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A situation analysis of priority farm enterprises and technology adoption status in the south west highlands of Uganda

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ABSTRACT

Objective: The study was motivated by the fact that despite availability of technologies capable of solving farmers' constraints, the available relevant technologies have not been adopted sufficiently. This study examined the prospects of agricultural technology in enhancing farm productivity, rational resource utilization and farmers' livelihoods.

Methodology and results: Qualitative data were obtained using semi-formal and formal studies from seven sub-counties selected from Kabale, Kanungu, Kisoro and Rukungiri districts. Informal survey data heavily relied on PRA techniques. These were supplemented by secondary data, key informant interviews and direct observations. The situational analysis survey relied on formal data collection procedure using a questionnaire. Data collected focused on local farming systems and major enterprises; farm domestic resources and constraints; current mechanisms for technology packaging and dissemination; gender related and spatially oriented technology practices, needs and challenges; benefits of improved technology; and effectiveness of different technology packaging techniques and dissemination approaches in various farm typologies. Findings showed that *Solanum* potatoes, bush beans, climbing beans, vegetables, bananas, coffee and sweet potatoes are the major crop enterprises in the region. With respect to livestock enterprises, local breeds under traditional management systems characterized the common species raised in the zone, and goats and cattle are the dominant livestock in the region. Notably, exotic dairy cattle breeds were raised as a priority enterprise in less than 20% of the households sampled. Technology adoption was more prominent for priority crops compared to priority livestock enterprises. For crops, technology adoption emphasized crop rotation, spacing, pesticide application and soil and water conservation aspects of production as opposed to pre-production and post harvest management. Low prices for milk, banana and Irish potatoes, lack of improved and clean planting materials especially for bush and climbing beans, sweet potatoes and Irish potatoes grossly constrained production. Regular deworming was the dominant livestock technology adopted. Livestock production was particularly constrained by lack of improved breeds, feeding, housing and health management technologies. Improved feeding and breeds were however the key technology gaps for livestock. Farmer exchange visits and trainings were the most effective technology dissemination approaches. Findings on the sex of decision makers in the households suggest that both women and men farmers should be targeted for technology intervention. It was noted that

whereas there exists relevant technologies from NARO that can address farmers' constraints there is general lack of information about their existence.
Conclusion and application of findings: Small-scale irrigation is proposed as a remedy to counter effects of water stress especially for vegetable production. It is suggested that NARO publishes a list of all technology packages and provide copies to all districts. It is recommended that technology promotion be refocused to address gaps in raising yields of improved seed and planting materials as well as post harvest handling for crops. Due attention should be accorded to the livestock technology gaps particularly lack of improved feeds and breeds. Attainment of higher farm incomes to achieve the 'prosperity for all' objective should be addressed by fostering sustained adoption of productivity enhancing technologies and tripling of sales to gain escape velocity from poverty. This should be done mainly by combining farmer training and exchange visits, supplemented by simple radio messages, posters, leaflets and brochures tailored to technology gaps relevant to priority enterprises in the sub-county targeted.

Key words: Situation analysis, technology adoption, farm enterprises

INTRODUCTION

Despite availability of technologies capable of solving farmers' constraints their adoption has been too low in Uganda. Situations of low and in some cases declining productivity and low incomes therefore contradict the national economic development objective of 'prosperity for all' due to failure to realize the objectives of having a modern, market oriented and commercialised agricultural sector. Theories explaining causes of low adoption of farm technology can be traced from three distinct periods, i.e. 1950-60s, 1970-80s and 1990s – to date (Werner, 1993). Technology adoption models for the periods attribute causes of low adoption to farmer ignorance; farm level constraints; and inappropriate technology, respectively.

It has, however, since been recognized that farmers know a lot, and the cardinal principles of participatory processes are respect for knowledge and skills of farmers since farmers are the most important stakeholders and the role of outsiders is to support them (Minjauw, 2001; Conroy, 2005). Exploratory studies based on participatory methods are well suited to getting an understanding of the farmers' technology needs, adoption constraints and prospects for effective technology intervention. Use of participatory rural appraisal (PRA) and participatory situational analysis approaches accords respect to the knowledge and skills of the farmers, recognizes that farmers are the most important stakeholders and encourage target communities to freely express themselves, get involved and own the process (Mettrick, 1993; Conroy, 2005). In addition, participatory techniques ensure triangulation (FAO, 1998) in terms of methods of data collection; information sources; people involved in the process and the multidisciplinary of the research team composition.

