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Full Length Research Paper

Feed resource utilization and dairy cattle productivity in the agro-pastoral system of South Western Uganda

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A cross-sectional study was carried out in six sub-counties of Kiruhura district, South Western Uganda with the aim of assessing feed resource utilisation and dairy cattle productivity. Individual interviews using a semi structured questionnaire were conducted in seventy five households. The mean land holding, grazing land and cultivated land were 74, 70 and 2 ha, respectively. Majority (61%) of the farms kept Ankole × Friesian crossbred cattle and the average daily milk production per cow per day for low grade and high grade crossbred cows was 5.4±1.3 and 7.4±2.6 L, respectively. The mean in months for age at first calving (AFC) was 30.7±9.8 and 25.9±4.9, calving interval (CI) was 12.6±3.2 and 11.4±1.1, and open period 3.5±2.7 and 2.3±1.2 for low grade and high grade cross bred cattle, respectively. A few farms (7%) maintained a constant herd size from the previous two years, while (67%) registered decreases in herd size and 27% increased their herd size. Natural pastures were the major feed resource throughout the year for all households and the majority (71%) did not provide any feed supplement during dry season or conserve the excess pasture produced in the rainy season. The average stocking rate was 1.4 ± 0.98 TLU/ha which was high and this was aggravated by increasing use of land for cultivation. The use of crop residues and agro-industrial by products was low. The average annual dry matter production on farms meets only 83% of the annual dry matter requirements for an average herd. The major constraints to livestock production were the high costs incurred in disease prevention and treatment (62%), feed shortage (40%) and drought related challenges (31%). It was concluded that feed availability could be improved by equipping the farmers with feed resource management techniques such as improved management of grazing lands, conservation of pastures in the form of hay, and proper utilization of crop residues and agro-industrial by-products, through training and provision of dedicated extension services.

Key words: Dairy cattle, feed resource, crossbred, cattle productivity.

INTRODUCTION

The dairy production sector is expected to make a significant contribution to Uganda's future economy through provision of employment in rural areas and frequent income to many resource poor households (Ekou, 2014). Milk production contributes about 50% of the total output from livestock sector in Uganda (DDA, 2009). While there is some milk production from goats, cattle are the sole producers of marketed milk and a

considerable number of dairy cattle are reared in traditional systems with pasture as the main feed resource and minimal investment in feeding (Ekou, 2014). Extensive grazing is practiced in rangeland pastoral areas where dairy cattle are either continuously grazed or more rarely rotationally grazed where paddocks exist on farms (Roschinsky et al., 2012). Milk production in the rangelands is below potential. The low productivity of dairy cattle in these rangeland systems has been attributed to heavy dependence on natural pasture as a feed resource whose availability is influenced by the annual rainfall pattern (Grimaud et al., 2006, 2007; Ocaido et al., 2009), genetic type with Ankole cattle having low milk yields (Grimaud et al., 2007; Galukande, 2010) and poor adoption of productivity enhancing technologies and management practices (Elepu, 2006). However increased productivity has been registered in the western rangelands as a result of crossing the indigenous Ankole with Holstein Friesian cattle (Galukande, 2010). These crosses are producing more milk but compared to the Ankole cattle, they have larger daily milk yield fluctuations during the year which reduces their overall productivity (Galukande, 2010). The demand for milk on the local and regional market on the other hand continues to grow and in order to meet this demand; efforts have to be put into increasing productivity of dairy cattle. An improvement in the productivity of these crossbred cattle will require better management and utilization of the pasture resources (Grimaud et al., 2007; Roschinsky et al., 2012) and integration of other feed resources like agro-industrial by-products (Grimaud et al., 2007). Indeed the development of feed resources has been highlighted as one of the major areas that will contribute to increasing dairy cattle productivity in Uganda (Ekou, 2014). This study was aimed at assessing the feed resource utilisation for dairy cattle in the south western rangelands of Uganda.

