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Introduction of improved techniques of Feed Resource utilisation on Smallholder Dairy Farms in Uganda

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Abstract

Smallholder dairy farmers in Masaka have identified feed shortage especially in the dry season as the most critical factor limiting milk production in the district during diagnostic surveys carried out in 1999. Screening of identified potential solutions led to the development of a project for implementation in the district with three strategies. These were: feed conservation and fodder bank technologies and strategic utilisation of crop residues . A preliminary study was undertaken to verify the farmers' reports and this was followed by introduction of the strategies on farms in Masaka district. The study revealed that protein and energy shortages existed in the dry season. The strategies introduced provided increased DM production on the farms and data on farms where maize stover and lablab mixture was used for supplementation in the dry season showed increased milk production.

Introduction

Smallholder dairy farmers in Masaka have identified feed shortage especially in the dry season as the most critical factor limiting milk production in the district (LSRP report 1999). The farmers and scientists have adopted strategies to contain the nutritional problem. These include adoption of feed conservation and fodder bank technologies and strategic utilisation of crop residues. Reconnaissance surveys have noted the feed problems to be related to land tenure, ignorance of feed conservation methods and appropriate forage production and management practices. In some cases negative perception of recommended fodder bank technologies and feeding practices required verification.

A project in adaptive research and technology transfer was developed to, characterise the smallholder dairy production systems, verify the feed inadequacies identified by the farmers and improve the feed resource base under smallholder dairy systems in Masaka. This would also provide models for similar systems elsewhere. The undertaking sought to do the following: introduce and test compatible mixtures of elephant grass and forage legumes for improved availability of protein and energy, improve availability of protein during the dry season through supplementation with Calliandra, promote the adoption of feed conservation technologies for dry season feed security and strategically utilise crop residues to reduce dry season feed shortages. This was done in anticipation that the quantities of protein and energy on the farms would be increased particularly for use in the dry season. This would be likely to diminish the fall of milk production in the dry season hence stabilise the incomes of farmers and contribute to poverty reduction.

Methodology

Characterisation of the production system

Cross sectional surveys

Cross sectional surveys involving 30 households were carried out. Data was collected using a checklist

in the two seasons, numbers and weights of lactating animals on the farms. Information on household profiles was also obtained. The data on feed protein and energy was analysed using a spreadsheet model (Halberg 2000 unpublished) and deficits of energy and protein in the two seasons were estimated. The proposed strategies were then revised on the basis of the existing shortages.

Farmer training workshop

A farmer-training workshop to which all smallholder dairy farmers in the district were invited was held. The aim of the workshop was to train farmers in feed conservation technologies and to obtain an inventory of all smallholder dairy farmers in the district. This would later assist in selection of the farm households to participate in the project activities. The workshop was attended by 400 farmers who during the registration were requested to express their willingness to participate in the project activities.

Establishment of test interventions on-farm

Selection of sites and farm households for interventions and studies

Sub-counties were selected randomly from those with smallholder dairying activities and participating farm households were also selected randomly from lists of those who attended the training workshop held previously. Each sub-county was allocated one intervention as it was deemed that this approach would create more impact. Four sub-counties; Kingo, Bukulula, Mukungwe and Kalungu, were selected and six farm households were selected from each sub-county. Four of the selected farmers in each of the sub-counties were to implement an intervention and the other two were to provide data without any intervention. The aim of having the two 'non-intervention' farms was to continue studies on variation in availability of energy and protein at different periods of the year through primary data to verify the reports gathered from the farmers initially. The selected farm households were visited and detailed information within each one of them was gathered. Soil samples were also collected from each farm and analysed at Kawanda Agricultural Research Institute (KARI).

The proposed activities were then initiated on the farms. Lablab and maize were planted for the "crop residues" intervention for feeding of stover with lablab after harvest of maize. The fields were established and at harvest time the farmers were given manual "fixed knife forage choppers" manufactured at Agricultural Engineering and Appropriate Technology Research Institute (AETRI). These facilitated the chopping process of the fodder before feeding to the animals.