Furthermore, proper and gainful use of agricultural technologies heavily relies on the user's ability to exploit the potentials and possibilities of the opportunities offered by improved technology intervention. Nevertheless, factors that disable beneficiary, weakness of those providing support service and household peer attitude may render communication and adoption of worthwhile interventions futile. It is therefore evident that effective dissemination of crop and livestock technologies requires a sound understanding of users' agricultural technology sources, adoption levels and felt needs. Conroy *et al.* (2005) noted that although many projects rely solely on conventional government extension services to disseminate information to all farmer typologies the approach is often not effective. Matthewman *et al.* (1997) describes the sources of failure by conventional information delivery of technology packages as being the common use of 'top down' information flow with heavy reliance on 'progressive farmers' hoping that other farmers — of different objectives, preferences; circumstances

and resource endowment - will learn and copy from experiences of these farmers and subsequently adopt the technologies in question.

In addition, conventional approaches place overdue focus on intensively managed farms at the expense of low input - low output extensive farms and services are concentrated in high potential areas leaving out marginal areas where productivity and management adjustments are critical for yield and sustainability improvements. These approaches offer services that are often gender and scale biased dominated with men to men information flow and targeting large farms with little or no direct focus to needs of women and the land constrained or landless. They often argue that they reach women through their husbands. Just like in any demand - based theory, the process of technology demand realization, articulation, and preference ordering must be clearly conceptualized through invoking farmers' involvement. Poor households, particularly those in vulnerable ecological regions having suffered economic, political and institutional deprivations for centuries learn to adjust to and accept their predicament. They not only develop risk adjustment strategies in the field of resource management but also in the field of social exchange relations. Some of these adjustments over time become adaptations with implication that those affected may not even feel many of the needs that they have.

The main objective of this study was to examine the role of agricultural technology in enhancing farm productivity, rational resource utilization and farmers' livelihoods. This paper presents the findings of a situation analysis whose specific objectives were to identify available priority agricultural enterprises, constraints and status of technology adoption, and prospects to technology adoption enhancement.

METHODOLOGY

Site selection and sampling: The informal survey was conducted in seven sites. These were Kirundo and Nyakabande sub-counties (Kisoro district), Muko and Kyanamira sub-counties (Kabale district), Kebisoni and Nyakagyeme sub-counties (Rukungiri district) and Kambuga (Kanungu district). The criteria used in selecting the sub-counties were: to capture variability in agro-ecological characteristics that include high, low and mid altitude sub-zones; human population density and household land availability, socio-economic factors in terms of livelihoods patterns, household income diversity, staple food preferences and social networks; dominant farming systems and major crop and livestock enterprises, benefits and management practices; market and farm support service accessibility, intensity of technology dissemination by National Agricultural Advisory Services (NAADS), Area based Agricultural Modernization Project (AAMP), and other channels. Resource endowment was the major stratifying factor for the study. Resource endowment is a function of rainfall, population density, cattle ownership, farm sizes of major crops and market access (Scoones & Wolmer, 1999).

The formal (questionnaire) survey was conducted in six sites. These were Kirundo and Nyakabande sub-counties (Kisoro district), Muko and Kyanamira sub-counties (Kabale district), and Kebisoni and Nyakagyeme sub-counties (Rukungiri district). Sampling techniques heavily relied on multistage and systematic sampling procedure up to village level. In each sub-county the number of households interviewed was 50 making a total of three hundred (300) households. At village level the project team discussed the nature and objective of the study with the local committee members. Together with the village chairpersons and General Secretaries, inventories of all households in a village were developed. A household was the level of questionnaire interviews and the unit of analysis used in data management. Using the household inventory developed for each village, households were assigned counting numbers. Random sampling was used to select households in each village.

Steps for conducting the formal survey were:

(1) Enumerator orientation to appreciate the objective of the study; equip enumerators with rapport development, respondent confidence building and streamline sustained participation of respondents during the survey; and establish standard interpretation and elicitation of data from respondents.

(2) Discuss and undertake the rationale of sampling, representative household selection, multistage, purposive and random sampling procedure.
(3) Collect socio-economic raw data on the local farming systems enterprises, resources and constraints; assess available technologies and current mechanisms of packaging and dissemination of technologies; identify technology users, their needs and challenges as well as benefits and effectiveness in technology packaging and dissemination.