MATERIALS AND METHODS

Description of study area

The study was conducted in the sub-counties of Kazo, Burunga, Kenshunga, Rwemikoma, Kinoni and Buremba in Kiruhura district, South Western Uganda. Kiruhura is located at 00° 12°S, 31° 00°E with an average elevation of 1800 m above sea level. The district experiences a bi-modal rainfall pattern where the two rain seasons normally run from March to May and mid- August to October and the average annual rainfall is 900 mm (KDLG, 2012). The dry seasons are pronounced with temperatures ranging from 17 to 30°C. It forms part of the south western rangelands of Uganda that are characterized by open and wooded savannah grassland vegetation. The area is typified by a light to moderate cover of feathery-leaved, thorny *Acacia* trees dominated by *Acacia gerrardii* and *Acacia hockii* species (Byenkya, 2004). The landscape is made up of flat areas with rolling hills interspersed with wide valleys. The hills rise to an average height of 100 to 200 m above the valley bottoms (Mulindwa et al., 2009). It is estimated that 58% of its population is engaged in livestock farming, while 32% is engaged in crop production and 10% in trade and service provision (KDLG, 2012).

Farm selection and data collection

In each of the six sub-counties, farm households were contacted through farmer group leaders. A total of 75 farm households divided into 18, 14, 13, 11, 10 and 9 from Kazo, Burunga, Kenshunga, Rwemikoma, Kinoni and Buremba sub-counties, respectively were studied. Data was collected during the dry season period of July 2011 to August 2011 through individual interviews conducted using a semi structured questionnaire. In each household, the respondent was the household head, a wife or a key person involved in the daily management of cows. Data on household sociodemographic characteristics, land use, livestock production as well as feed resource utilisation was collected. The data for cattle production characteristics (cattle herd structure, milk yield, age at first heat and service, calving interval, weaning age) were obtained from the respondents' estimation at the time of the interview. Crossbred dairy cows were categorized into high grade cross for those with over 50% Holstein Friesian genes and low grade as those with 50% Holstein Friesian genes as evaluated by the respondents.

Feed dry matter availability assessment

The annual dry matter available from pastures was determined by multiplying the average grazing area by the estimated dry matter yield of 2 t/ha (FAO, 1987). The annual dry matter from cultivated fodder was determined using the estimated dry matter yield of 8t/ha (Alemayehu, 2002) and the crop residue dry matter yield determined using the estimated yield (FAOSTAT, 2015) and estimated dry matter yield (FAO, 1987; Wilaipon, 2009).

The herd annual dry matter requirement was determined using the average herd TLU (73.26) and the daily dry matter requirements of 6.25 kg/TLU (Jahnke, 1982).

Statistical analyses

The data were analysed using Stata for windows (version 11.2, 1989-2009). Descriptive statistics, analysis of variance and logistic regression were used for data analysis. The logistic regression was used to investigate the factors that influence pasture availibility on farms. Stocking rate expressed as hactares per tropical livestock unit (TLU) was used as the dependent variable indicating pasture availabilty. Stocking rate determines the proportion of pasture available for a cow to consume (Fales et al., 1995). The TLUs were computed using ratios attributed to estimated body weights as outlined in (LEAD, 1999) (bull ≈450 kg = 1.55, cow≈400 kg = 1.42, steer≈150 kg = 0.68, heifer≈100 kg =0.5, calf≈ 60 kg = 0.34, sheep≈35 kg = 0.23 and goat≈ 35 kg= 0.23). The computed stocking rate was coded into a binary viariable using the recommended optimum stocking rate of 0.7 TLU/Ha (Mulindwa et al., 2009) as the cut off. All those farms that had under 0.7 TLU/Ha

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Table 1. Socioeconomic characteristics of households.

Variable	N	%
Gender of household head		
Female	6	8
Male	69	92
Age of household head (years)		
30-39	8	10.6
40-49	22	29.3
50-59	25	33.3
60-69	15	20
70-79	5	6.6
Education of household head		
No formal education	4	5.3
Primary level	27	36
Secondary level	39	52
Tertiary level	5	6.7
Experience in livestock farming (years)		
10-30	44	58.6
31-50	28	37.3
51-60	3	4
Family size		
0-10	15	20
11-20	55	73.3
21-30	5	6.6

Table 2. Land holding (ha) and land use pattern in the study area.

