Body Condition Score and Lactation Responses in Indigenous and Cross-bred Cows in Smallholder Dairying Systems in a Semi Arid Area of Zimbabwe (R7010)

Lovemore Nyoni, Marion Titterton, Humphrey Hamudikuwanda And Charles Mutisi

Department Of Animal Science, University Of Zimbabwe, P.O. Box MP167, Harare, Zimbabwe.

Abstract

Body condition score (BCS) and lactation response were assessed in 20 indigenous and 20 Jersey indigenous cross-bred dairy cows, in a smallholder situation, in a semi arid area of Zimbabwe, after supplementation with sweet sorghum-lablab silage in late pregnancy. Cows were fed daily no silage (control), 3kg silage dry matter (DM), 6kg silage DM or *ad lib* silage for two months. The BCS of the supplemented groups were higher ($P < 0.05$) at calving than the unsupplemented group. The BCS of the cows in the 6kg DM silage and *ad lib* groups were higher ($P < 0.05$) throughout the post-partum monitoring period than the 3kg DM and control groups. The cows in the 3kg DM silage group were not significantly different from the unsupplemented group between 2 and 18 weeks after calving. The indigenous breds had higher BCS ($P < 0.05$) throughout the monitoring period than the cross-breds. Within bred there were no differences ($P > 0.05$) in BCSs, except between the Jersey-Tuli and Jersey-Nkone crosses, four to eight weeks after calving. Milk yield and lactation length was unchanged ($P > 0.05$) across the treatment groups. However, cross-bred cows gave more milk over a longer lactation period ($P < 0.05$) than the indigenous cows. It is concluded that supplementation before calving improved body condition, there was no improvement in milk yield.

Introduction

Numbers of commercial dairy farmers have declined, from 581 in 1980 to 328 in 1999. Milk production is around 180 million litres per annum while demand is 350 million litres (DDP, 1999). The dairy development programme (DDP) is encouraging smallholders to make up this shortfall in production, but many of their farmers are smallholders in semi-arid areas and, therefore, have severe dry season feeding difficulties (Mupunga and Dube, 1993; Machaya, 1994; Mupeta, 1999). Home-grown feeds are the most cost-effective sources of supplementation. For semi arid areas, sweet sorghum is preferred to maize, because greater drought tolerance results in higher yields (Havilah and Kaiser, 1992). However most smallholder farmers have no experience with forage conservation (Mupeta, 1999).

The small hardy indigenous breds, Mashona, Nkone and Tuli, form the basis of the smallholder herd. However, they have not been selected for milk yield, that is low (Mupunga *et al*,. 1993). The most suitable bred or cross-bred has still to be identified. This study seeks to assess the benefits of dry season supplementation of cows, before calving, as an option to improve bcs and subsequent milk production.

Materials and Methods

Site. The study was conducted at Matopos Research Station, in Matebeleland South Province of Zimbabwe. The site lies 20°S and 28°E and is 1340m above sea level. The mean maximum temperatures in summer are around 30°C and in the cool dry season around 20°C. The area receives low to moderate annual rainfall (570mm), mainly during the rainy season, between November and March. The area also experiences periodic droughts. The vegetation is mainly savannah woodland with acacia trees and shrubs being the predominant tree species. The pasture quality and quantity varies seasonally, being very good and abundant in the rainy season, but turning poor and scarce in the dry season (Ward et al, 1979). At the time of this study there was a drought (rainfall, 380mm) which reduced the yield and quality of silage (Titterton *et al.*, in press).

Animals. A total of 40 primi- and multiparous cows, 20 indigenous (10 Tuli and 10 Nkone) and 20 Jersey cross-breds (10 Jersey x Nkone and 10 Jersey x Tuli) were selected. Their initial body weight was 363 ± 52 kg and body condition score 2.5. Supplementation was offered from late August (two months before their estimated calving date) to November 1999. Data collection continued to July 2000. During the lactation period, calves suckled briefly in the morning, before milking, and were allowed to run with their dams after milking until separation in the evening. This is similar to smallholder practice.

Silage. The silage was produced from intercropped sweet forage sorghum (sugargraze) and *Lablab purpureus* (Dolichos beans) made in plastic bags using a technology developed by Titterton *et al.*, (in press) (chemical composition is shown in table 1).

