Farmers' organizations/groups	32.3	43.0	31.9
District agricultural officers	27.5	19.8	24.5
Input dealers	22.8	10.7	20.3**
Written materials (posters, brochures, newspapers, magazines)	21.2	14.0	18.4
Television	19.6	21.5	18.1
Mobile phone	16.9	11.6	14.8
Churches/religious institutions	10.6	4.1	8.1**
Research institutions	6.9	6.6	6.8
Internet	6.3	0	3.9

p value significance: *** (1%), ** (5%), * (10%)

Mobile phones, even though owned by 97.4% of farmers, are rarely used to access information. Only 16.9% of male and 11.6% of female farmers use mobile phones to access feed information (Table 17). Television, on the other hand, owned by only 32.6% of households, is used by 19.6% of male and 21.5% of female farmers to access information. With increasing importance and usage of ICT in rural development, more awareness and promotion of available resources, for example television and mobile devices, should be enhanced to ensure more farmers can access information. The high number of farmers accessing information through PO extension assistants and VFTs can be attributed to the ongoing efforts of the EADD project in the area. There are few differences in information sources among males, female heads of household, and wives of male heads of households (Table 18).

Table 18: Information sources between men and women in different household types

Information sources	Male farmers (%)	Female heads	Wives of male heads	Females total (%)
	N=187	N=44	N=76	N= 120
PO extension assistants	73.9	75	82.9	80.0
Radio	70.2	65.9	63.2	64.2
VFTs	66.0	61.4	73.7	62.5
NGOs	64.4	61.4	63.2	69.2
NAADS	63.3	54.5	69.7	64.2*
Farmers organizations/groups	55.9	45.5	40.8	42.5
Exchange visit to skilled farmers	48.9	43.2	47.4	45.8
Private service providers	45.7	43.2	44.7	44.2
Other farmers (neighbours, friends)	44.7	40.9	40.8	40.8
Posters	33.0	31.8	25	29.2
Field days	32.4	31.8	27.6	27.5
District agricultural officers	27.7	18.2	21.1	20.0
Television	22.9	18.2	22.4	20.8
Mobile phone	21.3	15.9	9.2	11.7
Written materials (posters, brochures, newspapers, magazines)	19.7	13.6	14.5	14.2
Research institutions	17.0	4.5	7.9	6.7
Input dealers	10.6	4.5	14.5	10.8*
Churches/religious institutions	6.9	4.5	3.9	4.2
Internet	6.4	0	0	0

p value significance: *** (1%), ** (5%), * (10%)

Males access information from a slightly higher number of sources. Over 50% of males access information from six different sources, with 73.9% accessing from PO community extension assistants. Over 50% of female heads and wives in male-headed households access information from five different sources. For all three groups, more than 70% access information from the PO community extension assistants. The second most accessed information source for wives in male-headed households is through the VFTs (73.7%) which is higher than male heads at 66.0% and female heads at 61.4%. Both male farmers and female heads consider radio the second

highest source of information, whereas women in male-headed households have radio coming fourth. Even though 98.6% of wives of household heads own mobile phones and 95.4% of their households own a radio, they still do not access information from these sources. The results could suggest that a radio in a home is controlled by the man, who in turn listens to programmes of his choice. Besides, women may not have time to listen to the radio, as they have many chores to carry out. During the time when farm information is being broadcast on the radio, it is mostly likely that women would be cooking or carrying out other household duties away from the radio. As regards the mobile phone, women may not know how to access information, hence the need for more studies to understand the discrepancies between ownership and access. Female household heads, on the other hand, have unlimited access to owned assets used to access information. Male farmers have significantly higher education levels and that could imply that they are able to access information from different sources.

The study compared feed information sources between different POs (Table19). Members of each of the selected POs obtain information from different sources. The varying proportions of farmers accessing information in each PO from different sources may reflect the varying availability of the sources across POs.

Table 19: Feed information sources by POs

Feed information sources	Nabitanga Dairy Farmers Cooperative Ltd (N=25)	Sembabule TC (N=20)	Kinyogoga Livestock Farmers Coop Ltd (N=25)	Luweero Dairy Development Cooperative Society (N=48)	Dindo Kasawo Creameries Cooperative Society (N=20)	Namante Dairy Farmers Society N= (32)	Kirimya Dairy Farmers Group (N=16)	Mperewe St. Stephen HPI Women's (N=20)	Buikwe Dairy Farmers Cooperative Limited (N=32)	Nawanyago Dairy Farmers Cooperative Society (N=40)	Bugerere Cooperative (N=32)
District agricultural officers	44.0	35.0	12.0	14.6	60.0	25.0	25.0	10.0	28.1	5.0	34.4
NAADS	56.0	40.0	76.0	54.2	55.0	71.9	12.5	40.0	81.3	92.5	71.9
NGOs	64.0	80.0	32.0	72.9	55.0	90.6	81.3	55.0	62.5	37.5	71.9
Farmers organizations/ groups	36.0	25.0	16.0	6.3	40.0	90.6	93.8	10.0	56.3	37.5	15.6
Research institutions	12.0	5.0	0.0	2.1	10.0	9.4	12.5	15.0	18.8	0.0	0.0
VFTs	76.0	65.0	40.0	83.3	75.0	71.9	50.0	30.0	68.8	77.5	68.8
PO community extension assistants	88.0	85.0	48.0	83.3	50.0	90.6	100.0	25.0	93.8	90.0	62.5
Exchange visit to skilled farmers	60.0	80.0	60.0	16.7	60.0	40.6	43.8	65.0	65.6	70.0	37.5
Other farmers (neighbours, friends)	72.0	55.0	20.0	22.9	75.0	40.6	37.5	65.0	59.4	27.5	34.4
Input dealers	44.0	45.0	0.0	4.2	55.0	12.5	6.3	15.0	12.5	2.5	31.3
Private service providers	52.0	35.0	44.0	31.3	85.0	34.4	12.5	65.0	71.9	47.5	43.8
Mobile phone	44.0	5.0	4.0	8.3	15.0	12.5	25.0	0.0	28.1	2.5	25.0
Radio	80.0	85.0	48.0	62.5	55.0	96.9	87.5	60.0	62.5	70.0	50.0
Television	4.0	20.0	12.0	8.3	40.0	18.8	37.5	55.0	37.5	7.5	15.6
Written materials (brochures, newspapers, magazines)	40.0	10.0	12.0	8.3	15.0	50.0	0.0	15.0	18.8	17.5	9.4
Internet	0.0	0.0	4.0	2.1	25.0	6.3	0.0	0.0	3.1	0.0	6.3
Field days	36.0	20.0	24.0	27.1	35.0	12.5	43.8	20.0	34.4	15.0	87.5
Posters	44.0	5.0	4.0	18.8	60.0	59.4	75.0	20.0	46.9	45.0	56.3
Churches/religious institutions	12.0	5.0	8.0	0.0	30.0	6.3	0.0	0.0	18.8	12.5	0.0

Farmers in five of the POs most frequently accessed information from PO community extension assistants, three used mainly NAADS, and one each relied mainly on private services, exchange visits or radio (Table 20).

Table 20: Access to livestock feed information sources by the different POs

PO's access to information	Most accessed	Second most accessed	Third most accessed
Nabitanga Dairy Farmers Cooperative Ltd	PO extension assistants	Radio	VFT
Sembabule TC	PO extension assistants	NGOs	Exchange visits
Kinyogoga Livestock Farmers Coop Ltd	NAADS	Exchange visits	PO
Luweero Dairy Development Cooperative Society	PO extension assistants	VFTs	NGO
Dindo Kasawo Creameries Cooperative Society	Private service	Other farmers	VFT
Namante Dairy Farmers Society	Radio	PO extension assistants	Farmer organizations
Kirimya Dairy Farmers Group	PO extension assistants	Farmer organizations	Radio
Mperewe St. Stephen HP Women's Group	Exchange visits	Other farmers	Private service
Buikwe Dairy Farmers Cooperative Limited	PO extension assistants	NAADS	Private service
Nawanyago Dairy Farmers Cooperative Society	NAADS	PO extension assistants	VFT
Bugerere Dairy Cooperative	NAADS	NGOs	VFT

3.6.1 Farmers' access to information on livestock feed technologies

From the data collected in the different sites, more than 50% of farmers accessed information of up to 14 different feed technologies out of the total of 25 feed technologies (Table 21). The highest accessed feed technology by both men and women is mineral supplementation with 87.4% of farmers having accessed it. Access to information on feed technologies with regard to the farmers' proportion of access is shown in Table 21.

