IMPROVED LIVESTOCK FEEDING SYSTEMS IN TSETSE ENDEMIC WEST AFRICA

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FINAL REPORT

INTRODUCTION

Livestock managed under traditional systems depend on unimproved pastures to meet their nutrient needs on a year long basis. As the grazing lands appear to have reached their sustainable carrying capacity there is the need to conserve the available feed resources, provide supplementary feeds and judiciously allocate these resources to the most vulnerable class of animals.

Livestock production could be maximised by increasing the availability of feed resources and by improving their use at the individual farm level. The existing feed resources available to individual farmers include crop residues and crop by-products. Feed availability could be increased by cultivating forages but the land tenure system which does not quarantee exclusive access rights to the individual producer, lack of planting material and inadequate extension services are constraints to the establishment of pastures.

OBJECTIVES

The wider objectives of this project were to improve the use of existing feed resources and increase the availability of feed supplies by developing feeding systems for livestock.

The specific objectives were to:

1) Assess the potential for increasing the use of locally available feed resources;

2) Improve the methods of feed storage to preserve the nutritive value of crop residues;

3) Identify current patterns of browse use and possible options for greater use of browse tree leaves; and

4) Investigate methods of establishment and management of fodder trees in small holder farming systems.

In order to achieve these objectives, five activities were undertaken during the duration of the project and technical reports have been submitted to NRI. The major findings of each of the four research activities are summarised below. The fifth activity ended on April 27, 1994 and the data is being processed.

ACTIVITY 1: This component was carried out by staff of the department of livestock services in the North Bank and Western Divisions of The Gambia.

Methods: Sixty farmers representing about 15% of the total landholders in the two divisions were selected at random. The area of each crop cultivated by each farmer was measured, and six fields were selected for each crop for crop residue yield estimates. 100*100 cm quadrants were randomly placed on the crop fields just before harvest, the plants were then clipped and weighed green. The clipped samples were then placed in a well ventilated room for drying. After obtaining the dry weights the samples were taken for chemical analysis.

The effects of the different storage methods on the nutritive value of groundnut hay was determined by taking feed samples from randomly selected storage areas. Nine storage areas were randomly selected, three for each storage method. Feed samples were collected monthly from each stack until the stack was all used up. Sub samples from each stack of feed from each of the storage methods were taken for chemical analyses.

Main Findings: Area cultivated and yield of crop residues and crop by-products and their chemical composition are presented in Tables 1, 2 and 3 respectively. Groundnut hay, which is collected and stored by the majority of farmers, was the most abundant crop residue in the division. Cereal crop residues are grazed in the fields soon after the harvest, but some farmers collect and store these feeds for dry season use. The low crude protein (CP) content of the cereal crop residues indicates that these feeds cannot support livestock production if not supplemented with a protein source.

Table 1. Area Cultivated and Crop Residue and Crop By-Product Yields in Western Division (1991/92).

Crop	Hectares	Bran Prod. (tonnes)	Cake Prod. (tonnes)	Crop Res. Yield (tonnes)
Maize	1400	327	Nil	1932
Millet	5800	1362	Nil	6960
Sorghum	550	Nil	Nil	660
Rice	1650	1390	Nil	1782
Cowpea	80	64	Nil	29
Groundnut	9600	Nil	Nil	14592
sesame	80	Nil	13	Nil

Table 2. Chemical Composition of Crop Residues

Residue	DM	ASH	CP	NDF	ADF
	% Dry Matter				
Maize Leaves	92.1	6.2	6.1	73.2	43.2
Maize Stems	94.0	2.9	3.2	81.3	50.5
Millet Leaves	93.5	9.8	7.9	64.6	39.6
Millet Stems	93.7	3.9	3.7	78.9	55.8
Sorghum Leaves	94.4	5.6	6.8	67.7	38.9
Sorghum Stems	94.3	3.3	2.6	76.3	50.4
Cowpea Leaves	90.2	11.0	19.3	28.2	17.0
Cowpea Stems	91.0	3.4	11.3	49.5	34.7
Groundnut Leaves	92.1	10.0	18.3	34.1	30.2
Groundnut Stems	94.1	6.3	11.0	51.3	49.6
Rice Straw	94.4	11.0	5.3	68.7	40.1

