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Testing forage legume technologies with smallholder dairy farmers: a case study of Masaka district, Uganda

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Abstract

In a farmer participatory process, farmers in Masaka district identified intensive dairy farming using improved cattle breeds as potentially viable enterprise to improve household income and nutrition. The realization of potential economic benefits is however impeded by inadequate feeds during the dry season leading to low animal productivity. Findings from on-station research, suggest the possibility of incorporating forage legumes in farming systems that could solve feed shortages during the dry season. Participatory on-farm trials were therefore conducted on 24 dairy farms to demonstrate the effects of leguminous fodder on feed availability and response of dairy cows fed forages from cereal or elephant grass intercropped with forage legumes and supplemented with lablab hay and/or calliandra leaf hay. The study lasted 18 months. This paper presents benefits and constraints identified by farmers as a result of integrating forage legumes in farming systems and lessons learnt form working with resource poor farmers. Major benefits were improved feed and household food security and increased milk yield. Major constraints were high cost of resources; low yield of legumes in mixtures and land shortage. Lessons learnt from the study were: the performance of promising technologies developed on-station can be tested under "real-life" agro-ecological and management conditions; farmers' capacity and expertise for conducting collaborative research is built up and becomes a valuable resource for future research programmes; cross-visits and feedback workshops are very effective in sustaining and keeping farmers' interest and improving their skills; working with farmer groups enhance adoption of forage technologies as farmers share experiences and resources required for the technology to succeed and; development of positive rapport among stakeholders is a key to success of on-farm trials. In conclusion, the key to adoption of forage technologies is to allow farmers experiment, identify the constraints versus the benefits associated with the technology, adapt and expand.

Key words: Benefits; constraints; forage technologies; participatory, smallholder dairy farmers

Introduction

Dairy cattle production is a component of smallholder dairy farming systems in Uganda. Direct benefits of smallholder dairy cattle production include supply of high quality food (milk and meat); provision of raw materials such hides; strengthening of social relationships and they contribute to environmental quality. Unfortunately, animal feed resources are often scarce and unless farmers grow their own forages, animals can suffer from lack of feed or malnutrition. Forage legumes and fodder trees are important feed resources for dairy cattle productivity. A review by Kabirizi (1996) shows that a lot of work has been done and documented on forage legumes and fodder trees in Uganda. However, despite over 30 years of research on forage technologies, remarkably little adoption by farmers has taken place in Uganda. The traditional research approach of interviews with key farmers, identification of constraints by development workers, development of solutions by researchers and demonstration of technologies by model farmers has not resulted into spontaneous adoption. This is partly because technologies have often been developed and tested without the involvement of the intended users, and without an adequate understanding of the farming systems and constraints. Constraints on any of the factors of production: land, labour and capital can inhibit up take of forage technologies (LSRP, 2000). By definition, such constraints are most severe among resource-poor dairy cattle farmers such as those in Uganda, for whom forage technologies are most needed. The key to intensification and increase to output of dairy cattle production systems is the application of improved forage and feed technologies.

This paper presents results of a study that used participatory approach in identifying constraints and possible solutions to inadequate feed resource availability (baseline survey) and in testing forages (on-farm trials) for improved dairy cattle productivity. The study also attempted to link information obtained from the baseline survey to that from on-farm trials and to analyze the changes that had occurred in the households common to both. The specific objective of the study therefore was to assess farmers' constraints and benefits associated with use of improved forage legume and fodder tree technologies and document lessons learnt from working with poor resource smallholder dairy farmers in Masaka district. It was hypothesized that these constraints and benefits would form the basis for dairy farmers to adopt the technologies.