Variable	Mean	Standard deviation	Minimum	Maximum
Total land holding	74	75.4	3.8	456
Total grazing land	69.5	75.1	2.2	444
Cultivated land	2.42	2.7	0.15	14.6

were considered to have low to optimum stocking rates, while those that had over 0.7 TLU/Ha were considered overstocked.

RESULTS AND DISCUSSION

Household description

The socioeconomic characteristics of households in the study area are shown in Table 1. The average age of the household head was 53 and ranged from 33 to 76 years. The years of experience in livestock farming ranged from ten to sixty with an average of 29 years. Of the 75 farms only 8% were female headed.

The average total farm landholding and grazing area were 74 and 69.5 hectares, respectively (Table 2). Majority (48%) of the farms had private landholdings as either freehold or leasehold tenure, while 45% had public landholdings of customary or rented tenure and 7% had both public and private landholdings. Bananas were the major crop grown (Figure 1). The other crops included cassava, maize, groundnuts and sweet potatoes in decreasing order of importance.

Livestock production

All farms kept cattle for their milk and in addition 82.7, 56 and 35% farms reported keeping goats, chicken and sheep, respectively. The majority of the farms 61.3%

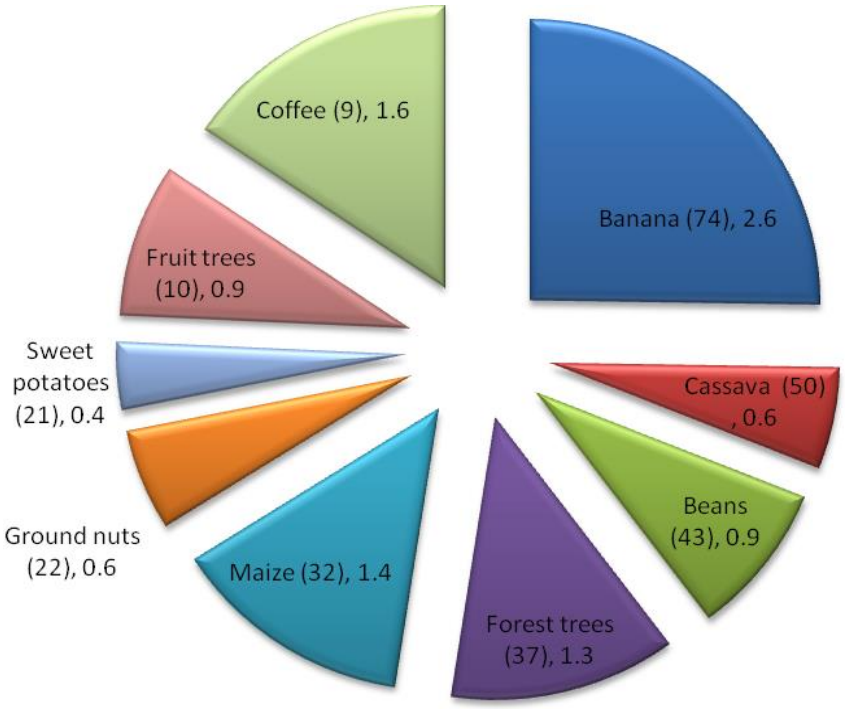

Figure 1. Average land area devoted to crops [(number of farms), hectarage].

Table 3. Cattle herd structure.

Category	Farms	Mean	SD
Cows	75	34	26.2
Heifers	75	22	17.1
Bull calves	73	14	10.3
Bulls	65	2	1.4
Steers	13	9	7.5

reported keeping only Ankole crossbred cattle while 38.7% reported keeping both Ankole and crossbred cattle. The average (±standard deviation (SD)) number lactating cows was 24.5±17.6. The mean (±SD) farm TLU was 62±40.6 and cattle herd structure comprised mostly milking cows followed by heifers and bull calves (Table 3). All but three farms reported using only natural mating. The three farms were using both natural mating and artificial insemination. Natural mating was preferred on many farms, because the alternative of artificial insemination was not readily available and was very expensive to use. The farms also found it relatively easy to acquire grade bulls for using on their farms. During the previous two years, majority of the farms registered a decrease in herd size (66.7%), while (26.7%) increased their herd sizes and (6.7%) maintained a constant herd size. Herd size reduction was mainly attributed to sale of animals to obtain cash for household use or farm development, but they were also sold in order to get rid of unwanted bulls on the farms. Disease related deaths were another reason that led to reduction in herd sizes. Increase in herd size was attributed to receipt of animal gifts, herd multiplication, improved management, and purchase of animals.

