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A SURVEY OF AVAILABLE FEED RESOURCES AND RATION FORMULATION FOR DAIRY ANIMALS AT THE FARM LEVEL IN BAHATI AND RONGAI DIVISIONS OF NAKURU DISTRICT, KENYA

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SUMMARY

A one week survey was conducted in Bahati and Rongai Divisions of Nakuru district to assess and take inventory of available feedstuffs at smallholder mixed farms. Four study sites were selected, two from each division of the two divisions. Five farmers were randomly selected from each site. Representative feed samples were collected for nutritional status determination. Feed samples were taken during the dry season in both divisions and analyzed for dry matter percentage and proximate analysis. Grass samples were cut from paddocks grazed by the animals. Three samples were taken from each feed type. Two samples were dried in the oven at 105^{0}C for 24 hours for dry matter (DM) determination and one sample at 70^{0}C for proximate analysis. During the survey, it was observed that farmers practised three production systems. These included free grazing, semi-zero grazing and zero grazing. Semi-zero grazing was the most dominant (80%)in both divisions. The results indicated that in Rongai, 60% of the farmers supplemented their animals with minerals, 30% with dairy meal, 40% fed Rhodes grass, 60% Napier grass, 40% sorghum forage and 20% sweet potato vines. In Bahati division, 100% of the farmers had Napier grass, 40% sweet potato vines while 20% and 10% supplemented their animals with minerals and dairy meal, respectively. It was, also, observed that farmers in Rongai (40%) and Bahati (30%) supplemented their animals with home-made rations which had an average CP % of 11.99 and 8.14%, respectively. From the results, it was concluded that the major limiting nutrient in most feedstuffs was low crude protein level (2.15%) and energy which characterised majority of the available feed resources.

***Keywords:** Forages/pasture grasses, quality, home-made rations, milk yield, production systems*

INTRODUCTION

Dairy industry plays a big role in Kenya's economy as it generates income and provides employment and high quality protein food. The dairy enterprise is an important component of smallholder mixed farming systems in both high and medium potential areas in Kenya as it contributes about 80 % of the total milk produced. Earlier research work indicate that napier grass is the most important feed resource for smallholder zero and semi-zero grazing systems (Anindo and Potter,1994). Under these systems, the main constraints to dairy cattle farming have been identified as inadequate quantity of feeds especially during the dry season which is characterised by low nutritive value. It has been observed that low protein content and low digestibility of Napier grass reduces (Anindo and Potter,1986; Wouters, 1987) utilization efficiency by dairy cattle. The low economic status of most small scale farmers has limited the use of concentrates to supplement for Napier grass basal diets and application of fertilizer to improve quality and total dry matter yield of Napier grass (Valk, 1990). In the struggle to look for cheaper alternatives,some farmers have resorted to making their own home made rations for supplementary feeding to improve milk production and reduce costs incurred through purchasing of commercial concentrates. The purpose of ration formulation is to provide a diet that contains all or part of the nutrients required by the animal to enhance production. However, the quality of available feed resources and the ingredients used in formulating rations by some farmers at the farm is not known. As a result, this may lead to formulating rations which are not balanced in terms of protein and energy. It is the feed and feeding management which determine profit or loss of a livestock production enterprise as feed costs comprise between 65 - 80 % of the total cost of raising animals (Mtimuni, 1995). In view of the foregoing information, data was collected during field survey by research and extension teams. The study aimed at identifying and analysing the quality of feeds widely used by farmers in an effort to document and give guidelines on how to make cost effective home made rations.

Objectives

1. To identify feed resources used by farmers in different production systems.
2. To determine the acreage of each forage.
3. To determine the chemical composition and nutritive value of available feed resources.
4. To formulate home-made rations.