Materials and methods

Area descriptions

The study was carried out in Masaka district, located between 0^0 15' and 0^0 43' South of the equator and between 31^0 and 32^0 East longitude. The western part of the district situated in the Lake Crescent area, is traditionally a dairying area, since the environmental conditions as well as climatic patterns are highly favourable for exotic and cross breeds (Anon, 2003). The district has two rain seasons (March to May and November to January) with annual average rainfall of 1100-1200 mm, 100-110 rainy days and an average humidity of 61.2%. The average minimum and maximum temperature is 15.8^{0}C and 30.3^{0}C respectively. The soil texture ranges from red laterite, sandy loam but is in general productive. The total geographical area of the district is about 6060.4 sq. km out of which 1500 sq.km is under water and 1,221 hectares are under cultivation. Various Government and Non Government Organizations have distributed in-calf heifers to improve income and nutrition of resource poor households especially women. The number of beneficiaries rose from about 840 in 1999 to about 6000 in 2003 (Anon, 2003).

Materials and Methods

Constraint identification and selection of possible interventions

Participatory on-farm evaluation of forage legumes technologies began in 2001 with a baseline survey to identify leguminous forages used in feeding dairy cattle and constraints to their utilization (Figure 1). During individual interviews and group meetings, farmers noted that inadequate feeds was a major constraint to dairy cattle production. They proposed on-farm trials to test forages that had been recommended for dairy cattle feeding. During a 3-day feedback workshop to present results of the survey, farmers visited on-farm trials conducted at the District Agricultural Training and Information Centre, Kamenyamigo where 9 improved forage technologies were being tested. All the technologies were based on on-station results. At the Center, farmers were guided by a scientist and extension workers to select technologies that they could apply on their farms.

Experimental design, Monitoring and Evaluation/ Farmers' perceptions of the technologies

Based on their willingness to participate in the study, 32 farmers were selected and were provided with planting materials/seed to establish i) 0.5 ha of *Pennisetum purpureum* (elephant grass)/legume mixtures (EGL) and 0.2 ha of *Lablab purpureus* cv Rongai (lablab) (L); ii) EGL; 0.2 ha lablab and 500 *Calliandra calothyrsus* (calliandra) trees (C); iii) pure stand of elephant grass; 0.2 ha of maize/lablab intercrop (ML) and 500 calliandra trees and; iv) sole elephant grass (as a control). The technologies were assigned to the 32 farmers in a Complete Block Design (CBD) with 8 replications. Forages from lablab, maize/lablab intercrop and calliandra were conserved and fed to the animals during the dry season.