Ankole cows had the lowest average daily milk yield per cow and this was significantly different ($p \leq 0.05$) from that of both high and low grade cross cattle (Table 4). The average AFC, age of calves at weaning, open period and CI were significantly lower for high grade crosses compared to Ankole cattle, but were not different ($p > 0.05$) from those of low grade cattle (Table 4). The better performance of Ankole-Friesian crosses in terms of milk yield, AFC and CI compared to Ankole cattle is similar to what was reported in Galukande (2010) and Galukande et al. (2013). While the classification into high grade and low grade and estimation of daily milk yield may not be accurate since there are no written records on farms, it has been shown that improving cows beyond 50% results

Table 4. Milk production and reproductive performance of Ankole and crossbred cattle.

Parameter	Farms	Mean	SD
Milk production/cow/d (L)			
Ankole	20	3.0[c]	1.3
Low grade cross	22	5.4[b]	1.7
High grade cross	57	7.4[a]	2.6
AFC (months)			
Ankole	22	35.2[b]	6.96
Low grade cross	22	30.7[b]	9.8
High grade cross	57	25.9[a]	4.9
Age at weaning (months)			
Ankole	20	10.3[b]	3.6
Low grade cross	23	8.5[ab]	2.4
High grade cross	57	7.7[a]	2.3
Open period (months)			
Ankole	21	5.7[b]	3.4
Low grade cross	23	3.5[a]	2.7
High grade cross	57	2.3[a]	1.2
CI (months)			
Ankole	21	14.9[b]	3.6
Low grade cross	23	12.6[a]	3.2
High grade cross	57	11.4[a]	1.1

Figures with different superscripts in the column are significantly different at $P \leq 0.05$

in higher daily milk yield. Cows are milked once or twice a day, milking usually starts as early as 05:00 h and ends at about 08:00 h depending on the number of milking cows in the morning and then again in the mid-morning from 11:00 to 13:00 h. The morning milking is what is apportioned for sale and is collected through local dairy coolers while the milk from the second milking is kept for home consumption. In a review on cross breeding for milk production in the tropics, Galukande et al. (2013) found that at 50% Bos Taurus crosses yielded 2.2 times higher milk compared to the local cattle in semi-arid areas. The average daily yield for 50% crossbred cows was 5.4 which is less than double that of the Ankole.

The mean (±SD) daily milk in litres per farm sold to dairy processors through the local cooling centres was 105±99, while the mean milk sold at the farm was 46±64. On some farms, the milk was split into two portions, one delivered to local cooling centres and the other sold at the farm to milk traders. The average farm gate price for a litre of milk was slightly better 376 UGX than that paid by the milk processor 365 UGX. Only thirteen farms were involved in commercial production of ghee. Besides milk and ghee, the other source of revenue was the sale of live animals. Cows and bull calves were the most frequently sold followed by heifers and in rare cases breeding bulls were sold. The mean (±SD) daily revenue in UGX from milk was 40551±48154 and the mean (±SD) revenue in UGX from sale of cows in the previous nine months was 12.6±1.2 million.

Livestock feed resources and feeding system

Pasture

Table 5 shows the major feed resources utilized on farms. Natural pastures are the major feed resource throughout the year and for most some farms it is the only feed resource. The predominant grass species on farms were *Brachiaria* species*, Hyparrhenia rufa, Cynodon dactylon, Themeda triandra, Sporobolus pyramidalis* and *Panicum maximum*.

