Farmers' preference and nutritive value of selected indigenous plant feed materials for cattle in drylands of south-eastern Kenya

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Abstract

This study was undertaken in the drylands of southeastern Kenya to identify and rank important indigenous plant feed materials for cattle. Through the use of a structured questionnaire administered at the household level, farmers were asked to identify and rank the plant feed materials. The households were selected through systematic sampling along road transects in three agroecological zones namely LM4, LM5 and IL5. Samples of edible plant parts of top ranked feed materials were collected and nutritional analysis done at University of Nairobi, Department of animal production nutrition laboratory. Farmers' preference, nutritional value rankings and climate variability were used to give the final ranking of the feed plant materials.

The top ranked grass species were *Cynodon plectostachys* and *Eragrostis superba*. Other grass species included *Cenchrus ciliaris* and *Panicum maximum*. Among the browse species, *Combretum exalatum* and *Duosperma kilimandscharicum* were the top ranked species. However, *Acacia tortilis, Melia volkensii* and *Combretum apiculatum* were also valuable browse plant species in the study area. The most important crop residues were from maize, pigeon peas and cow peas. However, maize stover may not be reliable especially with increasing aridity and hence more drought resistant cereal crops such as sorghum and millets should be promoted.

Key words: degradation, grasses, indigenous, Kibwezi, legumes, shrubs, trees

Introduction

Climate change is affecting drylands ecosystems with observed increase in woody plants species (Morgan et al 2007, IPCC 2007, Galvin et al 2004). This has a negative effect on cattle production that relies heavily on grass species. The growing seasons are expected to become shorter (Galvin et al 2004, Gimenez 2006) increasing difficulties in crop production hence more households will opt for livestock production (Thornton et al 2007). However, some climate change predictions suggest wetter seasons and longer growing seasons in northern Tanzania and southern Kenya (Thornton et al 2002). Efforts to reduce these constraints and improve cattle nutrition in the drylands have led to the introduction of feed plant species from higher potential areas but their survival and production in these drylands has been observed to be poor. Feeding cattle especially during the dry seasons and drought periods still remains the major challenge in drylands. Though cattle are largely grazers, trees and shrubs forage play an important role during the dry seasons and drought periods when the quality and quantity of biomass from herbaceous vegetation is low (Kamalak et al 2004). However, within the drylands, there exists a rich biodiversity of highly productive, nutritious and adapted plant species that can support improved cattle production all year long.

With increasing human population, changes in land tenure and land use, and decreasing agricultural productivity (Little et al 2001, Galvin et al 2004), clearing of more land for crop production and settlements are on the rise. This leads to many of the indigenous plant feed species being cut down and lost from the drylands ecosystems (Teklu eat al 2011). The main reason for this continued degradation of indigenous plant species is the low importance placed on them by the agro-pastoralists. Additionally, lack of information on their nutritive value compared to exotic feed species introduced to the drylands worsens the problem (Osuga et al 2008, Aregawi et al 2008). To rescue some of the indigenous plant feed species, efforts must be made to add value to them by generating and disseminating information on their usefulness as livestock feed. This study was an effort to identify and generate information on some of the most preferred plant species in the southeastern Kenya drylands.

Materials and methods

This study was carried out in Kibwezi district in the drylands of southeastern Kenya. Kibwezi District lies between the latitudes 206' S and 30 S and longitudes 37036' E and 38030' E (CBS 2000) and covers an area of 3954.6 km2 (GoK 2009). The human population is 258,120 persons with a density of 108 persons per Km2 (GoK 2009). The district is predominantly occupied by the Akamba agro-pastoralists (Musimba et al 2004, GoK 2009) whose main activity is livestock keeping (GoK 2009). The livestock populations are 1,020 dairy cattle, 52,925 beef cattle, 183,500 goats, 91,000 sheep and 142,460 poultry (GoK 2009). Other livestock species are kept but their numbers are low. The District is low lying with Athi River belt being the lowest (300 metres above sea level) and Chyullu Hills the highest (1100 metres above sea level). Kibwezi is largely a dryland district being covered largely by Agro-Ecological Zone (AEZ) LM4 (Lower Midland: Marginal cotton zone), LM5 (Lower Midland: Livestock – Millet zone) and IL6 (Inner Lowland: Ranching zone) (Jaetzold et al 2006). The annual rainfall is low and erratic averaging between 351.8 mm and 687.4 mm while the diurnal temperatures vary between 11.00c and