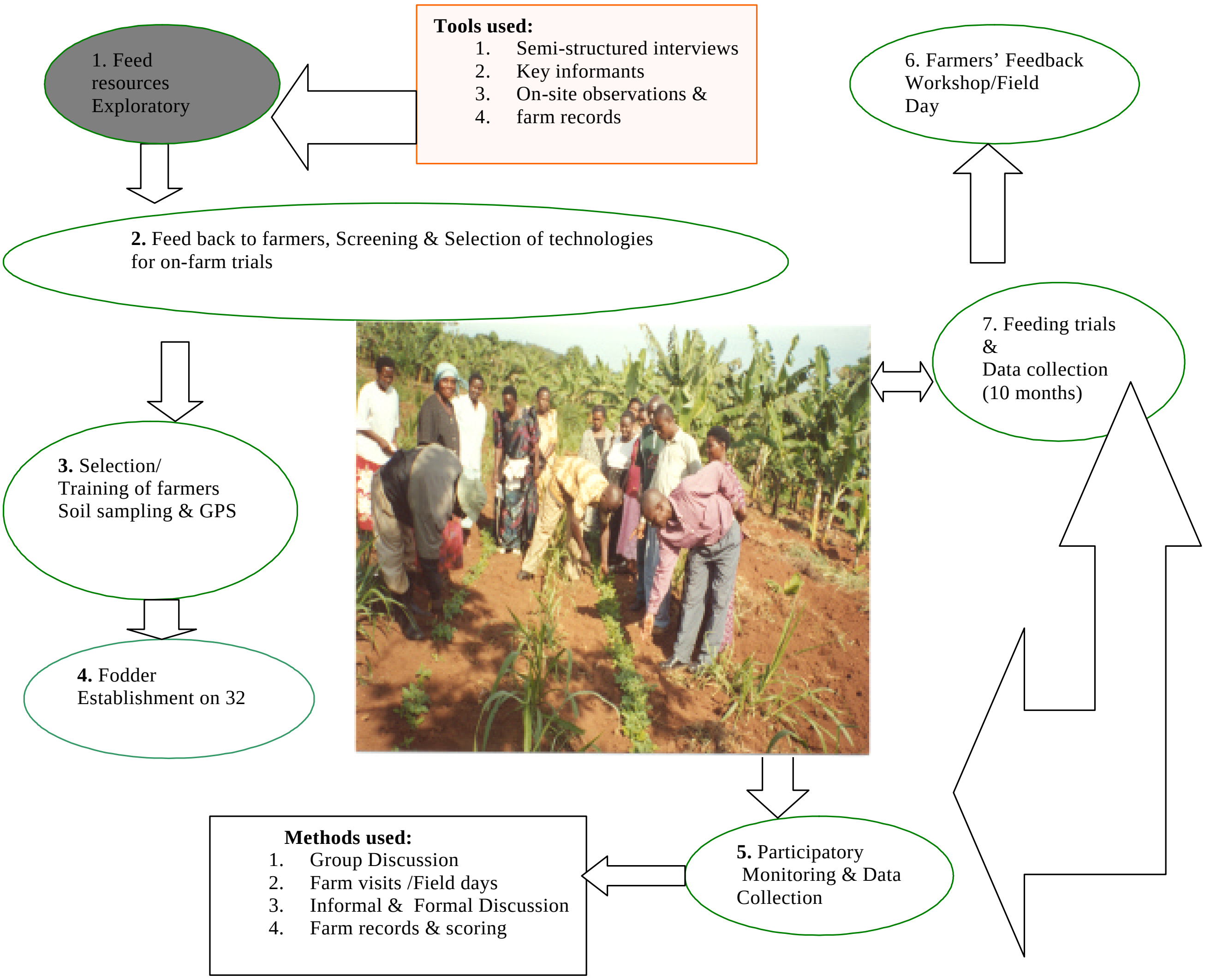
One of the criteria for being selected was farmer's willingness to allow other farmers to visit the trials for purposes of monitoring and evaluation and to enable non-participating farmers to learn from participating farmers. With these plots, farmers were able to evaluate the performance of the forages and their effects on animal productivity. The plots also provided some materials to expand/adopt the species that were appreciated most. The close involvement of farmers in every step of the project (monitoring and data collection and final evaluation of the technologies) was emphasized throughout the study period. Meetings were held at village level to solicit views on how the farmers felt about the technologies that were introduced to them. Apart from individual visits, group visits to individual plots were likewise done. Through the exchange of ideas, individual farmers were able to share their experience. Field days were held to encourage interaction and collaborative learning between participating and non-participating farmers. Participatory evaluation was done using a check list (palatability; regrowth capacity; yield, resources-land, labour and capital required; drought resistance, effect on animal productivity (milk yield and body weight and body condition) and overall farm profit. Farmers scored (1-5) the contribution of the improved forage technologies to dairy cattle feeding and household welfare and the percentage of farmers reporting similar benefits/constraints by gender was calculated and recorded. The evaluation methods served to guide the farmers in making decisions as to which species they would expand or/and adopt**.** The farmers who did not plant the forages were likewise able to learn from those who planted. This made their choices of species to try more realistic. On the whole, farmers' cooperation was very good. One hundred farmers (46 men and 56 women) participated in monitoring and evaluating the technologies.

A feedback workshop was organized as part of the exit strategy to i) give a feedback on the results achieved by the farmers who participated in the study and the economic implications; ii) evaluate with farmers the key issues that made them suceed or fail during the study period and; iii) present results of their own qualitative evaluation of the technologies to other farmers. The implementing farmers were facilitated to explain technology implementation and perfomance to 450 non participating farmers visiting with technical backstopping from researchers and extension staff.The information given by farmers was documented and is presented in the results.