Table 3. Chemical Composition of Agricultural By-Products

By-Product	DM	ASH	CP	NDF	ADF	EE
	% Dry Matter					
Millet Bran	93.2	4.0	14.3	25.6	10.3	9.1
Maize Bran	90.5	2.5	11.2	35.8	19.3	5.6
Rice bran	94.6	22.1	6.9	55.6	42.3	7.0
Groundnut Cake	94.0	5.3	49.0	14.0	9.1	28.8
Sesame Seed Cake	94.1	9.1	37.4	16.4	9.6	31.6

Three methods of storing groundnut hay were identified during the survey: 1) in house, 2) on uncovered platforms and 3) on the ground - uncovered. The method of storage used was found to have an influence on the CP content of the feed. CP

content of groundnut hay was found to decline over time - the hay which was exposed to the wind and sunlight declined in value more rapidly than the hay stored inside a house.

CONCLUSIONS and RECOMMENDATIONS: Crop residues and crop by-products are important feed items for livestock producers. These feeds could contribute immensely to livestock production if properly managed. The extent of cereal crop residue storage and use in The Gambia is not known, this should be quantified. Farmers should, however, be encouraged to store more cereal crop residues rather than graze them immediately after the harvest, but the opportunity cost of collecting cereal crop residues rather than grazing them *in situ* should also be asssessed.

Cereal crop residues are characterised by low CP content. In order to increase their intake and digestibility these residues should be supplemented with protein rich feeds. There is a need to develop supplementation packages through research.

Extension efforts should be directed at encouraging farmers to store groundnut hay on raised platforms (protected from the sun and wind) or in houses to prevent a decline in quality.

COMPONENT 2: The current patterns of browse tree species use in The Gambia was investigated using the survey method. One hundred and sixty two respondents comprising of livestock owners, farmers and herders in eighteen villages in three districts were interviewed to survey the use of indigenous browse species, investigate issues of tree control and access rights and assess interest in planting fodder trees.

Main Findings: The browse species used by livestock and their chemical compositions are shown in Table 4. Livestock utilise browse throughout the dry season but utilisation peaks in the late dry season as a result of the inadequacy of the herbaceous biomass to meet the needs of the ruminants. The browse trees or shrubs are utilised directly in the fields either by direct browsing by individual livestock or through the intervention of the herdsman who cuts down branches to allow animals easy access to the leaves. The foliage of *Pterocarpus erinaceous*, with CP content of 16 and 12% in the early and late dry seasons, respectively, is however cut-and-carried by livestock owners to feed draught animals and small ruminants during the late dry and early rainy seasons.

Table 4. Proximate Analysis of Browse Species (% DM)

Species	Season	Plant Part	DM	CP	ASH	NDF	ADF
Adansonia digitata	E. Dry	Leaves	48	Nil	9	30	19
Newboulda leavis	E. Dry	Leaves	95	17	8	63	44
Piliostigma thonningii	E. Dry	Leaves	Nil	7	3	40	30
Cassia sieberiana	L. Dry	Fruits	Nil	9	3	40	30
Cassia tora	E. Dry	Leaves	Nil	Nil	13	23	19
Combretum sp	E. Dry	Leaves	64	Nil	4	41	30
Terminalia sp	E. Dry	Leaves	Nil	Nil	4	34	33
Psorospermum sp	E. Dry	Leaves	96	9	5	34	44
Psorospermum sp	L. Dry	Leaves	Nil	10	3	Nil	Nil
Parkia biglobosa	E. Dry	Leaves	97	Nil	6	46	43
Parkia biglobosa	L. Dry	Leaves	Nil	12	3	Nil	Nil
Entada africana	L. Dry	Leaves	74	Nil	7	63	60
Dicrostachys glomerata	E. Dry	Leaves	97	Nil	9	35	31
Ficus sp	E. dry	Leaves	Nil	Nil	10	34	33
Ficus sp	L. Dry	Fruits	Nil	7	16	Nil	Nil
Khaya senegalensis	L. Dry	Leaves	Nil	8	5	Nil	Nil
Pterocarpus erinaceous	E. Dry	Leaves	Nil	16	8	39	30
Pterocarpus erinaceous	L. Dry	Leaves	Nil	12	Nil	Nil	Nil

Farmers have no tenure rights on trees found in their crop fields and this was perceived to be a disincentive to propagate and manage trees on farmlands. However, there is a willingness on their part to plant trees if they are assured of sufficiently secure rights to harvest and use the tree foliage.