Calliandra seedlings for the "fodder tree" intervention were given to the farmers each receiving 500 seedlings. These were planted along the edges of the farm or plots and on trenches. Some farmers started cutting the trees after about 4 months and fed them to their cattle. They also dried some of the leaves making a leaf meal, which they mixed with dairy meal and fed to lactating cattle.

Farmers involved in the "feed conservation" intervention were given elephant grass cuttings and lablab and, when the fodder was harvested, silage and hay were made which the farmers used to supplement the feed in the dry season.

Farmers involved in establishment of grass-legume mixtures were given elephant grass cuttings and seeds of Centrosema (Centro) a tropical forage legume. The households were given data sheets and relevant data to be collected and means of collecting it were agreed upon. The 'non-intervention' farmers were also given data sheets for the relevant data and collection mechanisms discussed. Rainfall data for the district was also obtained from Kamenyamigo Agricultural Development Centre (ADC).

Recruitment of enumerators

Enumerators to assist the farmers in collection of the relevant data were recruited after a series of interviews. Each sub-county was allocated one enumerator. The enumerators met with the project team and were given their job description. They were also enlightened on the significance of each activity, the data to be collected, and the mode of collection. The enumerators were introduced to the farmers and their roles explained to them. They were also equipped with the necessary equipment to collect fecal samples from the farms once every month. These were later analysed using near infra red spectroscopy (NIRS) for feed components at the International Livestock Research Institute (ILRI) in Nairobi.

Data analysis

Analysis of data included estimation of descriptive statistical parameters and some general trends were observed among the farm households, feed resources, the livestock structure, land utilisation and production. Some of the data was also subjected to regression analysis and paired sample t tests. MINITAB and SPSS packages were used in the statistical analyses.

Results

Household Structure

Twenty eight percent of the selected households were female-headed and the average household size of all the farm households was 10 individuals. With all the households taken into consideration, the general ratio of male to female in total among the selected households

was approximately 1:1 as the average number of male household members was 4.7 and female household members 4.6. The household members were involved in the farming activities in all the households and most of the households employed labourers permanently or only during critical periods of the year.

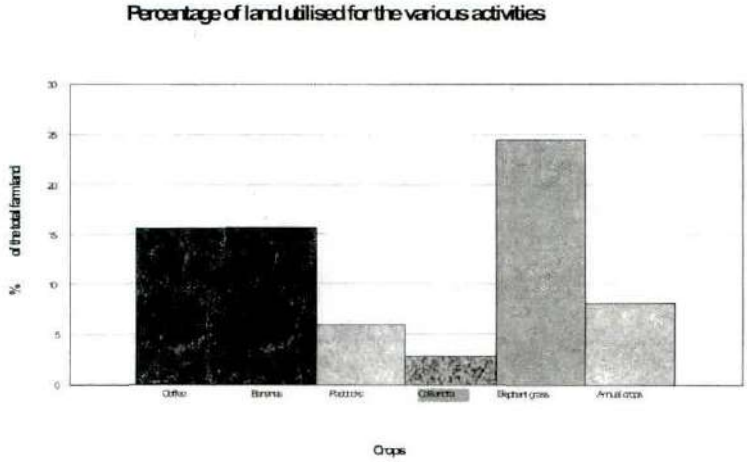
Land utilisation

The average farm size for the selected farms was 3.1 ha with a minimum of 0.4 ha and maximum of 6.5 ha. The distribution of major farm activities on the land by percentage of total land is shown in graph 3.2.1. The data shows that the priority activities allocated land are elephant grass, bananas and coffee. Farmers planted the largest proportion of land to elephant grass fodder.

Soil properties

Results obtained from the soil analysis from the project farms showed that most of the farms had sandy clay soils. The texture of 48.3% of the samples taken was sandy clay, 38% had clay texture and 13.8% had sandy clay loam texture. Table 3.3.1 shows the percentages of samples above the critical value for different soil properties. The soil analyses results were returned to the farm households translated into Luganda the local language.

Figure 1.



Major livestock

Among the major livestock activities, largest numbers of livestock reared were chicken, followed by cattle, goats and pigs. The average number of cattle among the households was 4.5 with a minimum of 1 and a maximum of 11. Results of an analysis of the numbers and structure of cattle herds on the farms aggregated on basis of gender and management are shown in tables 3.4.1.and 3.4.2.