Qualitative data collection was done using key informant interviews, mostly with district and sub-county production technical staff including veterinary, agriculture, fisheries and community development officers, sub-county chiefs and local council chairpersons, and coordinators of AAMP and NAADS. In addition, focus group discussions held at that level, drew participants that consisted of farmer forum members, parish coordination committees (PCCs), Community based facilitators (CBFs), special interest groups like women and youth groups, enterprise association members, CBOs, and Batwa representatives, FAL participants, primary school teachers, LCs, innovative farmers and contact/host or farmer leaders. Situational analysis survey relied on formal data collection procedure using standard data capture tools. Data collected focused on: local farming systems and major enterprises, farm domestic resources and constraints; current mechanisms for technology packaging and dissemination, gender related and spatially oriented technology practices, needs and challenges; benefits of improved technology; and effectiveness of different technology packaging and dissemination techniques in various farm typologies.

Qualitative data were summarized and presented using diagramming and visualization enhancement techniques namely trend, ranking and scoring analyses and preference matrices. Formal survey data were largely analyzed using SPSS and Ms Excel programmes to generate descriptive statistics that include frequencies and means. Relationships between key variables were assessed using cross tabulations, and difference between means.

RESULTS AND DISCUSSION

Data on socio-economic characteristics of the households is summarized in figures 1. The findings of the study show that overall about 70% of households are headed by monogamous men followed by female headed households at 22%. The proportion of female headed households is thus significant and should not be ignored by extension agents. Technology dissemination approaches should therefore target both men and women farmers. Matthewman *et al. (*1997) noted that among other factors, failures of conventional extension services are often due to gender bias and domination by men to men information flow with little or no direct focus to the needs of women. They sometimes argue that they reach women through their husbands. Some interventions are made without thorough gender assessment, and this leads to failure. For instance, Nanyeenya *et al.* (2008) observed that inadequate gender assessment led to the collapse of Rwimi oxen ploughing project that was intended to boost maize production in Kabarole district of Uganda.

Data obtained on mean annual gross farm revenue generation shows that farmers in Rukungiri were on average getting almost twice as much farm income compared to their counterparts in Kabale district. The corresponding figures were Uganda shillings 3,700,000 and 1,600,000. Farmers in Kisoro obtained about shillings 2,000,000.

Considering that the current target of Ush. 20,000,000 per household is required to achieve prosperity for all, a lot still needs to be done by all development agents and stakeholder in the agricultural sector. Distribution of income by sources (table 1) indicates that crops (70%) are the main source of revenue in all sub-counties. Livestock is an important source of income in Nyakagyeme with 30% of the revenue coming from milk sales and 20% from selling cattle. Goats are important sources of revenue particularly in Kebisoni (12%) and Kirundo (14%). Pig revenues are particularly relevant in Muko (15%).

Although cattle are important in Muko sub-county their low sales would suggest that they are most likely used to cater for non-cash household objectives. This is similar to the observations made by Ashley and Nanyeenya (2005) that livestock commonly serve as informal household insurance (risk aversion), savings and deposit accounts to substitute formal banking services where they are lacking, sources of materials for traditional and social safety nets, besides providing consumable products for sale and subsistence.

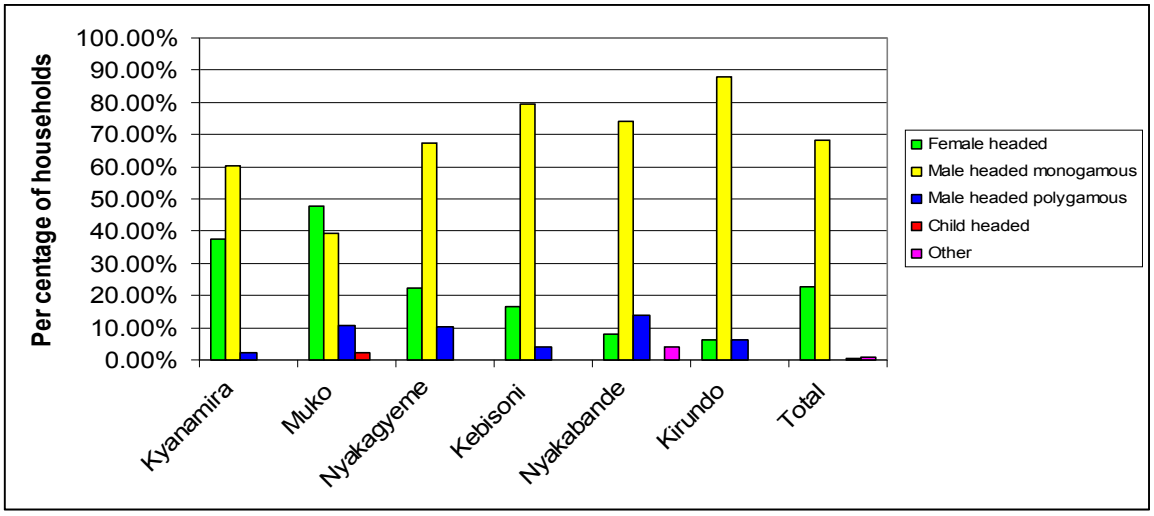

Figure 1: Gender and household headship in south west highlands of Uganda.