The annual dry matter requirement for maintenance of an average herd was 167 tonnes /year while the annual dry matter availability from natural pasture was 139 tonnes (Table 5). The annual dry matter yield from pasture which is the only feed for most farms meets only 83% of the annual dry matter requirements of an average dairy herd. The farms therefore need to increase feed availability in order to fill the gap.

Table 5. Feed resource utilisation and estimated annual dry matter yield.

Feed resource	Farms (%)	Average hectarage	Crop yield (tonnes/ha)	Conversion factor	Dry matter yield (tonnes/year)
Herbage					
Natural Pasture	100	69.5	-	2[1]	139
Planted pasture grass and legume mixture	20	1.7	-	8.0[2]	13.6
Planted pasture grass	20	0.3	-	8.0[2]	2.4
Planted pasture legumes	11	0.5	-	8.0[2]	4.0
Planted fodder trees	6.7	0.1	-	-	-
Crop residues					
Banana peels	40	2.6	4.25[3]	0.25[4]	1.1
Maize stover	1	1.38	2.75[3]	2[1]	5.5
Agro-industrial by-products					
Cotton seed cake	1	-	-	-	-
Maize bran	2.7	-	-	-	-

Cattle herd annual dry matter requirements

	TLU	Annual (tonnes)
Cows	48.28	110
Heifers	11	25
Bulls	3.1	7
Steers	6.12	14
Calves	4.76	11
Total	73.26	167

[1](FAO, 1987) [2](Alemayehu, 2002) [3](FAOSTAT, 2015) [4](Wilaipon, 2009).

Planted forage was not common on farms, 20% had planted pasture as a mixture of legume and grass stands, 20% had grass only stands and 11% had legume only stands, and 6.7% had planted fodder trees. The average acreage for all types of planted forage was less than 2 ha yielding a small amount (4.4 kg) of dry matter annually. These estimates indicate that the pasture resources, both natural and planted did not yield sufficient dry matter to sustain an average dairy herd in this system. The farms would need to improve their management of natural pasture and invest in planting more pasture to increase the dry matter yield from pasture.

Crop residues and agro-industrial by-products

Besides natural pasture, the other feed resource that was used was crop residues from bananas (peels) 30 farms (40.5%) and only one farm reported using maize stover. Only one farm reported using maize bran while another farm used a ration made from cotton seed cake and maize bran when prices were favourable. The major reasons for not using agro-industrial by-products on farms were unavailability, the high expense involved, low returns from milk making their use uneconomical or lack of facilities like milking parlour where they can be fed individually to animals.

With bananas as the major crop grown, widespread use of the residues both peels and pseudo stems as a dry season supplement would have been expected in this system, but this was not the case. Even on farms that reported use of banana peels, only a few cows were fed rather than the whole milking herd. Banana plant residues have been reported as important basal and supplementary feed for dairy cows in the tropics (Kimambo and Muya, 1991; Katongole et al., 2013; Lumu et al., 2013). Previous studies have found that the dry matter digestibility of banana pseudo stems and fruit peelings were 59 and 61%, respectively (Kimambo and Muya, 1991), while crude protein of banana peels was 6% (Nambi-Kasozi et al., 2014), 7.9% (Aregheore and Ikhatua, 1999) and metabolisable energy was 8.7 MJ/kg of dry matter (Aregheore and Ikhatua, 1999). Banana pseudo stems and fruit peelings could therefore provide additional energy and protein on farms even though supply may be limited in prolonged dry seasons. Extensive systems in east and southern Africa that rely on crop residues as livestock feed during the dry season often have to deal with limited supply during prolonged dry seasons (Valbuena et al., 2012; Takele et al., 2014).

Table 6. Dry season feeding strategies and utilization of excess pasture.

Strategy	Percentage response
Dry season feeding strategy	
Cattle feed on grazing land	71
Supplement with crop residues	16
Supplement with planted fodder	13
Rent land	9
Provide hay supplement	8
Utilise reserve paddock	4
Utilization of excess pasture	
Left for grazing	85
Conserved as baled or standing hay	12
Never have excess	2.7

Other crops that would provide residue supplements are maize, beans, ground nuts or sweet potatoes but their respective average hectarages were too small to yield substantial dry matter besides the fact that with the exception of beans, the other crops were grown by less than half of the households. Crop residue utilization for feeding livestock can be enhanced through increasing biomass production per unit area by strategic application of organic manure and developing technologies for efficient collection, processing and storage (Tui et al., 2013).