Production

Milk production was also found to vary in the wet and dry seasons on the selected farms, average milk production per animal in the wet season was 10 litres and fell down to 7 litres in the dry season. (see graph 3.5.1). Of this, 53% was sold, 27% given to calves and 20% consumed by the household.

Feed resource base

The data on feed resources gathered from the farms showed that there is a wide diversity of feed resources utilised. However, the amounts in which they are produced are not adequate to meet the nutritional needs of the cattle throughout the year. Table 3.6.1 shows the different feeds and the average quantities of production as well as the minimum and maximum values.

Table 3.3.1 Characteristics for soil samples from the project farms

Soil Properties	Critical level (mg per 100g of soil)	% of samples above critical
PH	5.2	22.4
Organic matter	3	96.4
Nitrogen	0.2	8.6
Phosphorus	5	39.7
Potassium	15	46.6

Table 3.4.1 Herd structure of sample cattle population in smallholder dairy systems in Masaka district by gender

	Female Headed Household (n=7)				Male Headed Household (n=15)			
Parameter	Sum	Mean	Min	Max	Sum	Mean	Min	Max
Total number of cattle	21	3	1	6	80	5	2	11
Friesians	3	<1	<1	1	11	1	0	6
Jersey	1	<1	0	1	0	0	0	0
Crosses	3	<1	0	2	36	2	0	10
Nganda	1	<1	0	1	3	0	0	3
No. of Cows	8	1	0	2	44	3	0	7
No. of Heifers	4	1	0	1	5	<1	0	2
Steers	3	0	0	3	5	<1	0	2
Bulls	1	0	0	1	4	<1	0	1
No .of Female calves	1	0	0	1	4	<1	0	1
No. of Male calves	<1	0	0	0	3	<1	0	2

Table 3.4..2 Herd structure of sample cattle population in smallholder dairy systems in Masaka district

	Open grazing (n=1)				Semi-intensive management (n=2)				Zero-grazing (n=8)			
Parameter	**Sum**	**Mean**	**Min**	**Max**	**Sum**	**Mean**	**Min**	**Max**	**Sum**	**Mean**	**Min**	**Max**
Total number of cattle	8	8	8	8	6	3	2	4	29	4	1	8
Fresians	6	6	6	6	0	0	0	0	2	<1	0	1
Jersey	0	0	0	0	0	0	0	0	0	0	0	0
Crosses	1	1	1	1	4	2	2	2	4	1	0	4
Nganda	0	0	0	0	0	0	0	0	0	0	0	0
No. of Cows	5	5	5	5	3	2	1	2	17	2	0	6
No. of Heifers	0	0	0	0	1	1	0	1	4	1	0	2
Steers	0	0	0	0	0	0	0	0	1	<1	0	1
Bulls	0	0	0	0	0	0	0	0	1	<1	0	1
No .of Female calves	0	0	0	0	1	1	0	0	1	<1	0	1
No. of Male calves	0	0	0	0	1	1	0	0	3	<1	0	1

These are further summarised in graph 3.6.1. The farms largely depend on grass feed particularly elephant grass and its availability is greatly reduced in the dry season. Availability of paddock pastures and herbaceous legumes was also affected by the dry season, however, that of crop residues and multi-purpose trees did not vary greatly in the 2 seasons. It is clear that there is minimal utilisation of concentrates and agro-industrial by-products.

Figure 3.5.1.

Average quantities of milk produced on the selected farms (Average

(Average No. of milking cows per farm = 1.5 approx. 1))