The choice of the most ideal location to plant fodder trees depended on the location, the availability, and the ability to control the land. 72% of the male and 90% of the female respondents said that they preferred to plant fodder trees in their backyards while the rest thought that the trees were better suited for planting in the inner fields.

CONCLUSIONS and RECOMMENDATIONS: The backyard garden is a suitable entry point for the introduction of fodder trees to traditional small ruminant producers. The addition of fodder trees in the backyards will further integrate trees, crops and livestock and offer farmers an opportunity to appreciate the benefits of trees in terms of primary and secondary production and management requirements.

COMPONENT 3: Improved livestock production depends on the availability of feeds to meet the maintenance and growth requirements of animals on a year long basis. Fodder trees which produce protein rich leaves throughout the year have been identified as potential sources of high quality feeds.

Agronomic studies were designed to investigate methods of establishing *Leucaena leucocephela* and *Gliricidia sepium* and the management of the trees in small holder farming systems.

The specific objectives were:

1) to determine the most appropriate establishment method;
2) to measure leaf biomass yield of the two species; and
3) to evaluate the persistence of the trees.

Methods: The seedlings were raised in polythene pots from April until July when they were transplanted. 150 seedlings of each of the species were transplanted each with 2 replicates at 2 sites. Intra and inter row spacing was 100 and 25 cm, respectively.

To compare establishment methods seeds of the 2 species were also planted each with 2 replicates at 2 sites; plant population was the same as above.

Main findings: Transplanting 90-day old seedlings were found to be more advantageous than direct seeding in terms of establishment. Over 90% of the transplanted seedlings were established at the end of the first rainy season as compared to less than 34% when the seeds were put direct on the ground.

Leaf dry matter yields of L. leucocephela and G. sepium cut at 3 different heights at 2 sites are shown in Table 2 and 3.

Table 4. Leaf Dry Matter Yields of L. leucocephela cut at 50 and 100 cm From Ground Level

	Cutting Height	Keneba DM g/tree		SD	CV%	Sololo DM g/tree		SD	CV%
Aug. '93	25 cm	79.3	a,b	55.8	70.4	73.3	a,b	72.6	99.2
	t/h	3.0				2.9			
Jan. 94		49.6	d	42.8	86.3	Nil			
	t/h	2.0							
Aug. '93	50 cm	83.3	a,b	77.0	92.4	60.5	a,b	47.0	
	t/h	3.3				2.4			
Jan. 94		35.7	e	27.8	77.9	Nil			
	t/h	1.4							
Aug. 93	100 cm	45.7	a,c	34.4	75.3	37.9	a,c	36.4	96.0
	t/h	1.8				1.5			
Jan. 94		28.4	f	24.4	85.9	Nil			
	t/h	1.1							

N.B: a: values on the same row marked with the same letter are not significantly different at the 0.05 level.

b,c,d,e,f: values on the same column not marked with the same letter are significantly different at the 0.05 level.

Leucaena leucocephela fodder yields obtained at the two sites in August were not significantly different, but there were significant yield differences between treatments.

The *L. leucocephela* flowers throughout the year and sheds a great deal of leaves. Leaf shedding is most pronounced during the dry season. In fact the trees in Sololo were not harvested in January because they were completely defoliated.

In August *G. sepium* leaf yields were found to be significantly different between sites but not between treatments. Dry season yields were however found to be significantly different between treatments.

Gliricidia sepium flowers in December and the pods mature in March/April during which time they shed their leaves. Dry season yields were not obtained in Sololo because the trees were completely defoliated in January.