Table 1: Main sources of income to households in the south west highlands of Uganda.

Sub-county	Main source of income (%)						
	Selling cattle	Cow milk	Goats	Pigs	Poultry	Crops	Other
Kyanamira	0	6.0	8.0	2.0	4.0	78.0	2.0
Muko	4.2	4.2	2.1	14.6	2.1	70.8	2.1
Nyakagyeme	20.0	30.0	8.0	0	0	42.0	0
Kebisoni	2.0	4.1	12.2	0	2.0	73.5	6.1
Nyakabande	0	2.0	05	2	0	82.4	13.7
Kirundo	8.0	4.0	14	0	4.0	70.0	0
Total	5.7	8.4	7.4	3	2.0	69.5	4.0

Note: Others include off farm employment, petty trade, artisans and selling labour.

Priority enterprises and farm constraints: Findings on priority farm enterprises and constraints are presented in tables 2 to 5. With reference to table 1, bananas are the main crop enterprise in Rukungiri district with 68 and 86% for Kebisoni and Nyakagyeme sub-counties, respectively. Sweet potatoes (48%) are the most important crops in Kyanamira sub-county followed by vegetables at 12%. Irish potatoes (94%) are most important crop enterprise in Muko and Nyakabande sub-counties (31%). The main crop enterprises in Kirundo sub-county are sweet potatoes, bananas and vegetables each at 26.5%. Besides diversification, technology interventions should target the above enterprises that farmers are already producing and for which comparative advantage in the region already exists. In terms of ranking the priority enterprises, data from the situational analysis is in agreement with the finding of the qualitative study.

With respect to livestock, (table 3), findings obtained show that overall cattle (32.4% and goats at 32.4% are the most important livestock enterprises in the region. Goats are particularly important (46%) in Kyanamira and Kebisoni (50%), Nyakabande (33.3%) and Kirundo (32.4%). Cattle are particularly important in Nyakagyeme (61%) and Muko (39%). Pigs are commonly raised in Muko (30%) and Kebisoni (18%). Keeping chickens was an important activity in Kirundo (27%), Nyakabande (25%) and Kyanamira (22%).

Findings on crop and livestock constraints are presented in table 5 and table 6, respectively. The main constraints in crop farming range from low prices (22%) particularly for milk and bananas in Nyakagyeme and Irish potatoes in Muko sub-counties, lack of planting materials (20%), low yielding varieties (19%) and lack of management skills (18%).

Table 2: Main crop enterprises in the south west highlands of Uganda.

	Main crop enterprises					
Sub-county	**Sweet potatoes**	**Irish potatoes**	**Vegetables**	**Bananas**	**Fruits**	**Other**
Kyanamira	48	6	14	2	6	24
Muko	4.2	93.8	0	0	0	2.1
Nyakagyeme	2	0	2	85.7	0	10.2
Kebisoni	20	0	0	68	0	12
Nyakabande	18.8	31.3	10.4	10.4	0	27.1
Kirundo	26.5	14.3	26.5	26.5	2	2
Total	20.1	23.8	8.8	32.3	1.5	13.3

Note: Bananas are predominantly cooking types; vegetables are mainly cabbages, carrots, onions and tomatoes. In Nyakabande others is mainly composed of climbing beans. In Kyanamira others is represented by sorghum (18 %) and beans (6 %)

Table 3: Main livestock enterprises in south west highlands of Uganda.

Sub-county	**Main Livestock Enterprises**				
	Cattle	**Goats**	**Piggery**	**Poultry**	**Others**
Kyanamira	24.3	45.9	5.4	21.6	2.7
Muko	39.1	15.2	30.4	15.2	.0
Nyakagyeme	60.5	23.3	14.0	2.3	.0
Kebisoni	18.4	50.0	18.4	13.2	.0
Nyakabande	20.8	33.3	12.5	25	0.9
Kirundo	20.6	32.4	14.7	26.5	5.9
Total	32.4	32.4	16.7	16.2	1.4

Note: others include sheep, rabbits and apiary.