Statistical Analysis

All data were entered in Excel Computer Programme and percentages were used to define the quantitative status of data collected.

Figure 1:The participatory approach used during the testing and evaluation of the forages



Results and discussions

Positive impacts identified by smallholder dairy cattle farmers as a result of incorporating leguminous forages in farming system

Positive impacts of forage technologies identified by smallholder dairy farmers in Masaka district as a result of integrating leguminous forages in the farming systems are shown in Table 1. All farmers acknowledged problems related to feed shortage during the dry season, indicating a need for using leguminous forages in dairy cattle production. However, the farmers reported that these impacts were very important, as they would influence their ability to adopt the forages. In general, farmers considered factors related directly to animals and household welfare to be more important than factors related to agronomic characteristics of the forages. Ninety percent (90%) of the farmers mentioned improved animal body condition and body weight during the dry season. This resulted in lower cases of animal diseases as mentioned by 61%. Majority (90%) of farmers mentioned less burden of searching for feed during the dry season due to improved quantity and quality of feeds. Animals usually suffered from insufficient feed during the dry season. It was at this time of the year when maize/lablab stover was harvested. The farmer therefore made use of the stover to fill the feed gap. The study showed that there were more women than men who mentioned less burden of searching for feed during the dry season (Table 1). This shows the importance of identifying not only the group that participates in research but also the target group that is likely to benefit more by adopting a particular technology. It should be appreciated that since women are more involved in nearly all processes of dairy cattle and fodder production (Kabirizi and Drania, 1997); any positive contribution such as improved all-year-round feed availability from this participation in research is likely to benefit not only the individual households but the entire community as well. All women reported that they had benefited from increased availability of firewood as a result of integrating calliandra fodder trees in the farming systems. Mostly women and children (after school) were in charge of searching for firewood and feed. By using the foliage as a feed and the trees as a source of fuel, it enabled the women and children to save time that was initially used to search for firewood and/or feed to do other household tasks. Improved food security (milk and maize grain) and fodder availability as a result of intercropping maize with lablab was cited by more women than men (Table 1) because of their greater involvement in managing dairy cattle and ensuring household food security.

Although the initial establishment of lablab legume was very poor, majority of the farmers appreciated that once established, lablab legume was fairly drought and shade tolerant. With its spreading habit, fast early growth, and ability to grow with little applied water; lablab was effective in smothering couch weeds and quickly provided an effective ground cover to protect soil erosion.

Farmers reported that intercropping in a banana or coffee plantation or maize enabled them to utilize their land more efficiently and maximize returns from limited resources and stabilizing income returns overtime. Land shortage is a major constraint in intensive smallholder dairy farming systems. Farmers observed that they could not permit any flexibility in the present cropping system due to very small land holdings, so forage cultivation has not been popular. Where land was available, it was often unproductive and of low quality. The other issue related to land was insecure ownership since majority (95%) of the women had no land title.

More men than women cited improved household income as a result of selling more milk or/and maize grain due to improved forage technologies (Table 1). Women were involved in all activities connected with dairy cattle and fodder production including sale of milk and they provided labour throughout the year but this was not reflected in decision-making regarding income. In general, men made decisions on important household expenditures. According to men, increased farm household income from sale of milk, livestock and grain was invested in expenditures for the family, for example children's education costs, purchasing drugs, cloths, agricultural inputs etc although the women did not agree with them.

Majority (72%) of farmers reported increased milk yield (Table 1). More than three quarters of the milk produced was sold while the rest was used for home consumption. Farmers were able to improve nutrition of the families and maintain a small cash income. The availability of milk for families substantially improved the family nutrition especially of the children although with increased milk production, a few (7%) of the farmers were faced with the problem of market for milk especially during the wet seasons when there was a lot of milk from other areas. However, with the introduction of a milk-processing machine by Masaka Diocese Development Organization (MADDO), it is hoped that the problem of milk marketing will soon be solved. Some (46%) farmers reported that calliandra leaf hay had marked positive effects on quality and taste of milk, a factor that was highly valued by farmers, even though many buyers as yet offer no better price for milk quality. The demand for such milk was very high.