Table 21: Farmer access to information on livestock feed technologies

Feed categories	Livestock feed technologies	Male % (N=189)	Female % (N=121)	Total % (N=310)
Conserved feeds	Hay making	74.1	73.6	73.9
	Silage making	69.3	73.6	71
	Utilization of crop residues	63	71.9	66.5
Feed practices	Mineral supplementation	89.9	83.5 *	87.4
	Management of dairy stock	73.5	58.7**	67.7
	Water harvesting	68.3	53.7**	62.6
	Concentrates	50.8	52.1	51.3
Fodder trees and shrubs	Fodder shrubs	66.7	80.2**	71.9
Grasses	Napier grass	77.8	92.6**	83.5
	Rhodes grass	52.4	62.0*	56.1
	Setaria spp	32.3	40.5	35.5
	Brachiaria (Congo signal)	22.8	33.1	26.8
Herbaceous legumes	Lablab	65.1	68.6	66.5
	Mucuna	54.5	67.8**	59.7
	Desmodium	33.3	42.1	36.8
	Lucerne	25.9	31.4	28.1
	Centrosema	24.3	26.4	25.2
	Sirato	19	23.1	20.6
Other feed practices	Paddockging	60.3	36.4**	51
	Feed formulation	47.1	53.7	49.7
	Bush clearing, weed control	59.8	33.9**	49.7
	Perimeter fencing	49.2	29.8**	41.6
	Agro-industrial by-products	32.3	25.6	29.7
	Over-sowing	24.9	18.2	22.3
Other fodder crops	Sweet potato vines	55	71.9 **	61.6
	Sorghum	18.5	25.6	21.3

p value significance: *** (1%), ** (5%), * (10%)

Male farmers significantly accessed information on mineral supplementation, management of dairy stock, water harvesting technologies, paddocking and perimeter fencing at a higher rate than women farmers, while women farmers significantly accessed information on Napier/elephant grass, fodder shrubs and sweet potato vines at a higher rate. The three most accessed feed-technology information by women are Napier/elephant grass (92.6%), followed by fodder shrubs (80.2%) and silage making at (73.6%). For male farmers, the three most accessed are mineral supplementation (89.9%), Napier/elephant grass (77.8%) and hay making (74.1%) (Table 21). Female farmers, both household heads and females in male-headed households, accessed information of approximately similar feed technologies from different sources; only two of the information on the feed technologies were significantly different. Wives in male-headed households significantly accessed information on setaria species (47.4%) and over-sowing technologies (23.7%) at a higher rate than female household heads (27.3% and 9.1%) respectively (Table 22).

Table 22: Types of livestock feed technologies accessed by females in male-headed households and female heads

Feed categories	Feed technologies	% of female heads (N=44)	% of wives of male heads (N=76)	Overall % (N=120)
Conserved feeds	Hay making	68.2	76.3	73.7
	Silage making	68.2	76.3	70.8
	Utilization of crop residues	61.4	77.6	66.2
Feed practices	Mineral supplementation	79.5	85.5	87.3
	Management of dairy stock	47.7	64.5	67.5
	Water harvesting	56.8	51.3	62.3
	Concentrates	43.2	56.6	51
Fodder trees and shrubs	Fodder shrubs	75	82.9	71.8
Grasses	Napier/elephant grass	88.6	94.7	83.4
	Rhodes grass	52.3	67.1	56.2
	Setaria spp	27.3	47.4	35.1**
	Brachiaria (Congo signal)	38.6	28.9	26.6
Herbaceous legumes	Lablab	65.9	69.7	66.2
	Mucuna	50	77.6	59.4**
	Desmodium	31.8	47.4	36.4
	Lucerne	29.5	31.6	27.6
	Centrosema	18.2	31.6	25
	Sirato	18.2	26.3	20.8
Other feed practices	Paddockking	43.2	32.9	51.3
	Bush clearing, weed control	43.2	28.9	49.7
	Feed formulation	52.3	53.9	49.4
	Perimeter fencing	31.8	28.9	41.9
	Agro-industrial by-products	22.7	26.3	29.2
	Over-sowing	9.1	23.7	22.4
Other fodder crops	Sweet potato vines	63.6	76.3	61.7
	Sorghum	27.3	25	21.4

p value significance: *** (1%), ** (5%), * (10%)

3.6.2 Preferred sources of livestock feed information

The study sought to identify the most preferred sources of information. The rankings were one for most preferred, two for second most preferred and three for third most preferred source. Table 23 gives the preferred sources of information by farmers. The overall preferred source of information with reference to the total number of farmers is from the PO extension assistants followed by NGOs and then NAADS. VFTs came in fourth.

Table 23: Preferred information sources defined by number of farmers

Information sources	Most preferred (frequency)	2 nd most preferred (frequency)	3 rd most preferred (frequency)	Total no. of farmers (frequency)	% of total farmers (N=310)
PO extension assistants	79	55	31	165	53.2
NGOs	84	29	20	133	42.9
NAADS	32	49	41	122	39.4
VFTs	18	50	37	105	33.9
Private service providers	33	19	29	81	26.1
Radio	17	21	36	74	23.9
Exchange visit to skilled farmers	6	28	28	62	20.0
Farmers' organizations	8	16	14	38	12.3
Other farmers (neighbours, friends)	7	9	12	28	9.0
Posters	4	2	16	22	7.1
Field days	1	8	12	21	6.8
District agricultural officers	7	7	6	20	6.5
Mobile phone	5	5	5	15	4.8
Television	1	2	8	11	3.5
Input dealers	3	2	3	8	2.6
Written materials	0	2	4	6	1.9
Research institutions	2	1	1	4	1.3
Internet	2	1	0	3	1.0
Religious institutions	0	0	0	0	
Total	309	306	303	918	

The most preferred source of information selected by 84 farmers was NGOs (Table 23). Preference was determined by farmers' feedback on their information source preference. The second most preferred information source was PO extension assistants and the third most preferred information source was NAADS. Overall preference, in terms of number of farmers accessing the source, was PO extension assistants followed by NGOs and NAADS.

A second way of assessing preference was using weighting preference scores, that is, to assess whether farmers tended to rank the sources first, second or third and to weight them according to the different rankings. Total scores on rankings as per the preference of farmers are presented in Table 24. The total score was calculated by a product of frequency (the number of farmers who ranked information sources) and weighted the rank of the different sources. Ranks were awarded as follows: the most preferred source was awarded a score of 3; the second most preferred was awarded a score of 2 and the third most preferred was awarded a score of 1.

$$T_s = \sum_{i=1}^n \sum_{j=1}^3 F_j * R_j \forall i$$

$$Avg_s = T_s/n$$

where,

T_s : total score for each information source

F_j : frequency of farmers who selected the information source in each level of preference

j : level of preference (1 to 3); 3 being most preferred and 1 being least preferred

R_j : score awarded in each level of preference

Avg_s : average score

n : total frequency of farmers in each information source

Table 24 presents results of the calculated total score, average score of each information source and its overall rank according to the average scores calculated above. VFTs are ranked highest with average score of 1.48 followed by exchange visits and farmer organizations. High average scores indicate high preference for a particular information source. The lower the average scores, the lower the preference. PO extension assistants were selected by most farmers, but its average score was low compared to other information sources and therefore ranked eighth in preference. The least preferred information sources were posters and religious institutions Table 24).

Table 24: Preferred information sources defined by weighted scores and ranking

Information sources	Total scores	Average score = (Total score/number of farmers)	Rank
VFTs	155	1.48	1
Exchange visit to skilled farmers	90	1.45	2
Farmer organizations	54	1.42	3
NAADS	171	1.4	4
Field days	29	1.38	5
District agricultural officers	27	1.35	6
PO extension assistants	220	1.33	9
Mobile phone	20	1.33	9
Written materials	8	1.33	9
Internet	4	1.33	9
Other farmers (neighbours, friends)	37	1.32	11
Radio	95	1.28	12
Input dealers	10	1.25	14
Research institutions	5	1.25	14
Private service providers	100	1.23	15
NGOs	162	1.22	16
Television	13	1.18	17
Posters	24	1.09	18
Religious institutions	0	0	19

A comparison between male and female respondents shows that PO extension assistants were ranked highest by females in the study, followed by NGOs and VFTs. Male farmers most preferred NGOs then PO extension assistants and NAADS (Table 25).