Table 4: Main sources of income to households in south west highlands of Uganda.

	Main source of income (%)						
Sub-county	**Selling cattle**	**Cow milk**	**Goats**	**Pigs**	**Poultry**	**Crops**	**Other**
Kyanamira	0	6.0	8.0	2.0	4.0	78.0	2.0
Muko	4.2	4.2	2.1	14.6	2.1	70.8	2.1
Nyakagyeme	20.0	30.0	8.0	0	0	42.0	0
Kebisoni	2.0	4.1	12.2	0	2.0	73.5	6.1
Nyakabande	0	2.0	05	2	0	82.4	13.7
Kirundo	8.0	4.0	14	0	4.0	70.0	0
Total	5.7	8.4	7.4	3	2.0	69.5	4.0

Note: others include off farm employment, petty trade, artisans and selling labour.

Findings on main livestock constraints consist of lack of sufficient grazing areas (37 per cent), scarcity of dry season feeding (16 per cent), poor veterinary services (22 per cent) and low productivity breeds (13 per cent). Technology interventions for crop and livestock development should therefore address issues of seed and stocking materials, selection of high yielding varieties/breeds, crop and pasture productivity enhancing, and feed supplementation and management technologies.

Table 5: Main constraints to crop production in the south western highlands of Uganda.

Subcounty	Planting materials	Low yielding varieties	Low knowledge on management	Low prices	Drought stress	Others
Kyanamira	20.4	16.3	14.1	12.2	8.2	28.7
Muko	22.9	14.6	4.2	37.5	18.8	2.1
Nyakagyeme	22.0	14.0	16.0	38.0	2.0	8.0
Kebisoni	18.4	24.5	49.0	4.1	0	4.1
Nyakabande	18.4	18.4	14.3	14.3	30.6	4.1
Kirundo	17.0	27.7	19.1	25.5	10.6	0
Total	19.9	19.2	18.2	21.9	11.6	9.2

Note: Lack of knowledge on management refers to diseases, soil management and input use; others include unexpected heavy rains and flooding. Others represent land shortage (14%) and labour and equipment shortages (14%).

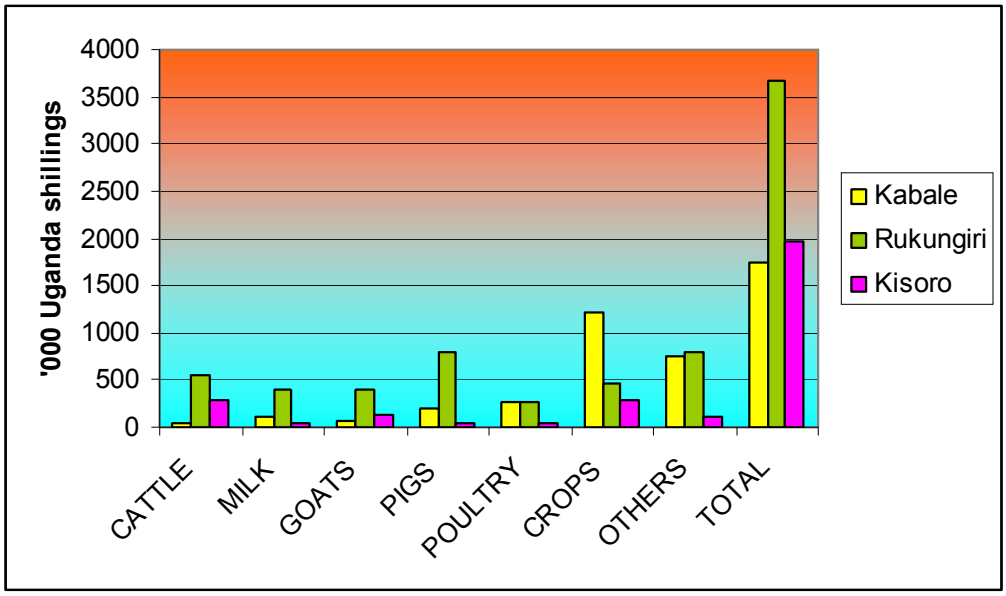

Figure 2: Annual mean gross farm revenues in south west highlands of Uganda.

Table 6: Main constraints to livestock production in the south western highlands of Uganda.