MATERIALS AND METHODS

Study sites

The study was carried out on smallholder mixed farms in Rongai(area,554 km^2) and Bahati(area,682 km^2) Divisions in Nakuru District. In Bahati, AEZ I and II are found in upper and lower parts respectively while Rongai has zones II in upper and III in lower parts. Zone I has annual rainfall of 1,270 mm and in zone II it ranges between 760 mm and 1,270 mm while zone III has less than 760 mm. These divisions (Bahati and Rongai) were chosen due availability of small farm sizes and dairy animals. Bahati and Rongai have an average farm size of 2.5 and 6.5 acres respectively. The number of small holdings are 20,418 in Bahati and 13,590 in Rongai (Nakuru District Agricultural Annual Report,1996).

Baseline data and training

The baseline data was collected by administering a questionnaire whereby both research and extension teams were involved. Data collected included farm size and forage acreage, feed ingredients, herd size, breed type, and milk production. Farmers were trained on proper establishment and management of forages/pasture grasses, fodder conservation (silage and hay making) feeding of dairy animals, fertility and record keeping.

Farmers' visit and feedback messages

A tour was organized for project farmers and they were able to visit other small scale farmers who practice good dairy husbandry in Njoro division. The purpose of the tour was to expose farmers to good dairy management practices and be able to learn from their fellow farmers. Out of the expected 120 farmers (30 from each site) 87 (64 Men and 23 Women) participated in the visit; Munanda 24 (21 Men and 3 Women), Bahati Scheme 21 (15 Men and 6 Women), Menengai 19 (14 Men and 5 Women) and Rongai 23 (14 Men and 9 Women) attended. A one week seminar was organized (November/December, 1999) for the farmers at study sites to present feedback messages on quality of available feeds at the farms and ration formulations. The attendance was as follows; Munanda 16 (15 men and 1 Women), Bahati Scheme 16 (9 Men and 7 Women), Menengai 24 (13 Men and 11 Women) and Rongai 22 (14 Men and 8 women).

Feed sampling and chemical analysis

Feed samples were taken during the dry season in both divisions. Three samples were taken from each feed whereby two were oven dried at 105^0C for 24 hours for Dry Matter (DM) determination and one at 70^0C which was ground for proximate analysis. Calcium and Phosphorus were also analyzed and reported as fed. Metabolisable energy (ME) was calculated from Digestible Energy (DE) and DE calculated from Total Digestible Nutrients(TDN) estimates. Cotton Seed Cake suspected to have aflatoxin was analyzed using Thin Layer Chromatography Technique (T.L.C.T.) and was proved positive for aflatoxin G and hence, it was undesirable as a livestock feed as the farmer had complained of frequent cases of mastitis in his dairy herd.

Statistical analysis

Chemical composition means for each feed type were calculated. However, comparison of differences between means using Least Significance Difference test was not computed due to limited number of observations (range 1 - 8).

Home-made rations

Factors to consider in ration formulation

i. Class of animal to be fed
ii. Nutrient requirement of the animal (see Table 1)
iii. Available feeds and feed ingredients
iv. Quality of the basal feed and other feed ingredients
v. Presence of harmful substances like aflatoxin
vi. Facilities to grind and mix the ingredients

Home-made-rations were formulated from feed resources which were locally available within the farm or bought from outside the farm. The most cost effective feed materials which can satisfy the nutrient requirements of a dairy cow were identified. The next step was to combine the feed ingredients in such a

way that the resultant ration had optimal nutrient composition. For the purpose of this study, ration formulation was done by using pearson square method and simultaneous equations.