Table 25: Information source preference across gender

Information sources	Females (N=120)		Male farmer (N=188)	
	Total scores	Ranks	Total scores	Rank
District agricultural officers	14	11	27	11
NAADS	75	4	157	3
NGOs	121	2	209	1
Farmer organizations/groups	37	7	33	8
Research institutions	3	15	6	17
VFTs	91	3	96	5
PO extension assistants	183	1	192	2
Exchange visit to skilled farmers	32	8	70	7
Other farmers (neighbours, friends)	18	9	33	8
Input dealers	3	15	13	13
Private service providers	63	5	103	4
Mobile phone	17	10	13	13
Radio	41	6	88	6
Television	4	12	11	15
Written materials (posters, brochures, newspapers, magazines)	2	17	6	17
Internet	0	18	8	16
Field days	4	12	25	12
Posters	4	12	28	10
Churches/religious institutions	0	18	0	19

Half of the farmers interviewed across age groups (youth, middle age and elderly) prefer PO extension assistants as a source of feed information. Youth were defined as those farmers below the age of 35 years, middle-aged are those farmers between 36-59 and all others (above 60 years) are considered elderly. Differences are noted in the second most preferred information source. The youth prefer private service providers (36%) then NGOs (32%) and NAADS (28%). The middle-age category prefers NGOs (48.8%), then NAADS (37.2%) and VFTs (34.3%). The elderly category preferred NAADS (47.4%), followed by VFTs (42.1%), then NGOs (31.6%) (Figure 3).

Figure 3: Preferred information sources across age groups

An analysis of the effectiveness of most preferred information sources with reference to volunteer farmer training was done. Effectiveness was measured by the use of four predefined criteria: reliability, frequency, accessibility and affordability.

Each of the predefined criteria had been ranked on a scale of 1-5 where 1 = the lowest, 2 = the second lowest, 3 = medium, 4 = high, and 5 = the highest. To calculate the weighted score of the three most preferred information sources by farmers, the frequency of farmers that scored in each category was multiplied by the score of each variable using the formula below:

$$F = \frac{1}{n} \sum_{i=1}^4 X_i * k$$

where:

F: total weighted score of each information source

n: number of responses from each information source

X: predefined criteria scores [1-5]

i: criteria used to analyse effectiveness; accessibility, affordability, reliability and frequency of contact

K: frequency of farmers who ranked specific criteria

The total weighted scores obtained from the equation above for each preferred information source and the comparison between male and female farmers are presented in Table 26. Comparison was only done across the four most preferred livestock feed information sources.

Table 26: Effectiveness of information sources vs VFT by use of weighted scores

Information sources/total weighted scores	Accessibility (weighted scores)		Affordability (weighted scores)		Reliability (weighted scores)		Frequency (weighted scores)		Total average scores for all criteria	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
NAADS	3.14	1.78	3.27	1.94	3.67	2.05	3.03	1.60	3.28	1.84
NGOs	3.07	1.90	3.28	2.10	3.61	2.30	3.07	1.70	3.26	2.00
VFTs	3.19	2.64	3.34	2.98	3.68	3.03	3.13	2.22	3.34	2.72
PO extension assistants	3.21	2.93	3.38	3.22	3.70	3.56	3.19	2.71	3.37	3.11

Both male and female farmers gave PO extension assistants the highest scores on all four criteria: accessibility, affordability, effectiveness and frequency. Male and female farmers each ranked VFTs second across all criteria. NGOs ranked third on some criteria while NAADS ranked third on others.

3.7 Trainings on livestock feed technologies offered to farmers

In all POs surveyed, 95.5% of farmers had been trained on livestock feed technologies irrespective of training provider. Eight of the 13 farmers not trained were males. Most farmers received training from PO extension assistants (77.8%), NGOs (64%), NAADS (58.2%) and VFTs (53.5%) (Table 27).

Table 27: Sources of livestock feed technology training

Training provider	% of farmers (N=310)
PO extension assistants	77.8
NGOs	64.0
NAADS	58.2
VFTs	53.5
Self-training	28.6
Farmer training officers	21.2
District agricultural officers	20.2
Research institutions	3.4

In an assessment of training frequency, interviewed farmers were asked to indicate the frequency of training in the past six months. The frequency of training as provided by different sources is presented in Table 28. It presents the percentage of responses as one trainer would provide training on more than one livestock feed technology in a six-month period.

Table 28: Training frequency of different sources of training over a six-month period

Trainers (% responses)	Number of times trained							Total number
	Once (%)	Twice (%)	Thrice (%)	Every month (%)	Every two weeks (%)	Every week (%)	Very often (%)	
PO extension assistants	69.1	50.0	27.0	47.0	13.0	12.2	40.0	230
NAADS	78.6	46.2	21.4	56.1	14.5	11.6	39.3	173
District agricultural officers	98.3	64.4	27.1	55.9	13.6	10.2	66.1	59
NGOs	79.1	58.1	29.3	49.7	9.4	8.9	36.6	191
Farmer training officers	77.8	63.5	23.8	55.6	28.6	14.3	44.4	63
Self	67.1	58.8	20.0	49.4	15.3	9.4	81.2	85
Research institutions	140	60.0	0.0	40.0	0.0	10.0	50.0	10
VFT	77.2	55.1	25.3	48.7	13.9	14.6	44.9	158

Most institutions offered training once or twice over the six-month period preceding the survey (Table 28). Most farmers therefore often resorted to training themselves (81.2%). More than 60% of the farmers had received training on Napier/elephant grass, mineral supplementation, fodder shrubs, silage and hay making (Table 29). A significantly higher proportion of women than men received training on a number of practices including Napier/elephant grass, fodder shrubs, sweet potato vines and lablab.

Table 29: Training offered to farmers on different feed technologies

Feed categories	Type of feed technologies offered	Male (N=181)	Female (N=116)	Total (N=297)
		% of farmers	% of farmers	% of farmers
Conserved feeds	Silage making	59.7	67.2	62.6
	Hay making	61.3	62.1	61.6
	Utilization of crop residues	47.5	63.8	53.9**
Feed practices	Feed formulation	30.4	44.8	36.0**
	Over-sowing	14.4	15.5	14.8
	Management of dairy stock	51.4	46.6	49.5
	Agro-industrial by-products	10.5	21.6	14.8**
	Mineral supplementation	69.1	72.4	70.4
	Concentrates	31.5	37.9	34
Fodder shrubs	Fodder shrubs	54.1	76.7	63.0**
Grasses	Rhodes grass	47.5	49.1	48.1
	Napier/elephant grass	70.7	83.6	75.8**
	Setaria spp	21.5	33.6	26.3**
	Brachiaria (Congo signal)	10.5	19.8	14.1**
Herbaceous legumes	Lucerne	14.9	24.1	18.5**
	Desmodium	21	30.2	24.6
	Sirato	11	14.7	12.5
	Lablab	42.5	62.1	50.2**
	Centrosema	14.4	19.8	16.5
	Mucuna	44.2	56	48.8**
Other feed practices	Perimeter fencing	34.3	15.5	26.9**
	Bush clearing, weed control	49.7	24.1	39.7**
	Paddock	40.3	20.7	32.7**
	Water harvesting	49.2	42.2	46.5
Other fodder crops	Sorghum	11	16.4	13.1
	Sweet potato vines	44.8	61.2	51.2**

p value significance: *** (1%), ** (5%), * (10%)

Training received by male farmers at a higher rate than females includes perimeter fencing, bush clearing, weed control and paddocking (Table 29). Notably, these are practices for extensive areas, where men tend to have greater responsibilities for managing livestock than in intensive areas. There were few differences in the frequency of training received by female heads and females in male-headed households. Females in male-headed households received significantly more training on mucuna, setaria, over-sowing and concentrates; otherwise there were no differences between the two groups with regard to other technologies (Table 30).