The absence of grain mills or oil processing facilities in this area makes agro-industrial by-products expensive to use because of the additional transport costs involved. However, poultry farmers in peri-urban areas of Kampala opted for bulk purchasing of feed ingredients when supply was plenty as a way of coping with feed scarcity (Katongole et al., 2013), a strategy that could be adopted on agro-pastoral dairy farms.

The majority of the farms (71%) did not provide any feed supplement for cattle in the dry season (Table 6); the cattle scavenged on whatever was left of the pasture. Excess herbage during the rainy season was not conserved on most (85%) farms. The lack of preservation of pasture will only perpetuate the dry matter deficit for dairy cows unless the farms adopt strategies like fencing off part of their rangeland during the rainy season to be used in the dry season when pasture availability is low as is being practised in some (Solomon et al., 2007; Abate et al., 2010; Selemani et al., 2012) rangeland systems. Another alternative that has been practised is to plant and preserve fodder banks of planted grass and legume pasture in the form of standing hay (Campbell et al., 1996).

Management of grazing land

The average stocking rate on farms was 1.4 ± 0.98 TLU/ha. This stocking rate is high when compared with the optimum stocking rate of 0.71TLU/Ha for the area according to a study by (Mulindwa et al., 2009). Semi arid rangelands tend to favour lower optimal stocking rates 0.61 TLU/ha (Maposa, 2012), 0.71 TLU/ha (Mulindwa et al., 2009) in order to maintain good levels of forage biomass production (Maposa, 2012). The amount of pasture available in relation to the number of grazing animals in the rangeland has a bearing on the intake, animal performance and long term ecological health of the rangeland (Fales et al., 1995; Mulindwa et al., 2009). High stocking rates have a greater impact on the ability of the animal to meet its nutrient requirements when rangeland pastures are in poor condition and rainfall is scarce (Fynn and O'Connor, 2000).

Farmer's assessment of herbage availability on their farms revealed that it followed the rainfall pattern with the highest amount available during the long rains from September to December and least during the dry period of June to August (Figure 2). Planted pastures had the highest availability followed by natural pastures and the least available was the herbage from planted fodder trees.

Many of the farms (78%) reported having cleared the bush on over 75% of their total grazing land. Bush clearing in the study area involves manual cutting down of shrubs during the dry season. The shrubs are often not completely destroyed so they are able to sprout again and therefore require regular clearing in order to maintain bush free pasture. Bush encroachment if left unchecked can lead to loss of grass cover and thus degradation of the rangeland (Macharia and Ekaya, 2005). Extensive management of bush encroachment on farms in south western Uganda was shown to offer economic benefit through improving herbage dry matter yield, gross income, milk yield and body condition score of cows (Mugasi et al., 2007).

All farms had some form of fencing on their grazing land, 44% reported complete perimeter fencing with paddocks, 42% perimeter fence only, 13% perimeter