Subcounty	Lack of dry season feeds	Water shortage	Low milk prices	Lack of improved breeding stock	Lack of veterinary services	Small grazing areas	Diseases
Kyanamira	13.5	2.7	5.4	21.6	21.6	18.9	16.2
Muko	31.1	2.2	15.6	8.9	13.3	28.9	0
Nyakagyeme	13.6	0	.0	11.4	25.0	50.0	0
Kebisoni	4.5	0	4.5	9.1	0	81.8	0
Nyakabande	17.9	5.1	2.6	12.8	35.9	17.9	7.7
Kirundo	13.6	9.1	2.3	15.9	36.4	20.5	2.3
Total	15.8	3.2	5.1	13.0	21.7	37.2	4.0

Status of technologies adopted, desired and not currently available: Data on crop and livestock technologies adopted by farmers is shown in figure 3 and table 6. Improved seed is used by only up to 10% of farmers in Kyanamira, Muko and Nyakabande. Local planting materials therefore dominate seed used in farm production (figure 3). Overall, the main livestock technology adopted was deworming (45%) (table 6). It

is therefore not surprising that majority of households (53%) indicated that improved planting materials is the key crop technology desired yet it is not utilized (figure 4), and that improved breeds (34%) and feeds (24%) are the key livestock technology that farmers wished to get access to (table 7).

Relative importance of technology dissemination approaches: Findings of the study on commonly used technology dissemination approaches and their rating in terms of effectiveness in improving management skills to farmers are presented in figures 5 and 6 and tables 8 and 9. Overall, farmer training/workshops (40%) and on farm demonstrations (30%) are the most common methods of technology dissemination.

Findings on effectiveness of technology dissemination approaches (table 8) suggest that radio messages (37%) and exchange visits (33%) are the most important channels of information delivery/farmer mobilization and technology exposure, respectively. Although on farm demonstrations were among the commonly used dissemination approaches, their effectiveness was minimal. Many times on farm demonstrations rely on labour intensive management systems and recommended inputs are presented as a comprehensive package (CIMMYT, 1998), yet farmers ordinarily adjust and undertake adoption of technologies in a step-wise manner.

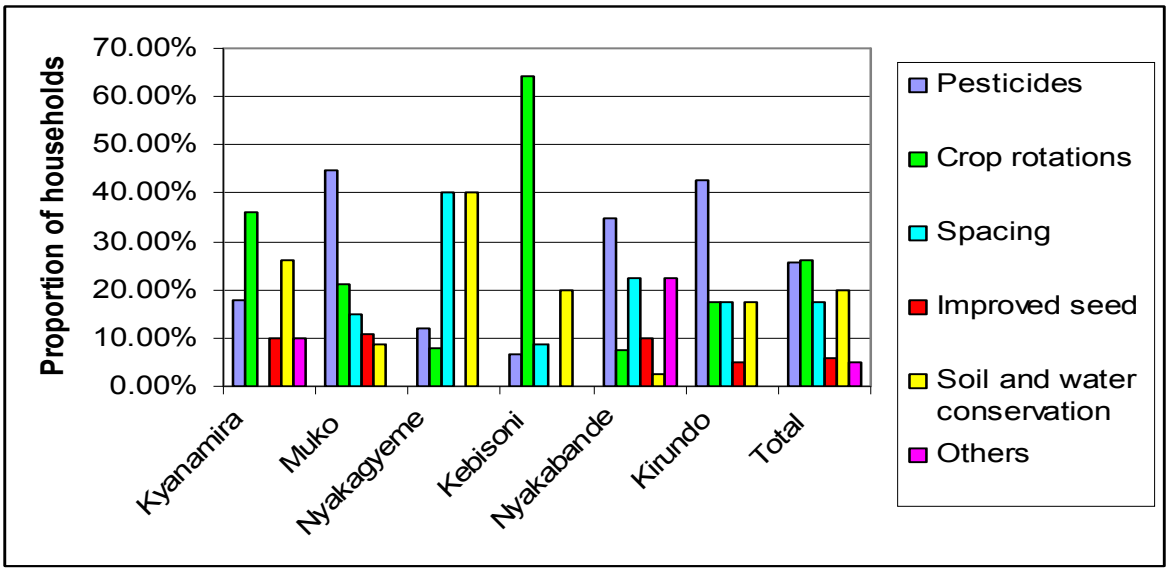

Figure 3: Status of crop technologies adopted by farmers in south west highlands of Uganda.

Table 6: Status of livestock technologies adopted by farmers in south west highlands of Uganda.