Participating farmers reported that their success in the trials attracted many other farmers within and outside the district. During the study period, the number of adopters increased from 5 to 145 but more important, the farmers formed groups. The groups involved themselves in various economic activities such as crop and livestock production and drama as a means to raise their standard of living. Being together in groups helped them to combine their efforts in improving their economic activities. The groups also helped women to get recognition in the village and respect by their husbands.

According to farmers, the attitude and approach of extension staff changed. In the past the extension staff were only concerned with animal health, when the study began they became more interested in animal feeding and breeding. Extension services especially artificial insemination, was more readily available and more reliable. Farmers received more training and were involved in workshops more often. Farmers mentioned that the study tours and workshops were a new experience for them and highly appreciated. The tours and workshops not only allowed them to learn new forage technologies but also about other farm activities and methods, so helping them to increase the efficiency on their farms. The participatory approach stimulated households to exchange knowledge on all aspects of farming.

Negative impacts identified by smallholder dairy farmers as a result of incorporating leguminous forages in farming systems

A number of negative impacts (constraints) related to incorporation of leguminous forages in farming systems mentioned by farmers are presented in Table 2. All farmers cited high cost or unavailability of forage legume seed as a major constraint to integration of forage legumes into elephant grass fodder (Table 2). The main source of seed was the small quantities of seed supplied by the project. Mureithi and Thorpe (1993) reported that unavailability or high cost of legume seed was a major reason given by farmers for not adopting Napier grass/legume mixtures (EGL) in Kenya.

Smallholder dairying is labour intensive; therefore, the economic rationale of dairying for farm families is heavily dependent on rural wage rates and the opportunity cost of family labour. High labour demand was mentioned by majority of the farmers (Table 2). The major source of labour was household members but hired labour was also available. The most demanding activity during the study period was reported to be row planting of forage legumes, regular weeding, manure application, harvesting, transporting, drying and conserving forages. Due to labour constraints, farmers could not return manure to the fodder fields and were unable to weed and harvest the fodder fields properly. Planting and weeding forage legume fields required extra care and labour because the seeds are very small compared to seed of food crops the farmers are used to. Conserving

Table 1: Positive impacts identified by dairy farmers as a result of incorporating forage legumes in farming systems

	Number of men and women		Percentage of men and women	
Impacts	**Men (N= 46)**	**Women (N=54)**	**% Men**	**%Women**
Improved animal body condition and weight during the dry season (C & ML)	40	50	87,0	92.6
Less burden of searching for legumes during the dry season (C)	25	50	54.3	92.6
Lablab is drought tolerant (L)	40	46	87.0	85.2
Improved food and feed security (ML)	30	52	65.2	96.3
Improved quality of feed (ML)	35	41	76.1	75.9
Improved milk yield (C & ML)	33	39	71.7	72.2
Calliandra provides stakes and firewood (C)	22	54	47.8	100
Improved household nutrition	27	49	58.7	90.7
Group formation	20	50	43.5	92.6
Suppresses weeds (L)	29	40	63,0	74.1
Maximum utilization of resources (ML & L)	20	49	43.5	90.7
Improved household income (ML)	40	20	87.0	37.0
Better feeding, lower cases of diseases (ML & C)	22	29	47.8	53.7
Improved milk quality (taste) (C)	24	22	52.2	40.7
Improved knowledge and skills	25	50	54.3	92.6
Better services from extension staff	15	30	32.6	55.6

The technology referred to is indicated in the brackets ML= maize/lablab intercrop; C = Calliandra; L = Lablab