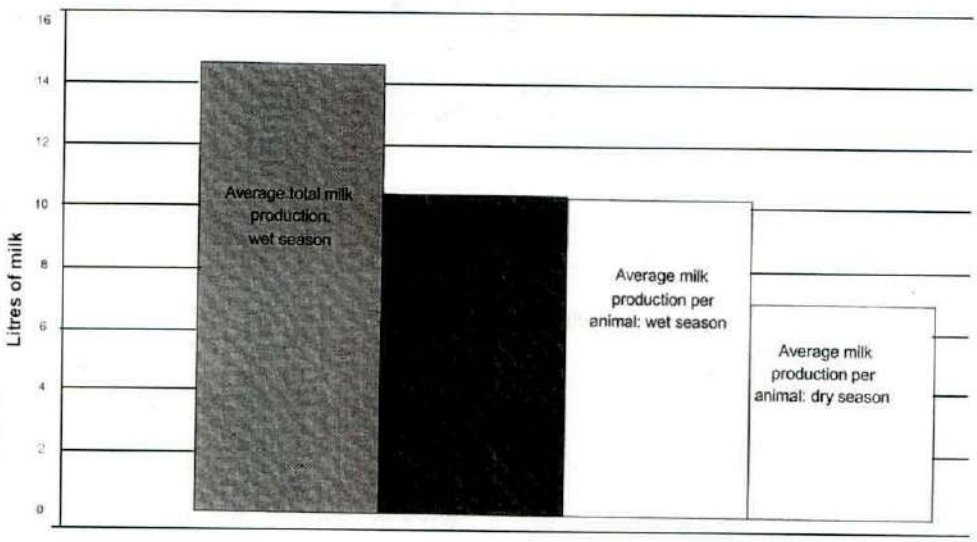
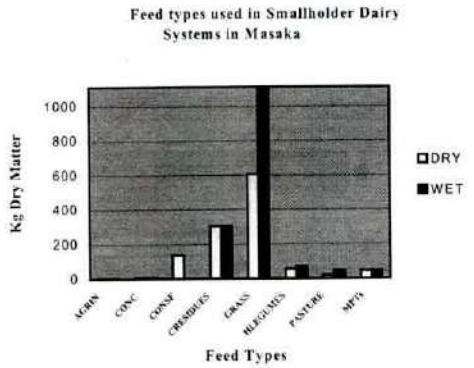


Table 3.6.1 **Amount (kg. DM) of various feedstuffs offered to cattle by season in Masaka District.**

Feed	Dry Season			Wet Season		
	Mean	Minimum	Maximum	Mean	Minimum	Maximum
1. Elephant grass	43	0	100	79	01	80
2. Dairy meal	1	0	3	1	0	3
3. Calliandra	2	0	10	2	0	10
4. Gliricidia	<1	0	1	<1	0	1
5. Banana flowers	1	0	15	0	0	5
6. Sesbania	1	0	10	1	0	10
7. Banana psedostem	4	0	35	5	0	25
8. Sweet potato vines	7	0	40	9	0	40
9. Bean haulms	1	0	10	1	0	5
10. Groundnut haulms	1	0	10	1	0	7
11. Lablab	3	0	15	4	0	15
12. Mululuza (Vernonia sp)	0	0	1	0	0	1
13. Crotalaria	0	0	1	0	0	2
14. Setaria	0	0	1	0	0	2
15. Giant Panicum	0	0	0	<1	0	<1
16. Siratro	<1	0	1	4	0	1
17. Elephant grass hay	2	0	30	0	0	0
18. Guatemala	0	0	1	<1	0	1
19. Desmodium	<1	0	2	<1	0	5
20. Mucuna	<1	0	1	<1	0	5
21. Banana leaves	2	0	15	1	0	10
2.2 Maize stover	3	0	15	2	0	15
23. Maize bran	0	0	3	<1	0	3
24. Silage	8	0	109	0	0	0
25. Centrosema	0	0	1	<1	0	1
26. Paddock pasture	1	0	20	4	0	50

Figure 3.6.1



Where: AGRIN = Agro industrial by-products, CONC = Concentrates, CONSF = Conserved feed, CRESIDUES = Crop residues, GRASS = Fodder grass, HLEGUMES = Herbaceous legumes, PASTURE = Grazed pasture and MPTs = Multi-purpose trees

AGRIN:	Agro industrial by-products
CONC:	Concentrates
CONSF:	Conserved feed
CRESIDUE:	Crop residues
GRASS:	Fodder grasses mainly elephant grass
HLEGUMES:	Herbaceous legumes
PASTURE:	Paddock pastures
MPTs:	Multi-purpose trees

These results showed that due to the feed resources and patterns used by the farmers. The dairy animals did not get adequate nutrition and hence the fall in milk production during the dry season. These gaps in the feed requirements were estimated for the major feed components required by cattle: energy and protein. The outcome showed that there were shortages of both components in the dry season and shortage of only energy in the wet season. The calculations were based on the average weight of the cows on the farms, which was 400kg and the average milk production per animal per day during the wet season which was 10 litres. Graphs 3.6.3 and 3.6.4 show these findings. The intention of the strategies implemented in this project was to bridge the identified gaps in the feeding of dairy cattle on smallholder dairy farms.