Table 30: Training offered on different feed technologies to female household heads and females in male-headed households

Type of feed technologies offered		Female heads % (N=40)	Females in male-headed HH % (N=75)	Total % (N=115)
Conserved feeds	Silage making	72.5	64	67
	Hay making	67.5	58.7	61.7
	Utilization of crop residues	60	65.3	63.5
Feed practices	Feed formulation	42.5	45.3	44.3
	Over-sowing	7.5	20	15.7*
	Management of dairy stock	40	49.3	46.1
	Agro-industrial by-products	22.5	21.3	21.7
	Mineral supplementation	75	72	73
	Concentrates	25	44	37.4**
Fodder trees and shrubs	Fodder shrubs	70	80	76.5
Grasses	Rhodes grass	42.5	53.3	49.6
	Napier/elephant grass	87.5	82.7	84.3
	Setaria spp	22.5	40	33.9*
	Brachiaria (Congo signal)	15	22.7	20
Herbaceous legumes	Lucerne	22.5	25.3	24.3
	Desmodium	27.5	32	30.4
	Sirato	10	16	13.9
	Lablab	67.5	60	62.6
	Centrosema	20	20	20
	Mucuna	42.5	64	56.5**
Other feed practices	Perimeter fencing	20	13.3	15.7
	Bush clearing, weed control	30	21.3	24.3
	Paddockking	22.5	20	20.9
	Water harvesting	40	44	42.6
Other fodder crops	Sorghum	22.5	13.3	16.5
	Sweet potato vines	70	56	60.9

p value significance: *** (1%), ** (5%), * (10%)

3.8 Livestock feed technologies practised

Farmers practised between three and 20 technologies (Table 31). A higher proportion of farmers in male-headed households practised between four and nine technologies with a mean of eight. Female-headed households practised between three and six technologies with an average of seven technologies. Overall, the average number of technologies practised by all households was eight.

Table 31: Number of feed technologies practised

Number of feed technologies practised	Frequency			Percent (total)
	Male-headed HH	Female-headed HH	Total	
0	1	0	1	.3
3	13	5	18	5.8
4	21	6	27	8.7
5	35	5	40	12.9
6	38	8	47	15.2
7	30	2	32	10.3
8	25	4	30	9.7
9	27	2	29	9.4
10	14	3	17	5.5
11	8	4	12	3.9
12	12	1	13	4.2
13	13	1	14	4.5
14	9	1	10	3.2
15	4	0	4	1.3
16	5	1	6	1.9
17	5	0	5	1.6
19	1	1	2	.6
20	3	0	3	1.0
Total	264	44	310	100

The most practised technologies by both male-headed and female-headed households were Napier grass planting (73.3%), mineral supplementation (72.6%), sweet potato vines (62.1%) and 57.3% practised crop residue utilization (Table 32). Generally, male-headed households practised most of the feed technologies at a higher rate than female-headed households. Female-headed households used several livestock feed practices more than did male-headed households: (e.g., utilization of crop residues, Napier grass, fodder shrubs, sweet potato vines and water harvesting). In contrast, male-headed households practised hay making, management of dairy stock, over-sowing, bush clearing/weed control and paddocking at significantly higher rates than female-headed households. These technologies were more commonly practised in extensive areas, where men have greater responsibility for livestock management than do women.

Table 32: Feed technologies practised by male-headed and female-headed households

Feed technology practised		% Male-headed households (N=263)	% Female-headed households (N=44)	Total (N=307)
Conserved feeds	Hay making	19.4	9.1	17.9*
	Silage making	14.4	13.6	14.3
	Utilization of crop residues	55.5	65.9	57.0
Feed practices	Feed formulation	14.4	13.6	14.3
	Management of dairy stock	38.0	22.7	35.8*
	Mineral supplementation	73.8	65.9	72.6
	Over-sowing	10.3	2.3	9.1*
	Concentrates	25.5	25.0	25.4
Fodder trees and shrubs	Fodder shrubs	47.9	52.3	48.5
Grasses	Brachiaria (Congo signal)	16.3	13.6	16.0
	Napier/elephant grass	72.6	77.3	73.3
	Rhodes grass	33.5	22.7	31.9
	Setaria spp	12.9	13.6	13.0
Herbaceous legumes	Centrosema	11.8	13.6	12.1
	Desmodium	16.7	11.4	16.0
	Lablab	35.4	31.8	34.9
	Lucerne	6.8	9.1	7.2
	Sirato	9.5	9.1	9.4
	Mucuna	28.5	25.0	28.0
Other feed practices	Agro-industrial by-products	4.9	2.3	4.6
	Bush clearing, weed control	52.9	38.6	50.8*
	Paddocking	36.9	20.5	34.5**
	Perimeter fencing	35.4	31.8	34.9
	Water harvesting	43.3	47.7	44.0
Other fodder crops	Sorghum	2.7	4.5	2.9
	Sweet potato vines	61.2	68.2	62.2

p value significance levels: *** (1%), ** (5%), * (10%)

Comparison between females in male-headed households and female heads showed that females in male households practised, on average, 20 technologies while female heads practiced, on average, only four. Females in male-headed households had significantly used and practised technologies such as Rhodes grass and Napier/elephant grass ($p < 0.05$) (Table 33). Female heads practised perimeter fencing more than females in male-headed households ($p < 0.05$).

Table 33: Feed technologies practised by female heads and females in male-headed households

Feed technology practised		% Female heads (N=44)	% Females in male-headed households (N=76)	Total (N=120)
Conserved feeds	Silage making	13.6	14.5	14.2
	Hay making	9.1	18.4	15
	Utilization of crop residues	65.9	72.4	70
Feed practices	Feed formulation	13.6	18.4	16.7
	Over-sowing	2.3	7.9	5.8
	Management of dairy stock	22.7	23.7	23.3
	Agro-industrial by-products	2.3	3.9	3.3
	Mineral supplementation	65.9	69.7	68.3
	Concentrates	25	36.8	32.5
Fodder trees and shrubs	Fodder shrubs	52.3	64.5	60
Grasses	Rhodes grass	22.7	38.2	32.5**
	Napier/elephant grass	77.3	89.5	85.0**
	Setaria spp	13.6	19.7	17.5
	Brachiaria (Congo signal)	13.6	19.7	17.5
Herbaceous legumes	Lucerne	9.1	9.2	9.2
	Desmodium	11.4	15.8	14.2
	Sirato	9.1	10.5	10
	Lablab	31.8	43.4	39.2
	Centrosema	13.6	13.2	13.3
	Mucuna	25	32.9	30
Other feed practices	Perimeter fencing	31.8	17.1	22.5**
	Bush clearing, weed control	38.6	34.2	35.8
	Paddocking	20.5	17.1	18.3
	Water harvesting	47.7	32.9	38.3
Other fodder crops	Sorghum	4.5	3.9	4.2
	Sweet potato vines	68.2	78.9	75

p value significance levels: *** (1%), **(5%), * (10%)

3.8.1 Feed practices across different livestock feeding systems

A comparison between feeding systems shows that there is a significant difference between the number of technologies practised in the three feeding systems ($p < 0.05$). Farmers in the three feeding systems practised between three and 11 technologies. Farmers in extensive systems practised an average of seven technologies, while intensive and semi-intensive systems practised an average of eight and nine technologies respectively (Table 34).

Table 34: Number of feed technologies practised across feeding systems

Number of feed technologies practised	No. of farmers in different feeding systems		
	Extensive (N=102)	Semi-intensive (N=100)	Intensive (N=108)
0	1	0	0
3	6	1	11
4	12	9	6
5	23	8	9
6	23	9	15
7	10	18	4
8	5	11	14
9	9	6	14
10	3	10	4
11	1	2	9
12	0	7	6
13	2	4	8
14	1	6	3
15	1	1	2
16	3	1	2
17	0	4	1
19	1	1	0
20	1	2	0

Feed technology practices also differed between feeding systems. Farmers in extensive systems practised mostly bush clearing, perimeter fencing, paddocking, water harvesting and management of dairy stock as opposed to both intensive and semi-intensive systems. Farmers in intensive and semi-intensive systems practiced Napier/elephant grass planting, utilization of crop residues, fodder shrubs, planted lablab and used sweet potato vines more than farmers in the extensive system (Table 35).

Table 35: Feed technologies practised in different feeding systems

Feed technologies practised		Feeding system			
		Extensive (N=101)	Semi- intensive (N=100)	Intensive (N=108)	Total
Conserved feeds	Hay making	14.9	18.0	20.4	17.8
	Silage making	7.9	13.0	21.3	14.2**
	Utilization of crop residues	17.8	75.0	77.8	57.3***
Feed practices	Feed formulation	5.9	9.0	26.9	14.2***
	Management of dairy stock	55.4	27.0	25.0	35.6***
	Mineral supplementation	87.1	80.0	51.9	72.5***
	Over-sowing	10.9	4.0	12.0	9.1
	Concentrates	11.9	24.0	39.8	25.6***
Fodder trees and shrubs	Fodder shrubs	14.9	61.0	68.5	48.5***
Grasses	Brachiaria (Congo signal)	10.9	29.0	8.3	15.9***
	Napier/elephant grass	21.8	99.0	98.1	73.5***
	Rhodes grass	22.8	43.0	29.6	31.7***
	Setaria spp	5.0	25.0	9.3	12.9***
Herbaceous legumes	Centrosema	9.9	17.0	9.3	12.0
	Desmodium	5.0	34.0	9.3	15.9***
	Lablab	12.9	43.0	47.2	34.6***
	Lucerne	4.0	11.0	6.5	7.1
	Sirato	3.0	16.0	9.3	9.4***
	Mucuna	13.9	45.0	25.0	27.8***
Other feed practices	Agro-industrial by-products	3.0	5.0	5.6	4.5
	Bush clearing, weed control	88.1	29.0	36.1	50.8**
	Paddock fencing	74.3	11.0	19.4	34.6***
	Perimeter fencing	78.2	12.0	15.7	35.0***
	Water harvesting	77.2	31.0	25.9	44.3***
Other fodder crops	Sorghum	0.0	4.0	4.6	2.9
	Sweet potato vines	11.9	86.0	87.0	62.1***

p value significance levels: *** (1%), ** (5%), * (10%)

A comparison of feed technologies practised between different sites was also performed. Six of the 11 sites had over 90% of farmers practising Napier grass planting (Table 36).