Table 1. Nutrient requirement of dairy animals

(a)Growing heifers (400 g daily gain) growth and maintenance		
Bodyweight (Kg)	**ME (MJ)**	**CP (g)**
200	52.1	604
250	55.2	656
300	62.2	713
350	67.2	738
(b)Lactating cows	**(i) Maintenance**	
350	45.3	341
400	50.0	373
450	58.7	403
500	59.1	432
(ii) Production nutrient requirement per kg of milk at 3.5% butter fat		
Amount of milk	**ME (MJ)**	**CP (g)**
1	4.9	82
10	49	820
20	98	1640

Source: NRC,1978

RESULTS AND DISCUSSION

Farm size/acreage of roughage /dairy cows

The average farm size for farmers who participated in the study in Rongai Division was 11.25 acres (range, 2 - 25) and in Bahati, average farm size was 3.4 acres (range, 1.5 - 9). The mean acreage of Napier grass per farm in both divisions was 0.25 acres which was quite insufficient for the number of animals kept. The average acreage of 3.5, 0.75 and 0.5 for Rhodes grass, sweet potato vines and forage sorghum, respectively were recorded in Rongai Division. In Bahati, farmers with sweet potato vines had on average less 0.25 acre. The average number of cows per farm in Bahati was 2 and Rongai 7 and this was attributed to the size of the farms. In both divisions, breeds included mainly Friesians, Aryshires and cross breeds respectively.

Basal feeds and production systems

From the study, it was observed that in Rongai Division 60% of the farmers had napier grass, 40% Rhodes grass, 40% sorghum forage, and 20%-sweet potato vines. In total, 10% of farmers in Rongai practised Zero-Grazing (ZG), 80%, Semi-Zero Grazing (SZG) and 10% Free grazing (FG). For Bahati Division, 100% of the farmers had napier grass, (20%-ZG, 80%- SZG), 40%-Sweet Potato Vines (SPV) (40% -SZG) and 50%-; Maize Stover 10%-ZG, 40% - SZG).Other forages included Kikuyu ,and star grass grazed or cut and stall fed.

Energy and protein sources for Rongai and Bahati Divisions

Energy sources for Rongai division included maize germ, maize flour waste from posho mill, rice germ and wheat pollard whose Metabolizable Energy (ME) in MCal/kg DM ranged from 2.6 to 3.37 while CP% range was between 6.3 and 11.69 (Table 2). Protein sources included cotton seed cake, poultry manure and pyrethrum marc. Fodders and the bulk of crop by-products contained inadequate amounts of energy and proteins. A ration of a domestic animal will be satisfactory if it provides the animal with sufficient quantity and quality of proteins, energy, correct balance of minerals and vitamins and enough water for metabolism and heat regulation (Pagot,1992). Crude protein was the major limiting nutrient in most feeds in both divisions. The mean crude protein percentage of Napier grass in Rongai and Bahati was 5.0 and 10.24 (Tables 2 and 3) respectively. This difference in quality was attributed to differences in soil fertility and moisture, management, agro-ecological zones between the divisions and the age at which grass was sampled.

Table 2. The (average) proximate analysis (g kg^{-1} DM) and metabolizable energy (ME) of feeds in rongai division