Figure 3.6.3 Quantities of energy and protein provided to the cattle in the wet and dry seasons compared to the requirements

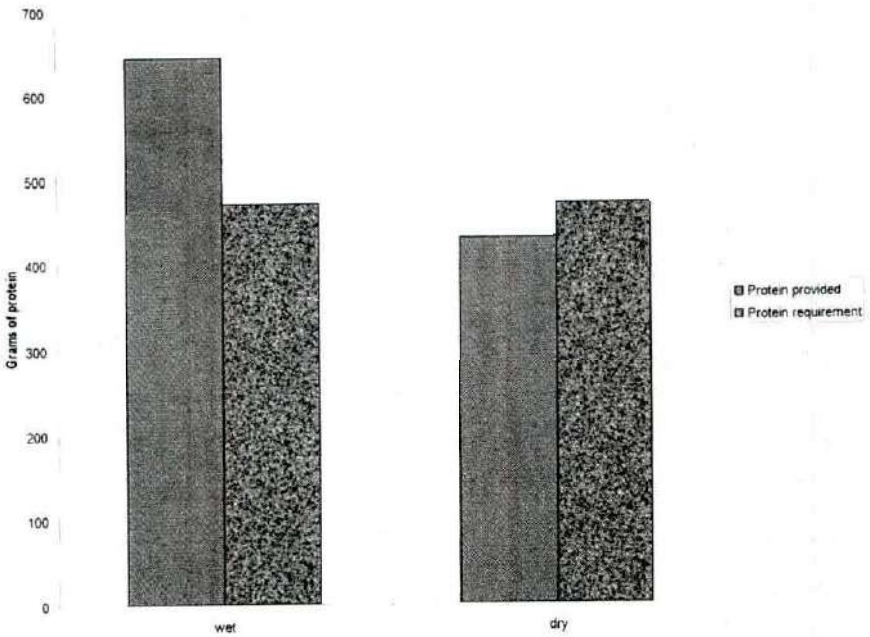
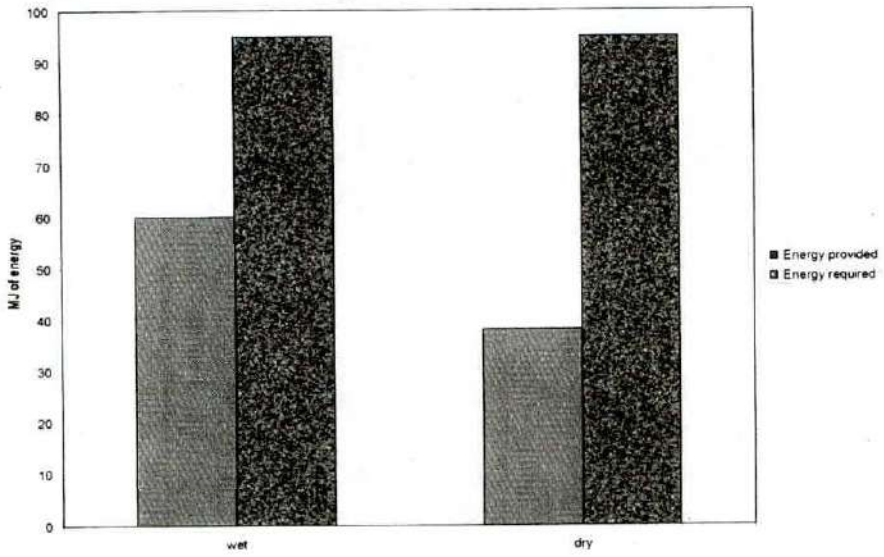