Table 36: Feed technologies practised across sites

Feeding technologies practised across districts		Extensive systems				Semi-intensive systems		Intensive systems			
		Sembambule (N=40)	Nakaseke (N=33)	Kayunga (N=32)	Lyantonde (N=5)	Luweero (N=40)	Mukono (N=52)	Wakiso (N=24)	Buikwe (N=32)	Kamuli (N=40)	Kampala (N=12)
Conserved feeds	Hay making	17.9	12.1	15.6	60.0	17.5	13.5	16.7	12.5	22.5	41.7
	Silage making	5.1	9.1	12.5	40.	12.5	9.6	25.0	15.6	15.0	50.0
	Utilization of crop residues	17.9	24.2	21.9	80.0	87.5	61.5	70.8	84.4	95.0	16.7
Feed practices	Feed formulation	2.6	3.0	12.5	20.0	12.5	5.8	37.5	25.0	15.0	50.0
	Management of dairy stock	48.7	60.6	53.1	80.0	15.0	32.7	8.3	56.3	15.0	8.3
	Mineral supplementation	89.7	97.0	75.0	100.0	87.5	71.2	70.8	75.0	35.0	8.3
	Over-sowing	5.1	6.1	25.0	0.0	0.0	5.8	4.2	18.8	15.0	0.0
	Concentrates	7.7	6.1	28.1	0.0	10.0	34.6	79.2	37.5	30.0	0.0
Fodder trees and shrubs	Fodder shrubs	17.9	12.1	18.8	40.0	87.5	42.3	95.8	65.6	62.5	41.7
Grasses	Brachiaria (Congo signal)	10.3	12.1	18.8	0.0	25.0	30.8	4.2	12.5	10.0	0.0
	Napier/elephant grass	17.9	42.4	18.8	60.0	100.0	98.1	95.8	100.0	100.0	91.7
	Rhodes grass	17.9	6.1	34.4	60.0	40.0	51.9	29.2	9.4	47.5	25.0
	Setaria spp	5.1	0.	3.1	40.0	30.0	25.0	4.2	0.0	22.5	0.0
Herbaceous legumes	Centrosema	12.	0.0	9.4	40.0	7.5	26.9	16.7	6.3	10.0	0.0
	Desmodium	5.1	3.0	0.0	40.0	37.5	36.5	12.5	9.4	5.0	16.7
	Lablab	10.3	9.1	25.0	20.0	40.0	46.2	66.7	40.6	47.5	25.0
	Lucerne	2.6	0.0	6.3	20.0	17.5	7.7	8.3	6.3	7.5	0.0
	Sirato	5.1	3.0	0.0	20.0	7.5	23.1	8.3	3.1	12.5	16.7
	Mucuna	10.3	27.3	12.5	20.0	55.0	36.5	41.7	12.5	30.0	8.3
Other feed practices	Agro-industrial by-products	0.0	0.0	6.3	20.0	5.0	5.8	8.3	6.3	5.0	0.0
	Bush clearing, weed control	94.9	63.6	81.3	100.0	2.5	53.8	8.3	50.0	47.5	16.7
	Paddockking	74.4	51.5	78.1	80.0	7.5	15.4	4.2	40.6	17.5	0.0
	Perimeter fencing	92.3	63.6	56.3	80.0	5.0	19.2	4.2	34.4	12.5	0.0
	Water harvesting	84.6	66.7	59.4	80.0	17.5	46.2	41.7	34.4	5.0	41.7
Other fodder crops	Sorghum	0.0	0.0	0.0	0.0	5.0	3.8	8.3	3.1	5.0	0.0
	Sweet potato vines	5.1	15.2	31.3	0.0	75.0	98.1	91.7	84.4	90.0	75.0

In the five remaining sites, Kayunga and Nakaseke both under extensive systems mostly practised mineral supplementation; Lyantonde which is under extensive systems also practised bush clearing and weed control and Semambule mainly practised bush clearing, perimeter fencing and mineral supplementation. The choice of technology practised is associated with the gender of farmers sampled in the area. In Nakaseke and Sembambule for example, more males than females were sampled. This may therefore skew results towards feed technologies more frequently used and practised by male farmers. The type of feeding systems also mattered as most districts under extensive systems practised technologies associated with extensive systems such as bush clearing, mineral supplementations etc. (Table 36).

3.9 Livestock feed technology preferences

Interviewed farmers were also asked to list the most preferred livestock feed technology practised by their households. Table 37 shows the most preferred and practised technologies. The top three with regard to number of farmers were Napier/elephant grass, sweet potato vines and mineral supplementation. Napier grass was ranked among the top three preferred practices by 66.5% of farmers, followed by sweet potato vines (36.8%) and mineral supplementation (31.3%).

Photo 5: A fodder shrub-calliandra

Table 37: Livestock feed technology preferences by use of farmer frequencies

Livestock feed technology preferences		Most preferred		Second most preferred		Third most preferred		Total	
		Frequency	% of farmers	Frequency	% of farmers	Frequency	% of farmers	Frequency	% of farmers
Conserved feeds	Hay making	2	0.6	5	1.6	6	2.0	13	4.2
	Silage making	4	1.3	3	1.0	4	1.3	11	3.5
	Utilization of crop residues	9	2.9	33	10.7	39	12.8	81	26.1
Feed practices	Feed formulation	1	0.3	2	0.6	4	1.3	7	2.3
	Management of dairy stock	16	5.2	6	1.9	11	3.6	33	10.6
	Mineral supplementation	15	4.8	25	8.1	57	18.8	97	31.3
	Concentrates	1	0.3	4	1.3	7	2.3	12	3.9
	Over-sowing	2	0.6	1	0.3	2	0.7	5	1.6
Fodder trees and shrubs	Fodder shrubs	5	1.6	20	6.5	29	9.5	54	17.4
Grasses	Brachiaria (Congo signal)	1	0.3	3	1.0	4	1.3	8	2.6
	Napier/elephant grass	162	52.3	28	9.1	16	5.3	206	66.5
	Rhodes grass	5	1.6	6	1.9	5	1.6	16	5.2
	Setaria spp		0	1	0.3	1	0.3	2	0.6
Herbaceous legumes	Centrosema		0		0		0		0
	Desmodium		0	1	0.3	1	0.3	2	0.6
	Lablab		0	3	1.0	7	2.3	10	3.2
	Lucerne		0		0		0		0
	Sirato		0		0		0		0
	Mucuna	5	1.6	1	0.3		0	6	1.9
Other feed practices	Agro-industrial by-products		0	1	0.3	1	0.3	2	0.6
	Bush clearing, weed control	29	9.4	22	7.1	18	5.9	69	22.3
	Paddockging	18	5.8	11	3.6	17	5.6	46	14.8
	Perimeter fencing	16	5.2	16	5.2	10	3.3	42	13.5
	Water harvesting	8	2.6	32	10.4	15	4.9	55	17.7
Other fodder crops	Sorghum		0		0		0		0
	Sweet potato vines	5	1.6	78	25.2	31	10.2	114	36.8

Feed technology practice preference, by use of weighted scores, between female and male respondents differed slightly (Table 38). The total score presented in Table 38 represents the sum of scores for each preference; most preferred, second most preferred, and third most preferred. Scores were obtained by multiplying frequencies on each preference level by scores assigned where least preference was given a score of 1 and high preference a score of 3. To obtain a weighted score, total scores were then divided by the total number of those who preferred a specific feed technology. The overall rank is derived from the total score with the highest scores having a rank of 1.