Table 2: Negative impacts identified by dairy farmers as a result of incorporating forage legumes in farming systems

	Number of women and men		Percentage of men and women	
Constraints	**Men (N= 46)**	**Women (N=54)**	**% Men**	**% Women**
High cost /Unavailability of legume seed (EGL)	46	54	100.0	100.0
Lack of capital	46	54	100.0	100.0
High labour and capital demands (EGL & L)	45	54	100.0	97.8
Lablab plants smoother banana plants (H)	44	53	98.1	95.7
Initial slow growth of forage legumes in EGL mixtures (EGL)	43	52	96.3	93.5
Low yields of legumes in EGL mixture during the dry season	42	50	92.6	91.3
Elephant grass disease affects fodder yield and quality (EGL)	37	48	88.9	80.4
Need for/high cost of storage facilities (ML & L)	34	49	90.7	73.9
Damage of legume seedlings/plants by pests and stray animals (EGL & L)	22	35	64.8	47.8
Land shortage	19	33	61.1	41.3

The technology referred to is indicated in the brackets ML= maize/lablab intercrop; C = calliandra; L = Lablab; EGL= elephant grass/legume mixture lablab foliage and maize stover and chopping fodder were reported to be labour intensive. Mugisha (2003) reported low adoption of knowledge and skills in rice production due to expensive and tedious practices especially row planting. Initial slow growth of forage legumes in mixtures during establishment phase was cited as a constraint by both men and women (Table 2) because it facilitated a quick invasion of weeds and so required intensive weeding and this meant more labour and money spent on weeding.

All farmers reported that use of improved forage technologies resulted in changes in their cropping patterns, in hiring of more casual labourers or increased workloads for household members especially during harvesting and drying of fodder.

Majority (97%) of the farmers were resource poor, they could therefore not afford to raise enough capital to purchase the required inputs and later meet the labour costs required to manage the forages. Access to credit for purchasing inputs plays a crucial role in the development and adoption of new technologies and improved feed resources especially in low-income households such as those found in Masaka district. The main source of capital would be credit but farmers were not keen to apply for it because they did not want to risk their land being sold for defaulting. Mureithi and Thorpe. (1993) reported that capital availability was a major factor affecting adoption of improved forages in Kenya. High cost of materials and labour to construct storage facilities for the conserved forages was cited by 57%,

The low herbage DM yield of forage legumes in mixtures during the dry season discouraged many (87%) farmers because they could not have sufficient fodder for the animals. Farmers reported that elephant grass/legume mixtures were not the best option for solving dry season feeding because of the low yield of legumes during the dry season and this is likely to be a major constraint to adoption of this technology.

Farmers who planted lablab in banana plantation noted with concern the reduction in banana yields in intercropped fields. Due to the severe drought during most part of the year (6 months) during the study period, lablab plants could have competed heavily with banana plants for water and other nutrients. Another constraint related to use of lablab hay was the resources (land, labour and capital) required to produce sufficient lablab hay for a full lactation. Majority (92%) of smallholders did not have sufficient land for fodder and food crops. The farmers suggested that lablab hay as a protein supplement is a good technology but is not suitable for smallholders.

Land shortage was identified as a major constraint because of the increasing pressure on land with increasing population. Women indicated that the small piece of land allocated to each household had to be shared with other food crops. Many farmers wanted to rent land to plant forages but landowners could not allow them to plant fodder trees on these lands because of their permanent nature. Another problem was, culturally, land in Uganda belongs to all household members despite the title deed bearing the name of the head of household. For land to be used as collateral, all members have to agree, a condition, which is difficult to satisfy in most cases. Other constraints mentioned were damage of seedlings/plants by free grazing livestock; pest problems, especially termites; aphids and cutworm attack on young seedlings during establishment, low soil fertility and low yields of elephant grass due to a new elephant grass viral disease (Kalule and Kabirizi, 2003).