Figure 3.6.4 Metabolisable energy provided to the cattle in the wet and dry seasons compared to the requirement



Performance of interventions

Milk production data gathered from the farms involved in feeding maize stover and lablab showed a significant increase of 1.4L/day in milk production after supplementing with the mixture. These results are shown in table 3.7.2 below. Data collected from the farms where elephant grass and centro were established in a mixture showed that growth rate for elephant grass in the plots of the mixture with

Table 3.7.2 Milk production with and without supplementation with maize stover and lablab

Milk production (L/day)		P-value
Without maize stover and Lablab supplement	With maize stover and Lablab supplement	
7.735	9.153	0.000

Fecal samples collected in the months of January and March 2001 when analysed using "Near Infra Red Spectroscopy" (NIRS) showed reduced percentage crude protein (%CP) in the animal feeds in March compared to January which was significant. A slight increase was observed in percentage digestible organic matter (%DOM), this was not significant (see table 3.6.2). This concurs with previous findings in this study, which indicate protein reduction in the dry season as March is at the end of the dry season. The %DOM increased slightly possibly due to slow plant growth in the dry season leading to feeding of young fodder.

Table 3.6.2 %CP and %DOM in feces collected from farms in the months of January and March 2001

	January	March	P-value
%CP	10.967	9.803	0.001
%DOM	61.450	61.656	0.666

Centro was consistently higher than that in pure stand on all the farms. However, the 2 were not significantly different when subjected to paired samples t test at a 95% significance level. The regression graphs for the farms for the inter-planted and the pure stand plots are shown in Graphs 3.7.1-3.7.6. This may indicate that Centro enhances growth of elephant grass when grown in a mixture.

Figure 3.7.1 Growth rate of elephant grass interplanted with C.pubescens on farm 1

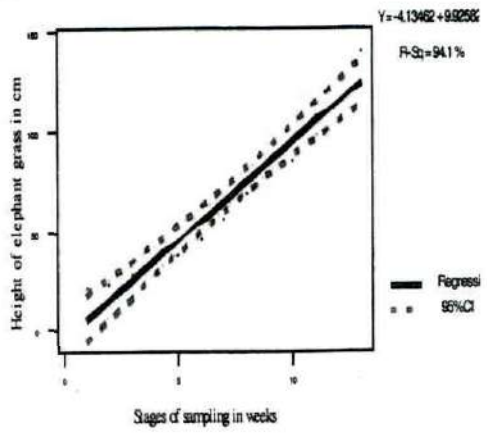


Figure3.7.2 Growth rate of elephant grass in a pure stand on farm 1

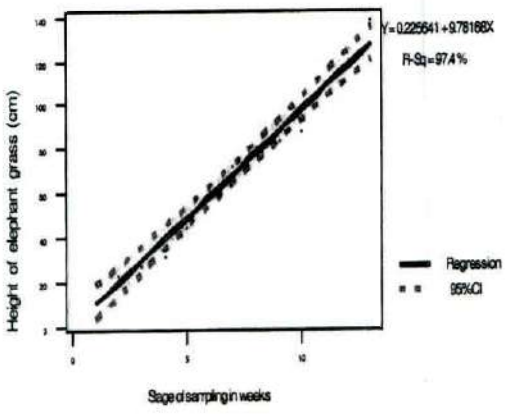


Figure 3.7.3 Growth rate of elephant grass interplanted with C. pubescens on Farm 2