35.80c (GoK 2009). The soils are dominated by the orthic, rhodic and xanthic ferralsols (Sombroek et al 1982)The dominant plant genera include *Acacia* sp, *Commiphora* sp, *Adansonia* sp, *Tarmarindus* sp and *Grewia* sp, *Cenchrus* sp, *Chloris* sp, *Panicum* sp, *Eragrostis* sp, *Digitaria* sp and *Enteropogon* sp (Nyangito et al 2008). However, expansion of cultivated land is changing the composition of the vegetation with introduction of planted exotic plant species and loss of indigenous plant species.

The listing and ranking of the preferred plant species was done through a questionnaire that was administered through a reconnaissance survey. The questionnaire was administered to household that were selected through a systematic sampling method along a road transect placed in each of the three major agro-ecological zones (LM4, LM5 and IL6). The respondents were asked to mention the most important cattle feed materials in the study area while the ranking was done through the pairwise ranking method (Defoer and Budelman 2000). Data collected was analyzed using the frequency and descriptive tools of the Statistical Package for Social Sciences (SPSS) version 12 (SPSS 2003) and weighted using the Likert scale weighting procedures (Vagia 2006).

Samples of important plant species were collected for nutritional analysis. Grass species samples were harvested from dry standing hay in natural pastures. The samples were collected in paper bags and oven dried at 60^0c for 48 hours to determine the Air Dry Matter (ADM). The air dried samples were then ground through a 1.0 mm sieve hammer mill and samples stored in labelled containers. The ground samples were oven dried at 105^0c overnight to determine the Dry Matter (DM) while the percent Crude Protein was determined through the Kjeldal procedure (AOAC 2005). The percent NDF, NDL and ADL were determined through the Van Soest et al (1991) method while the ash content was determined by burning the sample in a muffle furnace at 550^0c. The IVDMD was done through the Tilley and Terry procedure (Tilley and Terry 1963). The tannin content was determined using the Folin Ciocalteu method (Makkar 2003). To rank the feed materials using the nutritive quality, the CP, IVDMD and the mean percentage of the fibre components were used.

Results

The highly valued grass species were *Cynodon plectostysus* and *Eragrostis superba* but *Cenchrus ciliaris* replaced *Eragrostis superba i*n the drier IL6 (table 1). For trees and shrubs, shrubs were more important than trees in the drier in IL6. Maize stover was the top ranked crop residue used for feeding cattle in all the three zones. Pigeon peas and beans pods residues were only important in the higher potential zone (LM4) and were replaced by cowpeas and green grams pods in the drier LM5 and IL6 zones.

All the grass species had low CP of less than 7% (Table 2). However, the indigenous trees, shrubs and crop residues had a CP of more than 7%.

Table 1: Farmers' ranking of indigenous plant feed materials for cattle in Kibwezi District, south-eastern Kenya