Lessons learnt

This study has shown that participation of the intended users can mean that before application of a new technology, it is necessary to conduct a survey in order to determine the practical conditions, farming systems, and farmers' willingness and ability to develop the technology under the field conditions. The study should be based on the 'on-farm participatory approach' that takes into consideration the farmers' evaluation of the technology. Planning and working with farmers should happen rapidly and with commitment. Farmers want quick action following problem diagnosis. Frequently, the experience of farmers has been that researchers who come to help them to develop their livestock systems are quick to collect information, but slow to provide new technologies in return. To ensure the active involvement of farmers in participatory technology development, it is essential that the research address a need that they regard as important. Accurate identification and understanding of priority needs by researchers is likely to require considerable time and effort, but this is thoroughly justified.

The study has shown that farmers' knowledge and experience can be incorporated into the search for solutions and that farmers' capacity and expertise for conducting collaborative research is built up and becomes a valuable resource for future research programmes. Researchers can be provided with rapid feedback on the technologies tested, and promising technologies can be identified, modified and disseminated more quickly, reducing the length of research cycles and saving time and money. Cross-visits and feedback workshops were found to be very effects in sustaining and keeping farmers' interest. These often served to broaden farmers' outlook and made them realize that there were things that they could do by themselves.

Technology development is a gradual and iterative process. Thus, a number of trials may be required with very *poor* people. One should also avoid technologies that require expensive inputs when working with resource poor farmers. For them it is important to draw on inputs that are locally available, either on their farms or in the nearby environment; or which can be introduced easily. Development of positive rapport between stakeholders when successive trials are conducted in the same village is a key to success of on-farm trials. On the side of a research team, adopting a facilitative role is more productive than taking the traditional role as a disseminator of packaged technologies. Though it may sound easy, being a facilitator/equal partner to farmers was a difficult task. It required skills and stamina for coordinating work. It also required skills in communicating not only with the farmers but also with other agencies/personnel that farmers could visit and learn from. Working with farmers is a real challenge in itself, like any other human being, farmers and farmer groups have different characteristics and traits.

Regular visits by the development workers (scientist and extension staff) during the early stages of the trials are very important to encourage farmers to persist with the evaluation and provide them with basic technical information about the technology. For example, forage seeds are small and the plants grow very slowly than many of the crops that farmers already grow. The young seedlings are easily damaged by grazing or uncontrolled weed growth. Without early encouragement from development workers, farmers would sometimes abandon the evaluation without having ever reached a stage where the forages were well established to provide benefits.

Farmer and farmer-groups are often slow at the start. With persistent facilitators, there came a time when the farmers caught up. As such, most farmers did not feel the urgent concern to establish forages in wet season. However, during the dry season, they realized the problem. Working with farmer groups enhances adoption of forages as farmers share experiences and the labour and other inputs required for the technology to succeed.

Factors influencing technology adoption and impact should be thoroughly examined by all parties concerned before embarking on research and development activities. Important factors must be carefully examined such as: i) suitability of the technology in the social and cultural content; ii) availability of inputs, services and credit required for using new technologies; iii) the technology characteristics especially in terms of management complexity, initial capital requirement and investment risk-interaction with the factors of production and the length of the production process and; iv) the user characteristics in terms of their economic situation and availability of production factors level of education and technical skills, risk and innovation attitude and social and cultural behaviour.

Conclusions and Recommendation

In conclusion, the key to adoption of forage technologies is to allow farmers experiment, identify the constraints versus the benefits associated with the technology, adapt and expand. The issues of seed availability, seed cost and low dry matter yield of forage legumes in mixture are major constraints to adoption of elephant grass/legume technology. There is a need for government and non-government organizations to support small-scale pasture seed scale production schemes to improve availability of seed. Activities related to increasing forage availability should be complemented with improvements of animal husbandry practices, i.e. nutrition, health and housing, the utilization of compost/manure and the marketing of livestock products. A more holistic approach addressing several farmer constraints simultaneously is expected to give better results than isolated interventions.

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