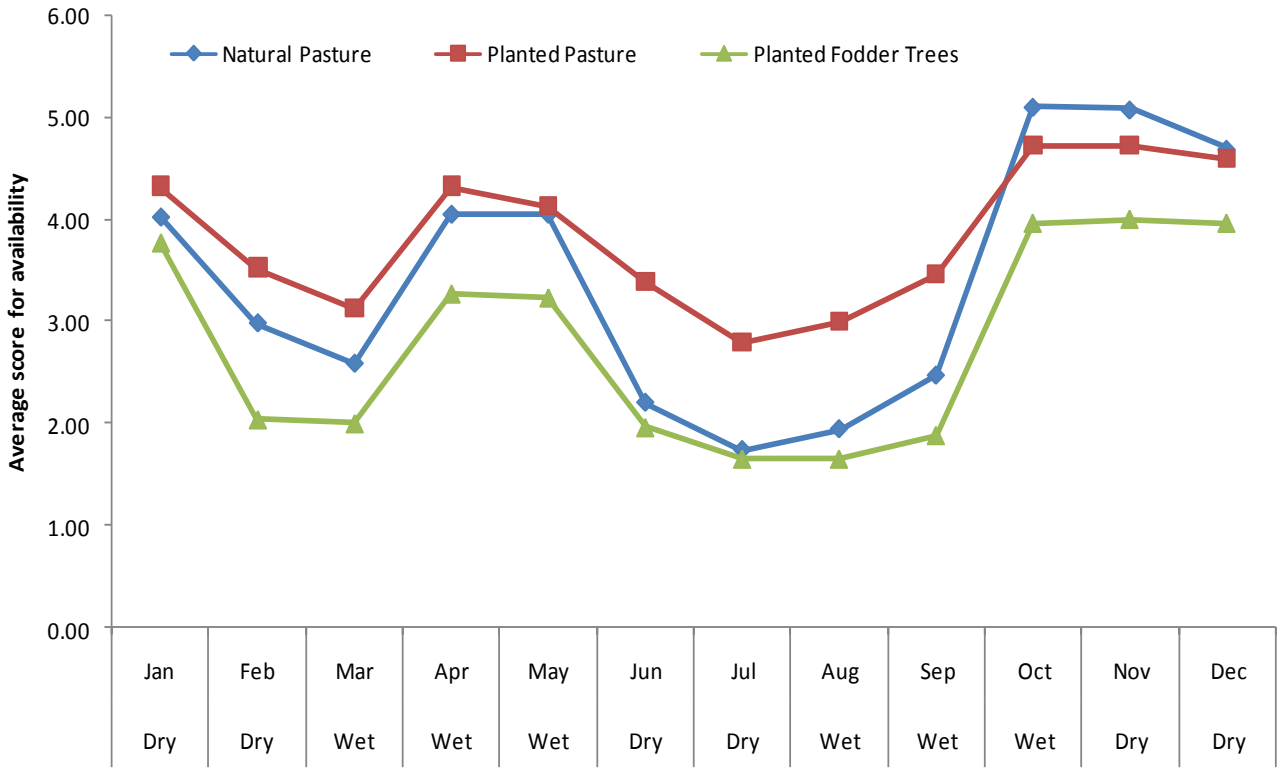

Figure 2. Annual trend for herbage availability. Scores: 1- very little available, 2- little available, 3- available in moderate quantities, 4- sufficient availability, 5- available in large quantities, 6- available in very large quantities

fence with only part of it paddocked and only one reported having an incomplete perimeter fence with no paddocks. Fencing is done using live fences of *Euphorbia tirucalli* species (oruyenje, local name) or timber poles obtained from the farms together with barbed wire. The labour costs for splitting the timber poles, digging holes and the cost of barbed wire makes it expensive to construct fences with barbed wire while the live fences are effective only during the first few years of growth before the hedges overgrow and become woody losing their ability to close in. Fencing in the rangelands permits protection of the grazing area, fodder banks and with paddocks it facilitates rotational grazing and implementation of pasture improvement technologies (Mwebaze, 2003). However, it has been argued that planned grazing can be done without fenced paddocks (Kirychuk and Fritz, 2010). According to Kirychuk and Fritz (2010), a grazing plan can be developed and documented so that animals are herded to specific areas at set times and their distribution controlled. This is a good alternative for reducing fencing costs on farms with large grazing areas, but requires ensuring that the herder adheres to the plan. Well fenced farms would incur less labour costs for herding, but have higher costs for infrastructure set up and maintenance while the reverse would be true for farms with a grazing plan that includes no paddocks.

Water for animals is got from water wells located in the valleys within the farms. The type of water wells and watering frequency are shown in Table 7. Majority of the farms water their cows two to three times a day. Watering is done by driving cows to the water wells from where water is drawn into troughs for the animal to drink. On most farms this is done immediately after morning milking before the cows are taken for grazing and just before mid morning milking. All farmers provided minerals in the form of rock salt and in addition 12% of the farms provided artificial mineral licks.