LM4	LM5	IL6
Grass species		
1. *Cynodon plectostachys* (K. Schum)	1. *E. superba* Peyr.	1. *C. plectostachys* (K. Schum)
2. *Eragrostis superba* Peyr.	2. *C. plectostachys* (K. Schum)	2. *C. ciliaris* L.
3. *Panicum maximum* Jacq.	3. *P. maximum* Jacq.	3. *E. superab* Peyr.
4. *Cenchrus ciliaris* L.	4. *S. nervosum* (Rottler) Stapf	4. *P. maximum* Jacq.
5. *Sehima nervosum* (Rottler) Stapf	5. *Cenchrus ciliaris* L.	5. *Enteropogon macrostachysus* (Hochst ex A. Rich)
Tree and shrub species		
1. *Acacia tortilis* (Forsk.) Hayne	1. *A. tortilis* (Forsk.) Hayne	1. *D. kilimandscharicum*
2. *Combretum apiculatum* Sond.	2. *Melia volkensii* (Gurke)	2. *C. exalatum* Engl.
3. *Duosperma kilimandscharicum*	3. *Grewia hexamita* Burret	3. *Cadaba farinose* Forssk
4. *Acacia mellifera* (Vahl) Benth	4. *C. exalatum* Engl.	4. *A. tortilis* (Forsk.) Hayne
5. *Combretum exalatum* Engl.	5. *Premna ologotricha* Baker	5. *G. hexamita* Burret
Crop residue species		
1. Maize (*Zea mays* L. ssp mays)	1. Maize (*Z. mays* L. ssp mays)	1. Maize (*Z. mays* L. ssp mays)
2. Pigeon peas (*Cajanus cajan* (L). Millsp)	2. Cow peas (*V. unguiculata*)	2. Cow peas (*V. unguiculata*)
3. Beans (*Phaselus vulgaris* L.)	3. Green grams (*Vigna radiata* (L.) Wilezek)	3. Green grams (*V. radiata* (L.) Wilezek)
4. Cow peas (*Vigna unguiculata*)	4. Pigeon peas (*C. cajan* (L). Millsp)	4. Pigeon peas (*C. cajan* (L). Millsp)

LM4 = Lower Midland: Marginal Cotton zone, LM5 = Lower Midland: Livestock – Millet zone, IL6 = Inner Lowland: Ranching zone

Table 2: Nutritive value of important indigenous plant feed materials in Kibwezi District southeastern Kenya

	% DM	% CP	% NDF	% ADF	% ADL	% Ash	% IVDMD	% Tannin
Grasses species								
Cynodon plectostachys (K. Schum)	89.2	4.93	77.3	42.3	25.1	0.08	35.2	-
Eragrostis superba Peyr.	89.4	4.88	75.5	41.2	19.1	0.08	44.9	-
Panicum maximum Jacq.	91.5	3.36	77.6	48.0	12.6	2.57	34.2	-
Cenchrus ciliaris L.	92.1	3.60	77.1	46.9	14.0	1.68	36.9	-
Sehima nervosum (Rottler) Stapf	92.3	1.78	76.5	50.4	20.3	11.6	34.4	-
Enteropogon macrostachysus (Hochst ex A. Rich)	91.6	3.90	80.5	41.5	12.4	2.43	39.2	-
Trees and shrubs species								
Combretum exalatum Engl. (leaves)	96.4	15.8	35.5	25.1	8.64	8.42	39.0	5.5
Duosperma kilimandscharicum (leaves)	95.2	18.1	54.5	18.5	7.76	18.1	71.8	1.26
Crop residue species								
Pigeon peas (*Cajanus cajan* (L). Millsp) (pods)	94.8	7.41	53.9	36.6	9.45	3.86	59.0	1.79
Cow peas (*Vigna unguiculata*) (pods)	95.6	7.14	67.0	45.9	7.74	3.78	56.3	2.75

- *Implies analysis not done*

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Discussion

The most preferred grass species in the Kibwezi district were *C. plectostachys, E. superba, C. ciliaris* and *P. maximum*. However, *P. maximum* is most preferred by farmers in cropped farms because of its high biomass production and is commonly grown on terraces in semi-arid lands of southeastern Kenya (Carnevalli et al 2006, Aganga and Tshwenyane 2004). The most common and highly preferred *C. plectostachysus* is not common in farms hence is accessed in natural pastures especially in higher potential microclimates. This may be because it has not been promoted as an important feed grass species for cattle production in the drylands of Kenya. The two other most preferred grass species, *E. macrostachyus* and are being evaluated for forage by range scientist (Mganga et al 2010, Bulle et al 2010, Ogillo et al 2010, Kirwa et al 2010).