Male farmers ranked mucuna highest while female farmers ranked Napier/elephant grass highest. Mucuna and Napier were interchangeably the two most preferred feed technologies. Female farmers' third most preferred feed practice was paddocking while male farmers' third

most preferred was over-sowing (Table 38). Mucuna had the highest weighted score overall, having the highest by male farmers and second by female farmers, even though only 16 farmers of 310 practised this technology. Napier grass scored second with a larger number of farmers practising it. Other technologies ranked highest by farmers include paddocking, perimeter fencing, and bush clearing. All these technologies are practised by more than 90 farmers.

Table 38: Preferred feed technologies practised by gender through the use of weighted scores

Feed livestock technologies practiced	Male			Female			Total no. of farmers	Total		
	Total score	Average score	Rank	Total score	Average score	Rank		Total score	Average score	Rank
Mucuna	12	3.0	1	5	2.5	2	16	17	2.8	1
Napier/elephant grass	287	2.7	2	271	2.7	1	206	558	2.7	2
Paddockocking	76	1.9	11	17	2.4	3	6	93	2.2	3
Perimeter fencing	70	2.1	6	20	2.2	4	2	90	2.2	4
Bush clearing, weed control	129	2.2	4	20	1.8	9	0	149	2.0	5
Management of dairy stock	62	2.2	5	9	1.8	10	0	71	2.0	6
Rhodes grass	20	2.0	7	12	2.0	5	54	32	2.0	7
Silage making	14	2.0	7	8	2.0	5	114	22	2.0	7
Water harvesting	80	1.9	12	23	1.8	11	2	103	1.8	9
Sweet potato vines	101	1.8	14	101	1.7	13	0	202	1.8	10
Concentrates	4	2.0	7	14	1.4	19	10	18	1.7	11
Collected/roadside forage	21	1.4	21	28	1.9	8	0	49	1.6	12
Utilization of crop residues	61	1.5	16	71	1.7	14	11	132	1.6	13
Over-sowing	9	2.3	3	1	1.0	20	13	10	1.6	14
Brachiaria (Congo signal)	6	1.5	17	7	1.8	12	81	13	1.6	14
Mineral supplementation	95	1.6	15	57	1.6	17	7	152	1.6	16
Fodder shrubs	42	1.5	17	42	1.6	15	5	84	1.6	17
Feed formulation	3	1.5	17	8	1.6	16	42	11	1.6	18
Setaria spp	1	1.0	23	2	2.0	5	69	3	1.5	19
Agro-industrial by-products	2	2.0	7	1	1.0	20	46	3	1.5	19
Hay making	19	1.9	13	3	1.0	20	55	22	1.5	21
Lablab	7	1.2	22	6	1.5	18	33	13	1.3	22
Desmodium	3	1.5	17	0	0.0	23	8	3	0.8	23
Lucerne	0	0.0	24	0	0.0	23	2	0	0.0	24
Sorghum	0	0.0	24	0	0.0	23	30	0	0.0	24
Sirato	0	0.0	24	0	0.0	23	97	0	0.0	24
Centrosema	0	0.0	24	0	0.0	23	12	0	0.0	24

3.10 Multiplier effect of information sharing by farmers to other farmers

Of all the farmers trained, 83.5% of them had trained other farmers. Male farmers most frequently shared bush clearing, paddocking and water harvesting information with other farmers. Female farmers significantly shared information on utilization of crop residues, Napier/elephant grass, fodder shrubs, concentrates and sweet potato vines (Table 39).

Table 39: Feed technologies shared by farmers

Feed technologies shared		Male (%) (N=167)	Female (%) (N=91)
Conserved feeds	Hay making	26.3	26.4
	Silage making	24.6	29.7
	Utilization of crop residues	28.7	45.1**
Feed practices	Feed formulation	9.6	14.3
	Management of dairy stock	32.9	6.6**
	Mineral supplementation	47.9	52.7
	Over-sowing	6.6	5.5
	Concentrates	11.4	23.1**
Fodder trees and shrubs	Fodder shrubs	36.5	56**
Grasses	Brachiaria (Congo signal)	7.2	3.3
	Napier/elephant grass	52.1	80.2**
	Rhodes grass	22.2	28.6
	Setaria spp	6.6	8.8
Herbaceous legumes	Centrosema	5.4	4.4
	Concentrates	11.4	23.1**
	Desmodium	10.2	11
	Lablab	20.4	25.3
	Lucerne	4.8	5.5
	Sirato	4.2	1.1
	Mucuna	13.8	20.9
Other feed practices	Agro-industrial by-products	4.2	2.2
	Bush clearing, weed control	48.5	27.5**
	Paddocking	41.3	13.2**
	Perimeter fencing	30.5	12.1**
	Water harvesting	42.5	18.7**
Other fodder crops	Sorghum	3.6	2.2
	Sweet potato vines	27.5	52.7**

p value significance levels: *** (1%), ** (5%), * (10%)

Most farmers shared between two to nine technologies with other farmers, with an average of five technologies (Table 40). There was no significant difference in number of technologies shared by male and female farmers, $p > 0.05$. About 17% of farmers did not share any knowledge with others after training.

Table 40: Number of technologies shared by farmers

Number of technologies	Percent N=310
0	16.8
1	.6
2	5.2
3	16.8
4	13.9
5	10.0
6	10.3
7	6.1
8	5.5
9	4.8
10	1.6
11	2.6
12	1.0
13	1.9
15	.6
16	.3
17	1.0
22	.3
24	.3
26	.3
Total	100.0

Comparisons of the training offered, practised and shared are shown in Table 41. In approximately 63% of the technologies, there is a decrease in the proportion of farmers trained to the proportion of farmers practising, and from those farmers practising to those farmers who shared feed technologies. A higher percentage of farmers were trained, but this percentage decreases with practice and sharing. There is an average of 9.9% decrease with farmers trained to farmers practising, while there is a further 6.9% decrease with farmers sharing. A higher percentage of farmers were trained on these technologies, but only a small percentage have the technologies on their farms. Hay making, silage making and feed formulation had the highest difference between training and practising. This could be due to the complexity of the technology or high cost of inputs associated with the technology.

Technologies with the fewest gap between training and practising include mineral supplementation, paddocking and water harvesting. There was a general decrease between technologies practiced and those that were shared. Technologies with the highest percentage decrease from practise to sharing, however, had the least percentage decrease from training to practice. For instance, the use of sweet potato vines and the utilization of crop residues and mineral supplementation have the least gap between training and practising but have the largest difference between practising and sharing.

Table 41: Proportion of farmers trained, practising and sharing feed technologies

Type of feed technologies		(%)Trained (N=297)	(%) Practising (N=309)	(%) Shared (N=258)
Conserved feeds	Hay making	61.6	17.8	26.4
	Silage making	62.6	14.2	26.4
	Utilization of crop residues	53.9	57.3	34.5
Feed practices	Feed formulation	36	14.2	11.2
	Management of dairy stock	49.5	35.6	23.6
	Mineral supplementation	70.4	72.5	49.6
	Over-sowing	14.8	9.1	6.2
	Concentrates	34	25.6	15.5
Fodder trees and shrubs	Fodder shrubs	63	48.5	43.4
Grasses	Brachiaria (Congo signal)	14.1	15.9	5.8
	Napier/elephant grass	75.8	73.5	62
	Rhodes grass	48.1	31.7	24.4
	Setaria spp	26.3	12.9	7.4
Herbaceous legumes	Centrosema	16.5	12	5
	Desmodium	24.6	15.9	10.5
	Lablab	50.2	34.6	22.1
	Lucerne	18.5	7.1	5
	Sirato	12.5	9.4	3.1
	Mucuna	48.8	7.8	16.3
Other feed practices	Agro-industrial by-products	14.8	4.5	3.5
	Bush clearing, weed control	39.7	50.8	41.1
	Paddockking	32.7	34.6	31.4
	Perimeter fencing	26.9	35	24
	Water harvesting	46.5	44.3	34.1
Other fodder crops	Sorghum	13.1	2.9	3.1
	Sweet potato vines	51.2	62.1	36.4

3.11 Level of understanding of livestock feed technologies

Interviewed farmers were tested on their understanding of feed technology aspects on which they had previously received training as shown in Table 42. A number of questions were posed for all technologies that farmers had been trained on with answers expected given to enumerators to enable them rate/score the answers given. Scoring for the answers given were based on a three-point rating scale: 0 for all incorrect answers, 1 for a partially correct answer and 2 awarded for all correct answers. Most farmers, both male and female correctly identified how Napier grass is established with 61.4% of male farmers scoring ‘correct’, while 80.2% of female farmers scored ‘correct’ in Napier establishment. On the process for Napier planting, 65.3% of women scored correctly, and in the identification of crop residues fed to livestock, 34.5% of women scored correctly. Feed technologies with high scores in the ‘incorrect’ column include recommended fodder trees that can be left on farm for seed

production and recommended spacing for calliandra for a hedge and the number of calliandra shrubs needed for a cow. Women scored these three technologies incorrectly: fodder trees 47.9%, seed production 43.0% and recommended spacing for calliandra (52.9%). About 31.2%, 28.6% and 35.4% of men, respectively, scored these technologies incorrectly.