	Major livestock technologies adopted					
Sub-county	**Stall feeding for improved goats**	**Improved housing and other farm structures**	**Improved breeding stock**	**Regular deworming**	**Acaricides**	**Others**
Kyanamira	5.9	20.6	11.8	44.1	11.8	5.9
Muko	6.7	11.1	53.3	24.4	2.2	2.2
Nyakagyeme	4.7	9.3	14.0	69.8	2.3	0
Kebisoni	2.7	13.5	2.7	70.3	10.8	0
Nyakabande	33.3	20.8	4.2	29.2	12.5	0
Kirundo	20.0	37.1	8.6	22.9	11.4	0
Total	10.6	17.9	17.9	44.5	7.8	1.4

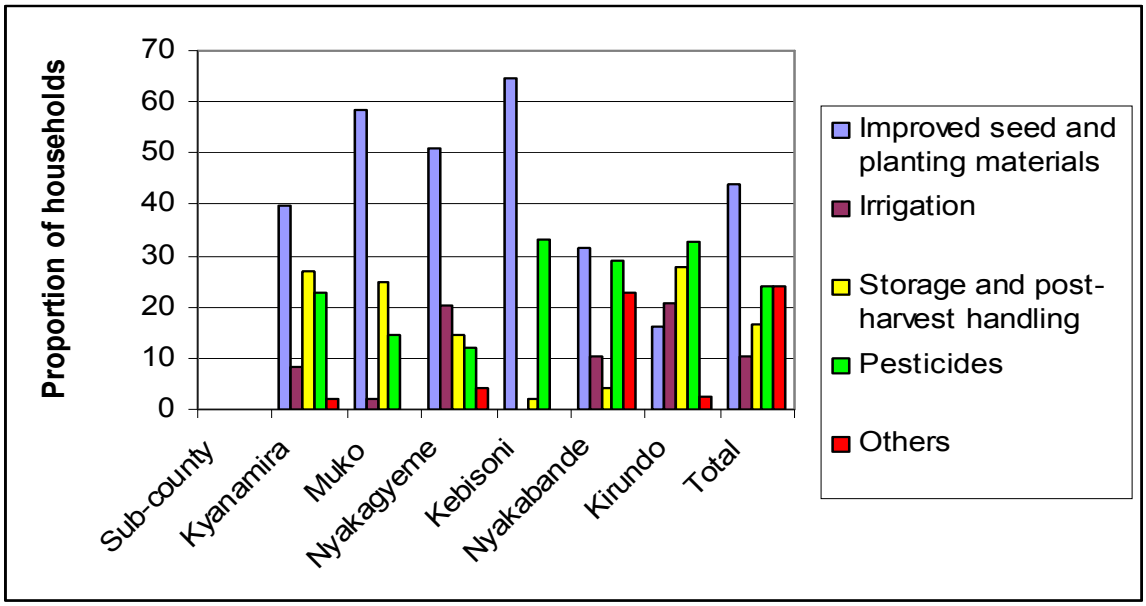

Figure 4: Crop technology gaps identified in south west highlands of Uganda.

Learning by seeing seems to be the main channel of decoding technical information by farmers probably that is why dissemination through radio (table 9) was considered to be the least (48%) effective in skills improvement although it is important in passing on information. Findings on farm demonstrations imply that farmers have limited exposure to them hence the indifference shown about whether they are effective or not.

Table 7: Livestock technology gaps identified in the south west highlands of Uganda.

	Major livestock technology needs					
Sub-county	**Improved feeds**	**Improved housing and farm structures**	**Improved breeding stock**	**Good dewormers**	**Acaricides**	**Others**
Kyanamira	23.5	14.7	35.3	11.8	8.8	5.9
Muko	22.2	4.4	42.2	28.9	.0	2.2
Nyakagyeme	27.9	23.3	48.8	.0	.0	.
Kebisoni	20.5	12.8	35.9	15.4	15.4	.0
Nyakabande	20	37.1	11.4	17.1	11.4	2.9
Kirundo	25	18.2	27.3	25	2.3	2.3
Total	23.3	17.9	34.2	16.7	5.8	2.1