Feedstuff	No. of samples	%DM	Ash	EE	CP	CF	NFE	Ca	P	ME (Mcal/kg)	ME (MJ/kg)
Grasses/Fodders											
Rhodes grass	3	55.02	99.5	22.0	49.4	408.6	420.6	3.2	1.5	1.94	8.15
Napier grass	3	22.34	176.5	44.1	49.9	306.8	422.7	3.4	2.5	2.33	9.79
Star grass	3	54.43	74.6	22.4	73.0	379.5	450.2	2.9	1.6	2.07	8.70
Kikuyu grass	1	24.98	112.2	27.7	59.0	364.2	436.9	3.9	2.6	2.16	9.08
Forage sorghum	1	32.42	115.7	36.4	69.1	331.3	447.5	4.1	1.0	2.31	9.71
Columbus grass	1	22.07	94.2	41.1	115.4	322.4	426.9	2.5	0.8	2.44	10.25
Sudan grass	1	29.50	100.6	34.8	94.7	318.7	451.2	3.0	1.1	2.36	9.92
Conserved feeds											
Maize silage	1	24.10	96.8	50.2	44.6	375.1	530.1	2.4	1.9	2.28	9.58
Rhodes grass	3	88.99	108.5	21.6	49.0	391.7	499.2	3.2	1.2	2.15	9.03
Sorghum Silage	1	35.26	115.7	36.4	69.1	331.3	447.5	4.1	1.0	2.31	9.71
Protein rich forages											
Sweet potato vines	1	14.89	151.8	47.1	163.5	181.0	456.6	12.0	3.0	2.70	11.34
Leucaena leaves & twigs	1	37.03	73.8	46.2	112.0	202.5	565.1	12.0	0.5	2.61	10.97
By products											
Cotton seed	4	90.08	56.5	71.7	258.6	271.5	342.0	2.1	8.8	2.77	11.64
Maize germ	2	87.30	41.0	149.0	113.0	94.1	602.8	0.3	8.4	3.14	13.19
Pye mark	1	91.20	87.6	38.6	133.2	293.7	446.9	3.8	2.3	2.17	9.12
Maize flour waste	2	90.61	32.1	130.9	83.2	85.2	668.6	0.5	6.0	3.01	12.65
Wheat pollard	1	88.91	34.2	43.2	116.9	82.0	723.7	0.7	6.0	2.73	11.47
Rice germ	1	90.44	168.4	86.6	63.0	295.3	386.7	0.8	8.1	2.6	10.92
Cotton hulls	1	89.17	30.4	40.9	48.5	552.4	327.8	11.0	1.9	1.99	8.36
Dairy meal/home made ration											
Dairy meal	2	89.60	107.5	60.3	117.3	138.2	576.8	15.2	7.8	2.77	11.64
Maize germ +Cotton	1	88.32	44.4	128.0	113.0	187.4	527.3	0.9	5.3	2.94	12.35
Cotton seed cake+ Wheat pollard+Rice germ	1	89.96	103.3	69.4	104.0	218.0	504.9	3.3	6.9	2.7	11.34
Poultry manure + dairy meal+ CSC	1	90.75	190.8	33.2	142.6	373.7	259.7	35.5	12.6	2.25	9.45
Amaranhus+Beans (plant)+sun flower leaves	1	27.37	140.8	39.2	196.0	230.8	392.8	1.3	0.3	2.62	11.01

CSC - Cotton seed cake

Table 3. The (average) proximate analysis (g kg^{-1} DM) and metabolizable energy (ME) of feeds in Bahati division

Feedstuff	No. of Samples	% DM	Ash	EE	CP	CF	NFE	Ca	P	ME(MCa/kg)	ME (MJ/kg)
Grasses/fodders											
Napier grass	8	17.55	182.3	39.2	102.4	321.0	347.0	4.8	3.6	2.42	10.17
Kikuyu grass	2	14.98	143.3	45	89.8	281.5	426.0	4.7	3.8	2.46	10.34
Forage sorghum	1	15.50	112	53.4	20.7	305.0	323.0	4.6	3.5	2.63	11.05
Oats	1	35.27	70.7	44.0	44.1	384.0	457.0	3.0	2.0	2.23	9.37
Conserved feedstuff											
Rhodes grass hay	1	85.56	135.5	22.3	30.8	434.0	377.0	2.2	2.4	1.91	8.03
Protein rich forage											
Sweet potato vines	3	14.06	126.9	42.6	120.0	216.5	515.5	11.6	2.4	2.51	10.55
By-products											
Maize stover	6	25.10	90.3	25.6	35.1	308.0	541.4	2.7	3.1	2.11	8.87
Banana stems	2	12.07	100.3	27.0	28.5	202.2	533.5	3.9	1.0	2.45	10.29
Barley husk	1	86.10	84.4	36.6	60.8	148.0	670.0	2.3	3.8	2.5	10.50
Bean stovers	1	84.66	74.1	37.6	59.6	529.0	300.0	8.4	1.1	2.06	8.66
Poultry manure	3	73.75	194.5	41.1	65.6	248.7	450.7	38.4	13.3	2.36	9.92
Maize germ	1	87.94	184.2	17.5	141.0	147.0	501.0	0.3	11.3	2.55	10.71
Dairy meal/home Made conc.											
Dairy meal	1	88.15	122.6	37.2	100.0	130.0	610.0	18.5	13.2	2.61	10.97
Poultry manure + Wheat bran	1	83.89	402.5	24.3	111.0	170.0	29.2	46.0	12.4	2.45	10.29
Maize germ + Poultry manure	2	85.58	118.0	58.0	77.5	216.5	530.5	10.2	13.1	2.57	10.80
Maize germ + Wheat bran + Sun flower cake	1	89.02	156.0	35.8	55.6	307.0	446.0	4.3	3.9	2.85	11.97
Miscellaneous											
Kales	1	16.45	101.0	47.6	47.5	192.0	612.0	14.0	3.0	2.49	10.46