Table 1. Dry Matter (DM) (*g/kg*), *chemical composition* (*g/kg* DM), *pH*, ME MJ/*kg and ammonia* N (AN) *of the sweet sorghum – lablab silage.*

DM	CP	Ash	ADF	NDF	MADF	DOM	pH	ME	AN
370	93.3	110	350.3	611	45.2	55.6	4.1	8.34	7.3

Treatments. Cows were allocated by bred to the four silage (sweet sorghum-lablab) supplementation levels. The four dietary treatments were as follows: 1),unsupplemented (control); 2), 3kg DM (one bag) silage /cow/d; 3), 6kg DM silage (2 bags) silage/cow/d; and (4), *ad lib* silage(average 12 kg, or 4 bags)/cow/day. The first three groups had access to natural rangeland. From calving, all cows received 2 kg /d of a 14% crude protein dairy meal.

Body condition scores. These were monitored weekly from the start of the supplementation period until 18 weeks after calving. The five-point scale (1-emaciated and 5-obese; Mulvany, 1981) was used. The same two people scored the cows on each occasion. Scoring was carried out by palpation of the transverse vertebrae and tail head to estimate the amount of fleshing, or fat cover in these two areas.

Lactation. Milking commenced 8 days after calving to ensure all the colostrum was available to the calves.. The cows were hand milked once a day, in the morning, and milk yield was recorded. Prior to milking, calves were allowed momentary suckling to stimulate the milk let-down response. Milking continued until the yield fell to 0.2 kg/d.. The lactation length was recorded as the number of days, from the eighth day after calving until the cow was dry..

Statistical analysis. Data on milk yields and lactation length were analysed using the GLM procedure of SAS (SAS, 1994). The model used was:

Yijkl = ì + Ti + Bi + (TB)ij + Pk + eijkl

where Yijkl = milk yield, lactation length; ì = population mean; Ti = fixed effect of supplementation level (I=1,2..4); Bj = fixed effect of bred (j=1.2..4); (TB)ij = supplementation level x bred interaction; Pk = fixed effect of parity (1and2); eijkl = random error.

Body condition score data, being discrete data were subjected to square root transformation (Gomez and Gomez, 1984) before the trends were analysed using the PROC MIXED procedure of SAS (SAS, 1994) for repeated measures analysis. The model used was :

Yijklmn = m + Ti + Bj + Pk + Wl + (TxB)ij + (TxW)il + (TxBxW)ijl + (BxW)jC(TxB)ijm + eijklmn Where:

Yijklmn = response variable (body condition)m = population mean; Ti = fixed effect of level of supplementation (i = 1,2..4);Bj = fixed effect of bred (j = 1,2,..4); Pk = fixed effect of parity(k = 1,2); Wl = fixed effect of time (week) (l = 1,2 …..20 weeks); (TxB)ij = treatment x bred interaction; (treatment x time interaction; (TxBxW)ijl = treatment x bred x time interaction; (BxW)jl = bred x time interaction; C(TxB)ijm = random effect of m^{th} cow in the i^{th} group and j^{th} bred, Eijklmn = random error.

Results

Because severe drought limited the growth of legumes, their inclusion rate in the silage was lower than anticipated, thereby reducing both yield and quality of the silage. During the trial one cow, in the control group, died. Her data was discarded.

Effect of prepartum supplementation on body condition scores.. At calving, cows in the supplemented groups had higher BCS ($P < 0.05$) than the control group . In all treatment groups, cows lost condition in early lactation, before beginning to recover five weeks-post calving. Treatment 2 (3 kg silage DM) cows had BCSs higher ($P < 0.05$) than the control group up to two weeks post-partum, after which the scores remained similar ($P > 0.05$) to the end of the monitoring period. The change in BCS from pre-feeding to calving was significant ($P < 0.05$) with the control group losing most and the *ad-lib* group gaining most (figure 1).

Figure 1: Changes in body condition scores in cows unsupplemented or supplemented before calving.