Testing farmers' understanding and knowledge of the technologies ensures that those who train other farmers have the essential knowledge and skills to effectively transfer the information. This is important, especially in the farmer-to-farmer extension approach where farmers have the mandate to train others effectively. From Table 42, a higher proportion of women scored highly (correctly) in most of the identified technologies than did men. This could imply that more women than men have a higher retention power for the trained technologies. These findings may not mean women farmers are better facilitators/trainers but that their ability to retain knowledge learnt is higher than male farmers. Retention of knowledge can be affected by a variety of factors, including the interest and drive of the trained farmer.

Table 42: Farmers' level of understanding of livestock feed technologies

Technology	Test questions	Male (N=189)			Female (N=121)		
		Incorrect (%)	Half correct (%)	Correct (%)	Incorrect (%)	Half correct (%)	Correct (%)
Napier	Napier grass establishment	1.6	11.1	61.4	1.7	10.7	80.2
	Planting of Napier canes	4.8	18.0	48.1	5.8	17.4	65.3
Feed formulation	Ingredients for making feed ration	9.0	11.6	27.0	6.6	18.2	33.1
Silage	Best stage for cutting Napier	5.3	18.5	43.9	5.8	31.4	36.4
	Materials needed to make tube silage	11.1	19.6	33.9	9.1	27.3	33.9
	Name one method of silage making	7.9	12.2	45.0	5.8	21.5	41.3
	The best stage to harvest maize fodder for silage	8.5	10.6	46.0	10.7	20.7	38.8
Crop residues	Crop residues that can be fed to livestock	2.6	8.5	55.6	2.5	15.7	64.5
Fodder shrubs	Name shrubs used for improved fodder	7.9	15.3	43.4	8.3	30.6	45.5
	Suitable niches for growing fodder shrubs	7.9	22.8	33.3	13.2	24.8	44.6
	Recommended number of fodder trees that can be left on farm for seed production	31.2	21.7	11.6	47.9	24.8	9.1
	Recommended spacing for calliandra for a hedge	28.6	22.8	15.9	43.0	24.8	16.5
	Pre-treatment of calliandra seeds	27.0	13.8	23.8	29.8	29.8	24.8
	Number of calliandra shrubs needed per cow	35.4	19.6	10.6	52.9	19.8	7.4
Rhodes	Best time of the season suitable to sow Rhodes grass	5.8	18.5	30.7	7.4	15.7	41.3
	Number of 70 kg gunny bags of freshly-cut Rhodes grass required by a cow per day	13.8	18.5	21.2	17.4	22.3	16.5
Hay	Best stage to cut Rhodes grass for grass	8.5	16.9	30.2	11.6	13.2	38.0
Leguminous fodder	Leguminous fodder examples	9.0	16.4	32.3	8.3	30.6	30.6
Concentrates	Commercial concentrates for cattle	3.7	11.6	36.5	4.1	19.0	38.8
Mineral supplementation	Daily amount of mineral intake recommended for an average cow	25.4	28.6	29.6	30.6	28.9	20.7
Pasture improvement	Technologies/practices for pasture improvement	2.1	18.0	52.4	5.8	20.7	35.5
Water harvesting	Daily amount of water intake required for an average milking cow	13.2	23.3	36.5	12.4	25.6	21.5

4.0 Discussion

4.1 Comparison of volunteer farmer trainers to other information sources

Preferred information sources depend on the type of information to be delivered, the authority of the source of the information, and the availability of the source (Nobelius et al., 2010). At the study site, most farmers accessed information on livestock feeds from the PO extension assistants, followed by radio and VFTs. In terms of information source preference, PO extension assistants were most preferred, followed by NGOs and NAADS. The effectiveness of the identified information sources was measured through predefined criteria: accessibility, affordability, reliability and frequency. PO extension assistants were ranked most effective as they were rated highly on accessibility, affordability, reliability and have a higher frequency of contact with farmers. In an analysis between the different sampled POs, not all members of POs obtained information from PO extension assistants; only five out of the 11 sampled POs did. The rest of the PO members obtained information from NAADS, VFTs, NGOs and/or other farmers. Established POs are therefore an important information source to farmers but, depending on the proximity, the effectiveness and information needs of its members, it can be surpassed by other information sources.

Producer Organization extension assistants

Producer organizations (POs) are community-managed organizations whose purpose is to deliver services to farmers such as financing and technical support (Kiptot and Franzel, 2015). They also offer services such as artificial insemination, credit facilities and extension, and stock high-quality fodder seeds which they distribute to farmers. These POs act as a hub for milk bulking and most have an agro-vet. PO members can access any of the services provided from the PO at any given time. Each of the POs has extension staff who offer extension services to farmers. The results on preferred information sources could, however, be skewed towards PO extension assistants since the farmers interviewed in this survey are mainly members of the POs.

Radio

Radio has been shown to be a major source of information on a variety of subjects. From the research findings, radio was found to be the second most important information source for male respondents and female heads of households. Radio in Uganda is often used by farmers to relay general agricultural information and presents diverse issues pertaining to rural areas (Masuki et al., 2010). Radio often localizes programmes to fit the needs of the local population ensuring better understanding of the programmes and suitability to the intended population (Anderson and Elliott, 2007). Although most farmers in Uganda own a radio (95% of male-headed households), females in male-headed household's ranked radio fourth as their information source, implying such females may have limited access. Assets such as radios and TVs are often owned jointly by the households and are therefore accessed jointly. According to Kleih et al. (2004), radios are mostly owned by men; women only listen to radio when their husbands are listening which limits the females' ability to listen to programmes

targeting women if their husbands do not want to listen to it. Farmers listen to radios depending on the educative programmes available, diversity of programmes, up-to-date information and the use of the local language (UCC, 2012).

Volunteer farmer trainers

Volunteer farmer trainers were ranked second by both male and female farmers in terms of accessibility, affordability, reliability and frequency in comparison to other livestock feed information sources. They were the most preferred information source for females both in male-headed and female-headed households. Male farmers, however, did not consider VFTs among the top three most preferred information sources. Male farmers ranked NGOs, POs and NAADS as first, second and third respectively, while VFTs came in fifth place. VFTs have been shown to be more favourable to female farmers as they visit farmers' households for training; thereby eliminating barriers that could prevent females from receiving training, for example if the training is offered beyond their domestic sphere.

The VFT approach which is a form of farmer-to-farmer extension has been shown to reach more, lead to increased adoption of new practices and is less costly despite the costs incurred by these farmers such as transport and facilitation costs (Kundhlande et al., 2014). Opportunity costs incurred such as time forgone hamper the efficient delivery of information and innovations by the VFTs (Karuhanga et al., 2012, Kiptot and Franzel, 2012). VFTs have an added advantage due to the fact that they are themselves dairy farmers and they have the ability to train and demonstrate skills and technologies on their farms. In a report by Karuhanga et al. (2012), VFTs were highly-motivated to provide training due to increased demand for their services. VFTs, as shown by Karuhanga et al. (2012), demonstrate their skills on their own farm and establish bigger demonstration plots of applied technologies. This increases the awareness and buy-in from other farmers who can ascertain by themselves the extent and intensity of the taught technologies. The criteria used to select VFTs such as farmer-trainer willingness and interest to disseminate information and the condition that trainers should be resident in the community permits consistent passing of information to farmers whenever there is a need. This criterion surpasses seasonality of information sharing and since the farmer-to-farmer model is demand driven, farmers can obtain information on matters of interest at any given time. This triumphs over any other source of information such as radio or government extension in terms of efficiency and effectiveness.