The protein level of 10.24% is comparable to the results obtained by Kaitho and Kariuki (1998). When the crude protein content of tropical grasses falls below 6% appetite will be depressed by the crude protein deficiency in the animal (Minson, 1990) and animal performance will be affected negatively. Napier grass of this quality supplemented with fodder trees improved dry matter intake and sustained weight gain of dairy heifers (Kaitho and Kariuki, 1998). Growing Napier grass in combination with green leaf desmodium *(Desmodium Intortum)* gave yield of 17 tonnes of DM ha^{1} as compared to 12.3 tonnes for pure stand of Napier grass giving a significant increase in yield of 41% and the quality of the mixture was better than that of a pure stand of Napier grass (Snyders *et al.*, 1992). This combination is worth adopting as it offers optimal utilization of limited land, improves quantity and quality and *Desmodium* smothers weeds thereby reducing costs of weed control.

Supplementation

In Rongai Division, 30% of the farmers supplemented their animals with dairy meal and 60% with minerals. However, in Bahati Division 10% gave dairy meal to their animals and 20% offered minerals. Home-made-rations were also used as supplements in both divisions whereby 40% and 30% of the farmers fed home-made-rations in Rongai and Bahati, respectively. From chemical analysis results (Tables 2 and 3) the major limiting nutrient was found to be Crude protein (CP) in both commercial concentrates and home- made-rations. The low levels of CP and energy in home made rations is attributed to lack of knowledge of farmers about the quality of feed ingredients and improper ways of mixing. Crude protein percentage means of dairy meal were 11.3 and 10.0 for Rongai and Bahati, respectively which were below the standard of 16% CP for commercial concentrates. CP for home-made-rations were 11.99% for Rongai and 8.14% for Bahati.

Milk production

In Bahati, milk yield per cow per day was 7.8 litres with an average butter fat (BF) of 4.3%. The yield in Rongai was 10.1 litres per cow per day with BF of 4.2%. The differences in milk production was attributed to differences mainly in quantities and qualities of feeds offered to animals.

CONCLUSION

The quality of forages in both divisions was generally low in terms of energy and crude protein and, hence, the need for supplementary feeding is evident. The acreage of forages grown by farmers was inadequate for the number of livestock kept.

RECOMMENDATIONS

1. Farmers should be encouraged to grow protein rich forages like sweet potato vines, lucern, Desmodium and fodder trees to supplement low quality grasses.
2. Intercrop Napier grass with *Desmodium*
3. Farmers should be trained to adopt new technologies like tumbukiza to improve yield and quality of Napier grass
4. Evaluation of the quality of feed ingredients used in ration formulation is important.
5. Training of extension officers on how to make home-made-rations.
6. Forages/pasture grasses for making silage and hay should be harvested at the right stage where both quality and quantity are in equilibrium.
7. Growing enough forages/pasture grasses for a given number livestock units by the farmers
8. Development of annual forage production and utilisation calender.

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