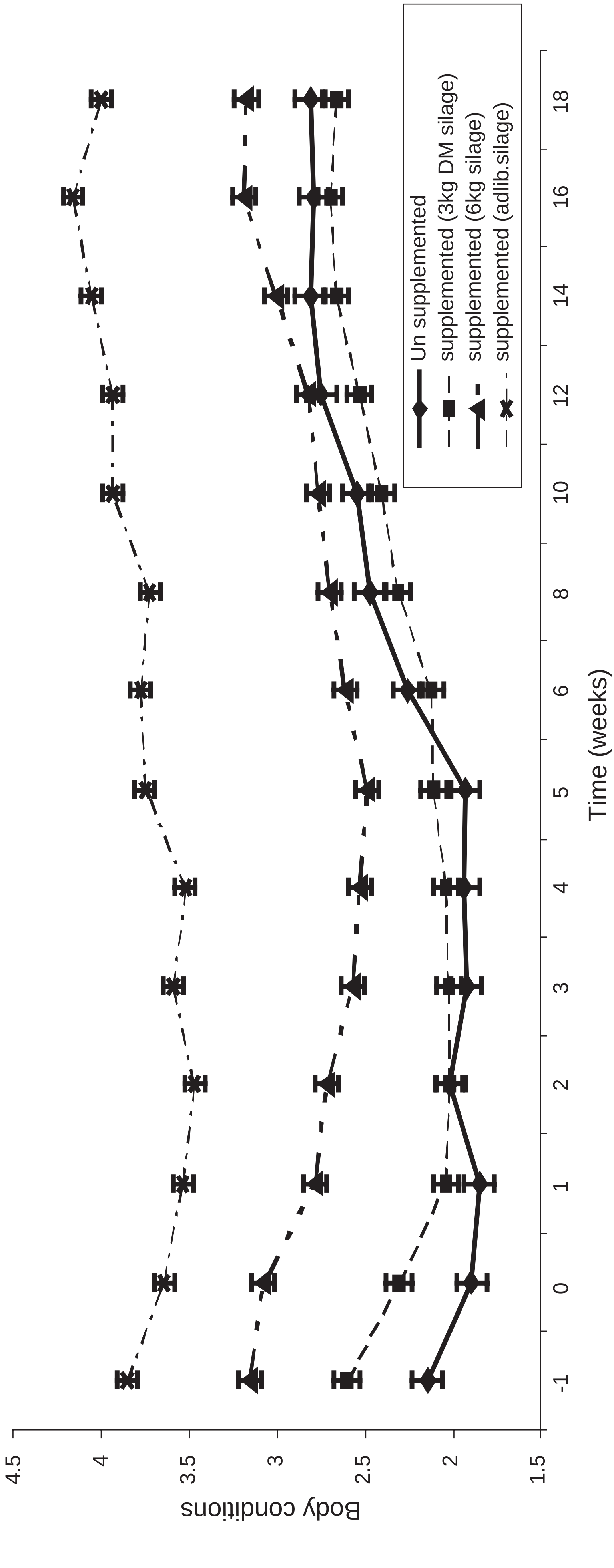
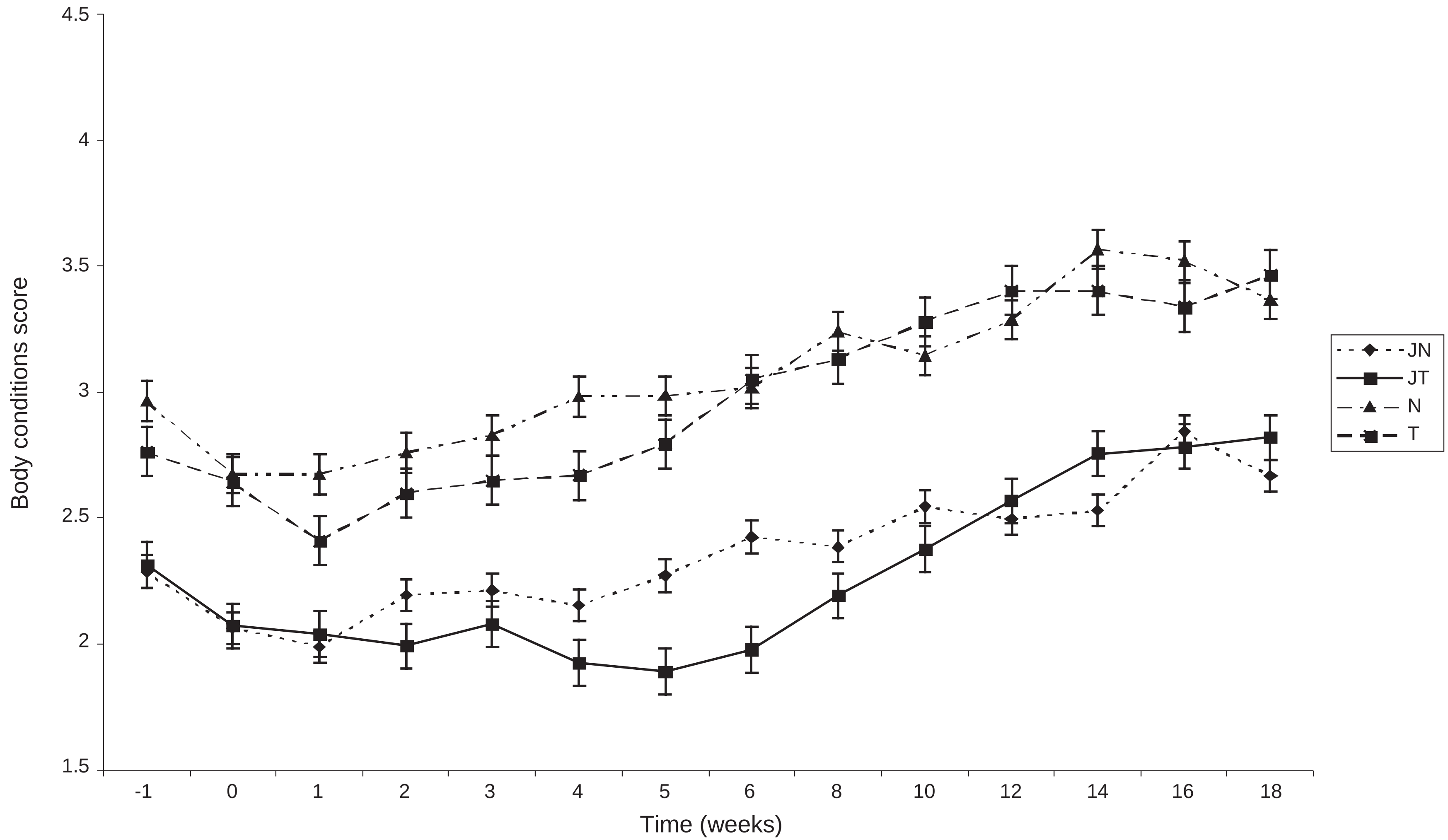