Nutritional analysis showed *E. superba* as the superior grass species with the highest percent IVDMD and the second lowest % NDF after *E. Macrostachyus*. However, *E. superba* produces low leafy material biomass with most biomass being in the stems, seeds and the roots (Mganga et al 2010, Opiyo et al 2011). Using production alone under the same environmental conditions, Mganga et al (2010) ranked *C. ciliaris* as the most productive followed by *E. superba* and *E. macrostachyus* in the second and third positions respectively. Similarly, working in southeastern Kenya, Nyangito et al (2008) found that *E. macrostachyus, P. maximum* and *E. superba* contributed substantially to the total energy intake of cattle. From both the farmers' ranking and nutritive analysis, *C. plectostachys* and *E. superba* were the top ranked grass species for cattle feeding in drylands of southeastern Kenya. However, using above ground biomas production, Opiyo et al (2011) working in the neighbouring Kitui county ranked *E. macrostachyus* higher than *C. ciliaris* and *E. superba*.

The most preferred trees and shrubs were *A. tortilis, C. apiculatum, M. volkensii, D. kilimandscharicum* and *C. exalatum*. However, *C. apiculatum* was only mentioned as a preferred species in the higher potential zone (LM4). Throughout the three zones, *A. tortilis, D. kilimandscharicum* and *C. exalatum* were the highly ranked tree and shrub species. Osuga et al 2008, working with goats and sheep used shrubs and trees from the semi-arid Egerton University's Chemeron Field station in Marigat Dvision, Baringo District Kenya and found *Acacia brevispica* to be the most preferred hence Acacia species are important source of livestock feed in most drylands in kenya. Shrubby plant species are easier to manage and harvest than trees. Therefore, *D. kilimandscharicum* and *C. exalatum* are important browse species for cattle feeding in Kibwezi district of southeastern Kenya. This concurs with findings by Nyangito et al 2008, though working on goats, found that both *D. kilimandscharicum* and *C. exalatum* were the key browse species. Between *D. kilimandscharicum* and *C. exalatum, D. kilimandscharicum* leaves were superior in terms of the percentage CP and IVDMD. However, *C. exalatum* is a larger shrub and produces more biomass than *D. kilimandscharicum*. Since the importance of *C. exalatum* increases with increasing aridity it should be the most preferred plant species in the drylands of southeastern Kenya. However, the tannin content of *C. exalatum* is high hence may depress its palatability and digestibility. The importance of browse plant species to livestock especially during the dry and drought periods cannot be over emphasized (Aregawi et al 2008).

The most common and preferred crop residues in southeastern Kenya drylands are from maize, pigeon peas, beans, cow peas and green grams. Throughout all the zones, maize stover was the most preferred. This concurs with Methu et al (2001) that maize stover is the most popular crop residues for cattle feeding in Kenya. The importance of beans and pigeon peas diminishes with increasing aridity being replaced by cow peas and green grams. Therefore, with increasing climate variability cow peas and green grams should be promoted for improved residue production for cattle feeding. In addition, other higher yielding and drought tolerant cereal crop species such as sorghum and millet should be promoted to improve the production of stover for cattle feeding in southeastern Kenya. Between the two crop residues that we analyzed for their nutritional value, pigeon peas had a higher percentage of CP and IVDMD and lower % mean (NDF + ADF + ADL) than Cow peas. However with increasing aridity the preference of pigeon peas decreases over that of cow peas. Therefore, under increasing climate variability, cow peas become more important for cattle feeding than pigeon peas. There is need to evaluate and promote dual purpose cow pea varieties for improved cattle feeding in drylands of southeastern Kenya.

Conclusions

- *C. plectostachys* and *E. superba* were the top ranked grass species for cattle feeding in dry lands of south-eastern Kenya.
- For the trees and shrubby species, *D. kilimandscharicum* and *C. exalatum* were the important species. A. tortilis is also an important plant species but its daily contribution to cattle feeding in southeastern Kenya is low. The importance of *C. exalatum* increases with increasing aridity, therefore, this shrubby plant species should be promoted for improved cattle nutrition under increasing climate variability in the drylands of southeastern Kenya.
- Cow peas and green grams should be promoted for improved residue production.
- To replace maize stover as the most important crop residue, other high yielding and drought tolerant cereal crop species such as sorghum and millet should be promoted to improve the production of cattle in southeastern Kenya especially under increasing climate variability.

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