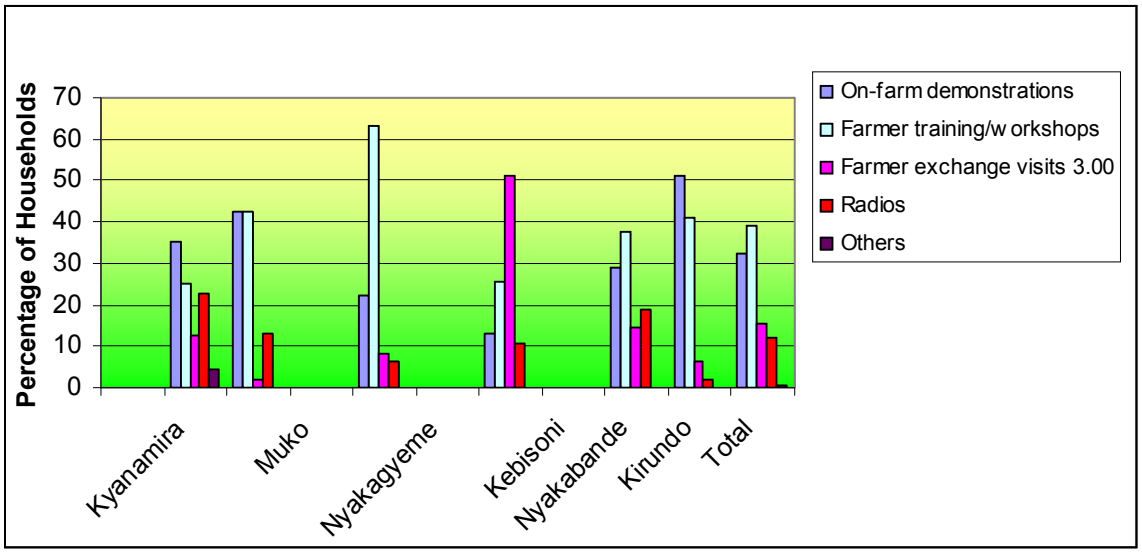

Figure 5: Common technology dissemination approaches in south west highlands of Uganda.

Table 8: Most effective technology dissemination approaches.

Sub-county	Most effective dissemination approaches			
	Farmer training/workshops	Farmer exchange visits	Radios	On-farm demos
Kyanamira	16.7	50.0	26.2	7.1
Muko	44.7	25.5	27.7	2.1
Nyakagyeme	42.9	28.6	28.6	.0
Kebisoni	21.3	57.4	21.3	.0
Nyakabande	11.1	20	55.6	13.3
Kirundo	4.4	15.6	64.4	15.6
Total	24	32.7	37.1	4.7

Table 9: Least effective dissemination channels for improving practical skills of farmers.

Sub-county	Least effective dissemination approaches				
	Training workshop	Farmer exchange visits	Radio	Other	On-farm demonstrations
Kyanamira	64.7	14.7	20.6	.0	.0
Muko	13.0	34.8	52.2	.0	.0
Nyakagyeme	.0	56.8	37.8	5.4	.0
Kebisoni	19.6	6.5	71.7	.0	2.2
Nyakabande					
Kirundo					
Total	22.7	27.6	47.9	1.2	0.6

CONCLUSIONS AND RECOMMENDATIONS

The main crop enterprises in the south west highlands of Uganda are Irish potatoes, bananas, climbing beans and sweet potatoes whereas goats and cattle are the dominant livestock enterprises. Technology adoption was more prominent for priority crops compared to priority livestock enterprises. For crops, technology adoption emphasized crop rotations, spacing, pesticide application and soil and water conservation aspects of production with little pre-production and post harvest management. Low prices of milk, bananas and Irish potatoes and lack of improved and clean planting materials especially for bush and climbing beans, sweet

potatoes and Irish potatoes grossly constrained production. Livestock technology adoption was dominated by regular deworming. Livestock production was particularly constrained by lack of good breeds, feeding, housing and health management technology. Improved feeding and breeds are the key technology gaps for livestock enterprises.

Farmer exchange visits and trainings are the most effective technology dissemination approaches. Small scale irrigation is suggested as a remedy to counter effects of water stress especially for vegetable production. Findings on the sex of decision makers in the households suggest that both women and men farmers should be targeted with technology interventions.

Finally, whereas there exists relevant technologies from NARO that can address farmers' constraints, there is general lack of information about their existence. To improve information dissemination, NARO publishing a list of all technology packages available and providing copies to all districts will go a long way in assisting farmers to seek for technologies available on the shelf.

It is recommended that technology promotion be refocused to address gaps in improved seed and planting materials as well as storage and post harvest handling for crops. Due attention should be accorded to the livestock technology gaps particularly lack of improved feeds and breeds.

Attainment of higher farm incomes to achieve the 'prosperity for all' objective should be addressed by fostering sustained adoption of productivity enhancing technologies and tripling sales to gain escape velocity from poverty. This should be mainly done by combining farmer training and exchange visits, supplemented by simple radio messages, posters, leaflets and brochures tailored to technology gaps relevant to priority enterprises in the sub-county targeted.

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