Figure 2: Changes in body condition scores in the indigenous (Nkone) (N) & Tuli (T)) and cross-bred cows (Jersey (J) x Nkone and Jersey x Tuli) from 1 week before calving to 18 weeks after calving.



The indigenous (Tuli and Nokone) had higher BCS ($P < 0.05$) than the cross-breds (Jersey x Nkone and Jersey x Tuli) from calving to the end of the monitoring period 18 weeks later. Between the indigenous groups there were no differences ($P > 0.05$) in the BCS, except for week 1 and week 4 post calving. The Jersey Nkone and Jersey Tuli had similar BCS ($P > 0.05$) except between weeks 2-8 after calving, when BCS of the Jersey Nkone was higher ($P < 0.05$) (Figure 2).

Milk yield. The cross-bred cows had higher daily and total lactation yields and longer lactations ($P < 0.05$) than the indigenous breds. Between the two indigenous (Tuli and Nkone) breds and between the two types of cross-bred there were no differences ($P > 0.05$) in milk yield and lactation length (Table 2). Supplementation did not affect milk yield or lactation length (Table 3).

Table 2: Milk yield (kg) and lactation length (d) in indigenous (Nkone, N; Tuli, T) *and cross-bred* Jersey (J) *cows*.

	Breds			
	JN	JT	N	T
Daily milk yield	2.8^{a} ±0.20	3.27^{a} ±0.18	1.1^{b}±0.19	1.2^{b}±0.19
Lactation yield	650^{a} ±46.8	760^{a} ±38.9	230^{b}±40.0	248^{b}±49.4
Lactation length	247^{a} ±11.0	242^{a} ±9.0	195^{b} ±9.7	195^{b} ±10.0

Least square-means with the same superscript in a row are not significantly different ($P > 0.05$)

Table 3: Milk yields (kg) and lactation lengths (d) for cows (indigenous, Nkone (N) and Tuli (T); cross-bred Jersey (J)) at four levels of silage supplementation

		Supplementation levels			
	Bred	Control	3kgDM /d	6kgDM /d	Ad-lib 12 kg/d
	JN	599^{1a}±89.6	621^{1a} ±70	630^{1a} ±89.6	760^{1a} ±89.6
Lactation yield	JT	660^{1a} ±70	875^{2a} ±87	775^{1a} ±85	731^{1a} ±75
	N	234^{2a} ±85	311^{3a} ±70	213^{2a} ±70	164^{2a} ±89.6
	T	304^{2a} ±89.6	122^{3a} ±85	335^{2a} ±70	232^{2a} ±75
	JN	2.8^{1a} ±0.41	2.7^{1a} ±0.32	2.5^{1a} ±0.41	3.3^{1a} ±0.41
Daily milk yield	JT	2.7^{1a} ±0.32	3.7^{1a} ±0.41	3.2^{3a} ±0.39	3.2^{1a} ±0.35
	N	1.1^{2a} ±0.39	1.6^{2a} ±0.32	1.1^{2a} ±0.32	0.7^{2a} ±0.41
	T	1.4^{2a} ±0.41	0.8^{2a} ±0.39	1.6^{12a} ±0.32	1.3^{2a} ±0.30
	JN	237^{1a} ±21	237^{1a} ±16	250^{1a} ±22	262^{1a} ±22
Lactation length	JT	246^{1a} ±16	233^{1a} ±21	259^{1a} ±21	230^{1a} ±18
	N	216^{1a} ±20.5	191^{21a} ±17	204.5^{1a} ±17	168^{2a} ±22
	T	221^{1a} ±21.6	163^{2a} ±21	209^{1a} ±19	185^{2a} ±18