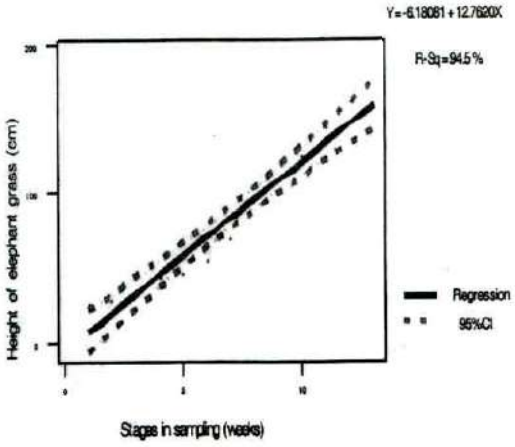


Figure 3.7.4 Growth rate of elephant grass in pure stand on Farm 2

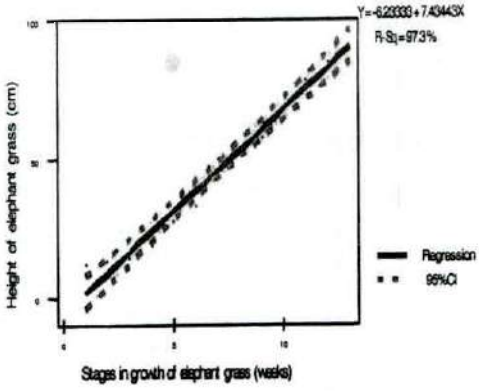


Figure 3.7.5 Growth rate of elephant grass interplanted with C. pubescens on Farm 3

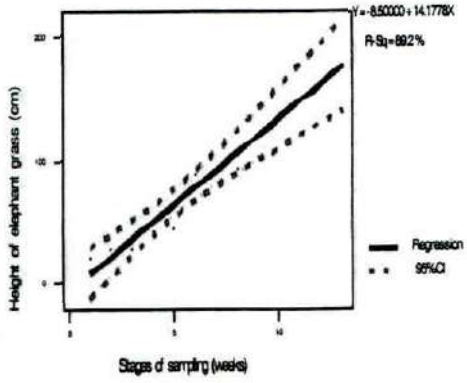
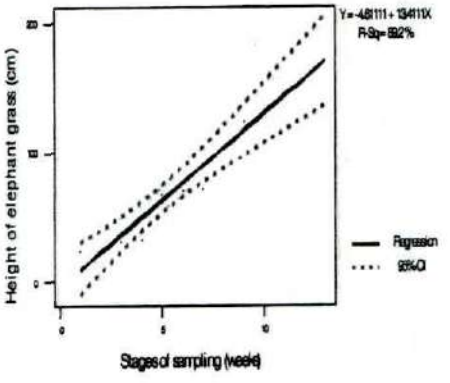


Figure 3.7.6 Growth rate of elephant grass in pure stand on Farm 3



Paper presented at the NARO Conference in December 2001

Fodder dry matter production ie kg/ha at all harvests was significantly (LSD 0.05) higher for the interplanted plots than the pure stand plots. The mean DM production from the interplanted plots was 20,491kg/ha and 18,236kg/ha from the pure stand plots. This is of benefit on the farms as it enables increased fodder production, some of which can be conserved for use in the dry season.

Farmers involved in establishment of Calliandra trees were each feeding on the average 0.39Kg DM/day which is approximately 0.9% of the total cattle feed per day during the first cutting phase. However, observations still need to continue for whole spans of both wet and dry seasons. Regression and correlation analyses for total fodderDM/day offered on each farm and Calliandra DM/day offered on each farm were carried out. The regression produced a positive slope of 3.94, although the regression Coefficient was only 24.6% with a P-value of 0. The regression equation is shown below.

Total DM/day Kg = 19.1 + 3. 94 Caliandra DM/da Kg.

The correlation coefficient between these same two parameters was 0.496 with a P-value of 0 showing some correlation between them. This indicates that Caliandara to an extent contributes towards increased feed availability on farms.

Conclusion and recommendations

The results presented here show the potential of the strategies to increase fodder production on the farms through which energy and protein will be increased particularly considering that they all involve both grasses and legumes. Maize stove and lablab mixture displayed the ability to increase milk production. Farmers participating in the project mentioned that they have found the technologies beneficial and some have increased acreage of the intervention fields. However, land is still a limiting factor.

Comprehensive analyses through a longitudinal survey to precisely establish the feed energy and protein availability during different periods of the year should continue. The effect of the strategies on animal periodicity should be studied for all the strategies. However, this is still rather complex considering the variation in dairy cattle breeds and lactation stages on each farm.

Cattle blood samples should collected on seasonal basis and analyzed for macro and micro elements to enable studies of movement of nutrients in the farm systems.

The economic and social acceptability of the interventions should also be studied as these largely influence technology adoption.

Acknowledgement

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