Table 5. Leaf dry matter yields of G. sepium cut at 25, 50 and 100 cm above ground level at 2 sites

		Cutting Height	Keneba Yield g/tree		SD	CV%	Sololo Yield g/tree		SD	CV%
Aug.	93	25 cm	136.9	a,c	113.9	83.2	46.8	b,d	34	72.6
		t/h	5.5				1.9			
	94		37.6	e	34.8	92.6	Nil			
	93	50 cm	103.2	a,c	58.2	56.4	49.9	b,d	28.1	56.3
		t/h	4.1				2.0			
	94		22.5	f	25.0	111.1	Nil			
		t/h	0.9							
Aug.	'93	100 cm	100.2	a,c	79.8	79.6	43.2	b,d	31.1	72.3
		t/h	4.0				1/7			
Jan.	'94		27.0	g	26.1	96.7	Nil			
		t/h	1.1							

N.B.: a,b: values on the same row marked with different letters are significantly different at 0.05 level.

c,d,e,f,g: values on the same column marked with the same letter are not significantly different at the 0.05 level.

Tree survival and post harvest tree persistence was higher in Keneba. In Sololo all the trees in one of the replicates died during the 1993/94 dry season and a 5% mortality rate was observed in the other replicate. The high mortality rates could be attributed to agro-climatic conditions like soil type and moisture regime, management factors like weeding, and poor tree establishment.

CONCLUSIONS: Transplanting had a higher success rate than direct seeding therefore farmers who wish to plant fodder trees should start raising seedlings in April so that they are ready for planting in July. The plants should be watered daily at a time when the farmers are busy preparing their fields in readiness for the cropping season. This would appear to be labour intensive, but the high success rate that would be achieved will compensate their efforts.

Management practices, agro-climatic factors and poor tree establishment seem to have affected tree survival and persistence. Fodder plots should be kept weed free during the first two years of establishment. Labour availability is critical during the cropping season, but the weeding of the fodder gardens could be carried out at the same time as when farmers are weeding other crops in the backyard.

The optimum time to harvest was not an issue in this trial but time of cutting appears to have an influence on tree establishment and dry season leaf growth and retention. The fodder trees should be protected for at least two years to allow maximum root development before they are harvested. To avoid defoliation *G. sepium* should be harvested before it flowers in December.

These yield data presented are preliminary. It is too early to draw any conclusions on the effects of cutting height on yield and persistence.

RECOMMENDATIONS

1) Continue to assess the effects of cutting height on yield and persistence;

2) Investigate different intervals and times of cutting in order to maximise dry season yields;

3) Identify and acquire higher yielding fodder tree cultivars for testing under Gambian conditions; and

40 Explore the feasibility and acceptability of establishing fodder gardens on farmers fields.

Component 4: Groundnut hay is widely used to supplement grazing rams in The Gambia. It is also used to feed draught animals, sold or exchanged. *L. leucocephela* and *G. sepium* could be used as alternative supplementary feeds.

The objectives of this trial conducted during the dry season of 1993 was to investigate the effects on liveweight gains of grazing trypanotolerant D'Jallonke rams when supplemented with one of three sources: groundnut hay, *L. leucocephela* and *G. sepium*.

Thirty six rams with mean liveweights of 22.2 kg were randomly assigned to 3 treatment groups of 12 animals each. Each of the 3 groups were again sub-divided into 2 so that each treatment group was replicated 2 times. The groups were assigned to one supplement as follows:

Group 1: *L. leucocephela* 200 g DM/day

Group 2: *G. sepium* 238 g DM/day

Group 3: Groundnut hay 526 g DM/day

The levels of each supplement were estimated to provide 50 g CP/day.

Main Findings: The acceptability of G. sepium was initially low but the animals were eating all the supplements by the end of the first week of the trial. The immediate acceptance of *L. leucocephela* foliage and groundnut hay shows that these feeds are highly palatable to sheep.

Daily liveweight gains throughout the trial were variable as can be seen in figure 1. Mean liveweight gains for groups 1, 2 and 3 during the first 28 days were not significantly different at 53, 63 and 63 g/day, respectively (Figure 1; t-test P>0.05). Group 2 was dropped from the trial because the *G. sepium* foliage was all used up.

Over the 48 day feeding period average liveweight gains were similar between treatments, at 53.5 and 58 g/day for group 1 and 3, respectively (t-test, P>0.05).