Non-governmental organizations

NGOs were ranked second by male farmers as a source of information. The preference of male heads for NGOs in the provision of information would be due to networks they have formed in the community and their easy mobility in and out of the community. Ofuoku et al. (2008) found that the majority of fish farmers obtain information from farmer groups, other farmers and NGOs. NGOs have been credited with providing innovative solutions to problems in rural areas and occasionally fill in gaps that could not be addressed by the national government. There are many NGOs in Uganda working on poverty reduction and improved health and livelihoods of the rural poor. At the end of 2013, an estimated 12,500 NGOs were registered in Uganda with the majority of them focusing on education and

training (UNNF, 2015; Barr et al., 2004). Most of the NGOs in Uganda are largely populated by small organizations headed by highly-educated Ugandans with minimum regulatory monitoring and evaluation by the Central government (Barr et al., 2004). Although most NGOs have been shown to perform needs analysis of communities interest, there is still evidence that the poorest of farmers may not fully benefit as they often fail to undertake the in-depth social analysis necessary to identify the target group (Barr et al., 2004). This may mean a failure to reach the most vulnerable of the rural groups, for example female heads who are widows and females in male-headed households who are tied to household responsibilities.

National Agricultural and Advisory Services

NAADS was also ranked among the effective and accessible information sources in the study site. NAADS² was a semi-autonomous public agency within the MAAIF responsible for public advisory extension services in Uganda. It specifically aimed at addressing constraints such as lack of access to agricultural information, knowledge and improved technologies among the rural poor. Since its establishment in 2001, NAADS has recorded success in the delivery of extension services, as 90% of households participating in NAADS had access to extension, while only 28% of non-NAADS had accessed extension in the period 2009/10 (Okoboi et al., 2013). However, this was not true during the early years (2001/2-2005/6) where there was no significant differences between NAADS and non-NAADS sub-counties in terms of technology adoption (Benin et al., 2007, Okoboi et al., 2013). This was thought to be due to low extension staffing in the local government. Perceived non-performance and alleged mismanagement of funds by the NAADS secretariat led to the disbarment of the national extension provider by the country's president. The president replaced NAADS coordinators with soldiers who were deployed to implement advisory and agricultural extension (Rwakakamba and Lukwago, 2014). This is a huge blow to the country at large as it takes extension back to the time before NAADS, where there was no policy in extension.

4.2 Training in livestock feed technologies

Of farmers trained in feed technologies, the majority (77.8%) received training from PO extension staff, 64% from NGOs and 58.2% from NAADS, while 53.5% received training from VFTs. Majority of the trainers in feed technologies, including VFTs, train only once or twice within a six-month period, and therefore farmers resort to self-training about 81.2% of the time. The number of farmers trained by VFTs was slightly lower in comparison to other trainers in the study site. This could be due to the nature and modes of operation of VFTs. VFTs are not paid any remuneration, including facilitation fees. They face constraints such as transport costs to reach farmers' homesteads, and opportunity costs incurred in terms of time away from their farm can be a huge hindrance to information dissemination. With enhanced resources and mobility, VFTs have the ability to reach far more farmers than other forms of extension.

²<http://www.naads.or.ug/>

Women and men in the study site received feed technology training on Napier grass, mineral supplementation, fodder shrubs, silage making, hay making and utilization of crop residues. Although all the training was offered to men and women, over 50% of women received training three times more than men. A significantly higher proportion of women received training on Napier grass, fodder shrubs, sweet potato vines, lablab and utilization of crop residues while men significantly received training on bush clearing, paddocking, and perimeter fencing. Training received by men is associated with extensive farming systems while training received by women is associated more with intensive systems. Training received by farmers in the study was mostly in accordance with daily activities and roles and responsibilities for each gender. Their training choices could be due to the interests of male and female farmers. Female members mainly received training on Napier, sweet potato vines and fodder crops compared to men who received training on bush clearing and paddocking. Extension service providers should therefore ensure training is well targeted for better adoption depending on the interests of the different gender groups. More females than males received training, implying an increase in female targeting and gender awareness of trainers in the study site.

4.3 Livestock feed technology preference, practices and sharing by farmers

In the study sites both male and female farmers practised, on average, eight technologies each. Most practised technologies were mineral supplementation and Napier grass planting. Both men and women practised technologies that they had been trained on. Female farmers mostly practised Napier grass planting, fodder shrubs, sweet potato vines, utilization of crop residues and mineral supplementation, while male farmers practised bush clearing, perimeter fencing and water harvesting technologies significantly more than female farmers. The most preferred technologies by over 50 % of farmers was Napier grass (67.5%), then sweet potato vines (37.4%) and mineral supplementation at 31.8%. Ranking of the most preferred practised technologies showed that mucuna was ranked highest by both male and female farmers, even though it is practised by only a few farmers. Napier grass was ranked second but was the most preferred practised technology with a proportionately higher number of farmers practising it. Paddocking was ranked third by female farmers while over-sowing was ranked third by male farmers. The least practised by farmers and ranked lowest was desmodium, lablab and hay making. Both male and female farmers practised technologies they had been trained on; preferred technologies were consistent to technology training received.

This suggests that the training offered may have a direct influence on technologies practised by farmers. Previous studies have shown that the socio-economic characteristics of farmers such as education level, farm size, family size, decreased distance to market, and the labour requirements of technology have an influence on technology adoption (Njeri et al., 2013, Mekonnen et al., 2010, Chiputwa et al., 2011). Although feed technologies may be offered as a package, farmers tend to adopt different components depending on their social economic characteristics (Chiputwa et al., 2011). Ascertaining the factors influencing farmer adoption of feed technology practices was however beyond the scope of this study.

Of all farmers trained, 83.5% had trained and shared the information and technologies taught with other farmers. Over 40% of male and female farmers shared information on five feed technologies each. Male and female farmers both shared Napier grass and mineral supplementation technologies. However, three technologies shared by male and female farmers differed: male farmers shared paddocking, bush clearing and water harvesting, while female farmers shared fodder shrubs, sweet potato vines and utilization of crop residues. From the findings, approximately 95.5% of farmers were trained, 85.4% of those trained practised and 77.5% of farmers shared the technologies practised. Training shared followed a similar pattern of training offered where farmers often shared training offered and/or practised. For instance, male farmers mostly attended training on paddocking, perimeter fencing and bush clearing, which they further practised and shared with other farmers, although at a decreasing rate. The multiplier effect is often assumed, where farmers are expected to reach out to other farmers on the training they receive. This therefore calls for further analysis on the whys and wherefores for the decline in information sharing.

Conclusion

The study sought to assess effectiveness of the VFT approach in comparison to other information sources. Access to information is a prerequisite for improved agricultural productivity and eradication of rural poverty. In the sample sites, farmers receive information from a variety of sources. From the findings, important information sources for farmers is through PO extension staff, radio and VFTs. In terms of information source preference, PO extension staff were most preferred followed by NGOs and NAADS. VFT were however the second most preferred by female farmers. VFTs were also ranked second most effective in terms of accessibility, affordability, reliability and frequency of contact.

Among the most preferred information sources, VFTs were found to have trained fewer farmers compared to other trainers such as the PO extension staff, NGOS and NAADS. The feed technologies received by farmers were mainly Napier grass and mineral supplementation and this was promoted by all trainers. All trainers were found to visit farmers once or twice in a six-month period; this therefore leads farmers to resort to self-training. Most farmers who were trained did take up and share information learnt from other farmers. Practice and sharing was however mainly dependent on the training received by the farmer. Female farmers received training on Napier grass, fodder shrubs and mucuna at a higher rate than male farmers, while male farmers received training on bush clearing, paddocking and water harvesting. These farmers in turn practised and shared what they had learnt. However, it was found that there is a general reduction in the number of farmers trained compared to those who practice and in the number of farmers who practised compared to farmers who shared; hence, the need to undertake a study to find out the reasons.

VFTs have the ability to reach the poor and female members in homesteads as they are less costly and farmers can obtain information of interest at any given time. Male farmers, however, did not rank VFTs among the most preferred information sources. Other forms of information such as NGOs have limitations in reaching the poorest of farmers as they often fail to undertake an in-depth analysis of existing social structures. NAADS on the hand, although preferred by farmers has been considered ineffective due to organizational problems and mismanagement of funds and has been lately overhauled by the president of Uganda and given to soldiers to run the extension services. This sets back measures already put in place since its formation in 2001. Although radio is quite accessible to farmers, female farmers are disadvantaged because they have limited access to it.

The VFT approach has the ability to reach more farmers than it currently does in Uganda. This could be attributed to the nature of the VTF approach which is mainly based on volunteerism. Effectiveness of the VFTs can be enhanced with improved infrastructure and motivation for VFTs to improve their performance, for instance by recognizing their work by providing certificates and/or rewards for the best performing VFTs.

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