Factors affecting availability of natural pastures

The logistic regression model to determine the influence of household size, age, education level, land tenure, fencing, bush clearing, cattle breeds, cultivated land and livestock revenue on the likelihood of overstocking was statistically significant χ^2 (11) = 27.67, $p < 0.005$ (Table 8). Farm households that had received some form of training in livestock management tended to have lower stocking rates while a higher proportion of cultivated land to total land was associated with overstocking ($p<0.1$). This highlights the need to provide training on optimal utilization of pasture resources through reducing the herd size to match pasture resources, pasture improvement

Table 7. Water wells on farms and watering frequency.

	Farms	%
Well type		
Manually dug	32	46
Tractor dug	31	44
Both manual and tractor dug	7	10
Number of water troughs		
1-3	63	93
4-6	5	7
Watering frequency		
Once	2	3
Two - three	55	80
Four – six	12	16

Table 8. Logistic regression model for prediction of overstocking on study farms.

Variable description	Coefficient	SE	Significance
Number of persons living in the household	0.144	0.145	0.321
Age of household head	-0.018	0.055	0.740
Number of years the household head had been practicing livestock farming	0.045	0.050	0.373
Number of years household head spent in formal education	-0.112	0.136	0.411
Private (Freehold or leasehold tenure) or public (customary or rented tenure)	0.922	0.776	0.235
Proportion of bush cleared land	-1.524	1.435	0.288
Whether the grazing land is fenced with paddocks or not	1.435	0.965	0.137
Revenue from daily sale of milk	5.1e-06	9.2e-06	0.578
Whether the household had had any training in livestock management	-2.119	1.215	0.081
Revenue from sale of live cattle during the previous nine months	-2.3e-08	4.3e-08	0.589
Proportion of total land holding that is cultivated	-0.674	0.267	0.012
Constant	-0.098	4.459	0.982
$\chi^2(11) = 27.67$, Prob > $Chi^2 = 0.0036$	-	-	-
Pseudo $R^2 = 0.4013$	-	-	-
N = 59	-	-	-

The dependent variable was stocking rate and was coded 0 = low to optimum and 1= high

and adjusting cultivated area in relation to total land area.

Constraints to livestock production

The major constraints to livestock production were the high costs incurred in disease prevention (62%) and treatment, feed shortage (40%) and drought related challenges (31%) (Table 9). Other constraints to production included low and fluctuating milk prices, limited resources for investing in improved feeding, high costs of labour and labour shortage. Water and feed shortages in the dry season was the major constraint to livestock feeding. Bush encroachment and high cost of supplementary feeding were the other constraints mentioned. While feed shortage in the dry season was a major constraint to livestock feeding, many farms had no alternative feeds for their cattle during periods of pasture scarcity; the cattle depended on whatever was left on the range. The farmers saw the need to invest in improved feeding but cited insufficient resources as a hindrance probably due to the relatively low returns from sale of milk.

Conclusion

This study has shown that annual feed availability is not

Table 9. Major constraints to livestock production and feeding.

Constraint	Percentage response
Livestock production	
High costs of disease prevention and treatment	62
Feed shortage	40
Drought related problems	31
Low and fluctuating milk prices	21
Limited resources for investment in improved feeding	12
High cost and shortage of labour	9
High cost of inputs (e.g. barbed wire)	8
Livestock feeding	
Water and feed shortage especially in the dry season	86
Bush encroachment on grazing land	5

sufficient to meet the dry matter requirements for dairy cattle seeing that natural pasture is the main feed resource with minimal use of crop residues and agro-industrial by products. The average annual dry matter production on farms meets only 83% of the annual dry matter requirements for an average herd. This could be the reason why milk production and age at first calving of both low grade and high grade crossbred cattle are not good enough. Feed availability could be improved by equipping the farmers with feed resource management techniques such as improved management of grazing lands, conservation of pastures in the form of hay, and proper utilization of crop residues and agro-industrial by-products, through training and provision of dedicated extension services.

Conflict of interests

The authors have not declared any conflict of interests.

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