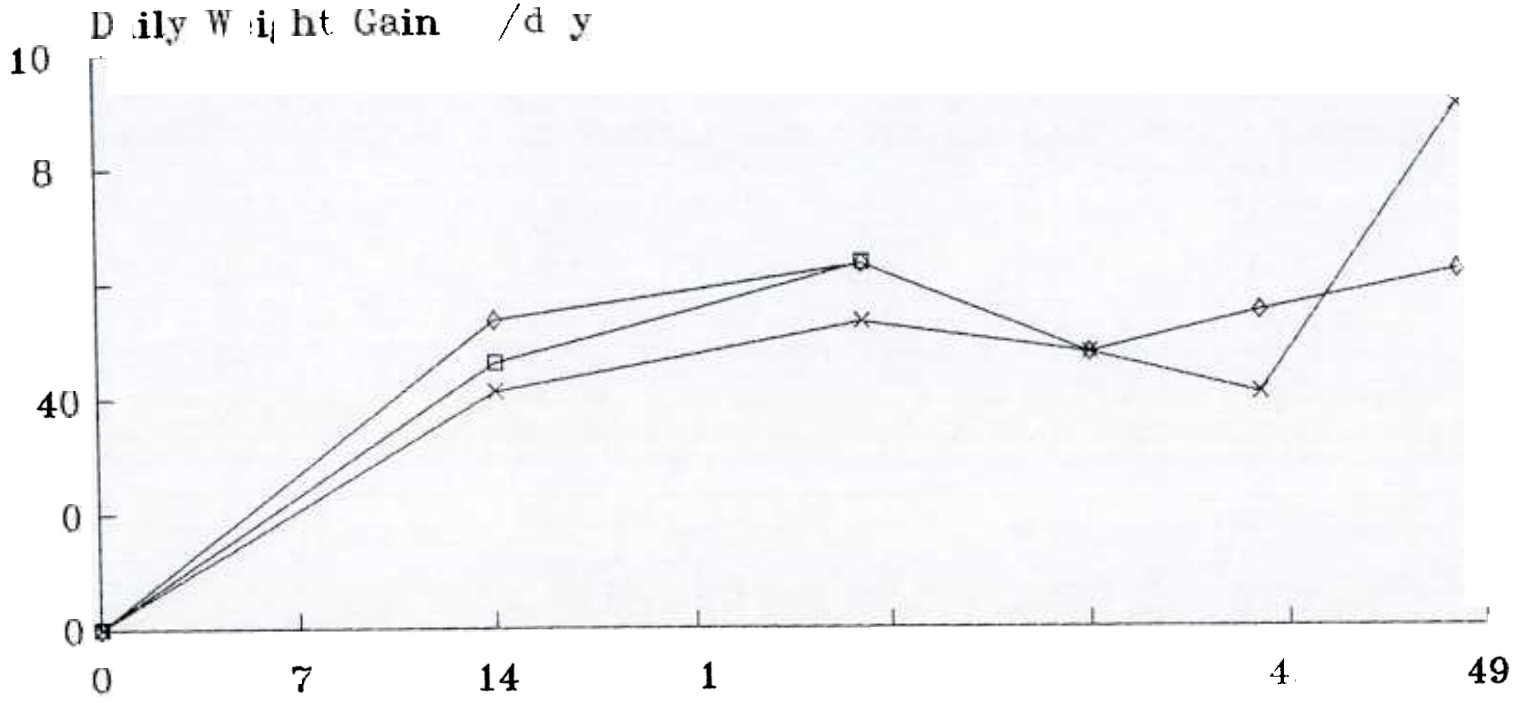
Table . Summary of Weight Changes

	Group 1	Group 2
Initial Weight (Kg	22.0	22.4
Daily Weight Gain To 48 Days (g)	53.5 SE=0.005	58.0 SE=0.009

CONCLUSIONS and RECOMMENDATIONS: both *L. leucocephela* and groundnut hay produced comparable levels of gain indicating that *L. leucocephela* foliage could be used as an alternative to the traditional practice of feeding groundnut hay. Appropriate methods of integrating the fodder tree in the traditional sheep production system should be explored. This would broaden the feed base and increase the availability of supplementary feeds to individual farmers.

Acknowledgements: Sincere thanks to Overseas Development Administration for funding this project. Appreciation is expressed to Drs. M. Gill, G. Hendy, B. Touray and Mr. Bennison for their support.

Figure 1 Eff ct o Supp m ntation on W ight Gain o Sh p Gra ng Natura Pa tur



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