Means with same letter in each row are not significantly different and means with the same number in each column are not significantly different ($P > 0.05$)

Discussion

When the cows calved, those in the unsupplemented group had lost more condition than the supplemented groups. This confirms the findings of Topps, (1977) that cattle in the tropics lose weight in the dry season due to the poor quality of natural pastures, often with crude protein contents as low as 3%. Two of the supplemented groups (6 kg silage DM/D and a*d-lib* silage) gained condition by the time of calving, thus showing that at these levels sweet sorghum-lablab silage was effective in reducing dry season nutritional stress. The indigenous cows had higher BCS than their cross-bred counterparts, probably due to an inherent ability to utilise lower quality feeds more efficiently (Hunter and Siebert 1990). Similarity between unsupplemented and supplemented cows in terms of milk production and lactation length could be an indication that an improved BCS at calving does not give any milk yield advantage for indigenous and cross-bred cows. The poor milk yields could also have been due to poor grazing during the post calving period.

High yielding cows must calve with adequate reserves for mobilisation to help meet energy and protein requirements of early lactation (Erb *et al*., 1990). However, Mupeta, (1999) in his study of Zimbabwean smallholder owned cows reported that B*os indicus* cattle gave priority to maintenance of body condition rather than milk production. Jingura (2000) working with smallholder cows reported that cows were not milking 'off their backs'. Khombe *et al*.,(in press) also state that indigenous cows on a higher plane of nutrition do not produce more milk but tend to put on weight. In this study, however, slight mobilisation of body tissues occurred, as evidenced by the drop in BCS, especially in the unsupplemented and 3kg silage groups. Because of a lower ability to mobilize body reserves for milk production, B. *indicus* cows and their crosses may not be able to utilise fat reserves in early lactation to the same extent as B. *taurus* cows.

The milk yields obtained (Table 3) in this study are slightly higher than those reported for the same breds by Hamudikuwanda *et al*., (in press) (0.7 kg and 2.47kg/ day for indigenous and cross breds respectively), but lower than the 5.5kg/day for cross-bred cows reported by Mupeta (1999). The lactation length of 194 days for indigenous cows was slightly higher than the 150 days reported by Mupunga and Dube (1993) and 180 days by Henson, (1992). The lactation length of 243 days in this study is comparable with the 250 days for the cross-bred cows reported by Mupeta (1999).

References

DAIRY DEVELOPMENT PROGRAMME (DDP) (1999). A *report given at the* A*nnual* S*mallholder* D*airy* P*roducer of the* Y*ear at* R*usitu*, C*hipinge on* J*uly* 30 1999. DDP, Harare, Zimbabwe.

ERB, H. N., SMITH, R D., SNIFFEN, C. J., CHASE, L. E. and COOPER, M. D. (1990). Relationship of changes in condition score to health in Holsteins. J*ournal of* D*airy* S*cience*, **73**: 3132-3140.

GOMEZ, K. A. and GOMEZ, A. A. (1984). S*tatistical* P*rocedures for* A*gricultural* R*esearch*. 2nd *edition*. John Wiley and Sons. New York. USA.

HAMUDIKUWANDA, H., MUNYORO, E., MUTISI, C., BALL, P. and MOYO, S. (in press). Smallholder dairy production and research in the Matabeleland provinces of Zimbabwe. UZ/RVAU/DANIDA- ERECA P*roject* R*eview* W*orkshop*, H*arare*, Z*imbabwe*, J*anuary*, 2000. University of Zimbabwe, Harare.

HAVILAH, E. and KAISER, A.G. (1992). Sorghums for silage: a review. In: P*roceedings* S*econd* A*ugust*. S*orghum* C*onference*, 4-6 F*ebruary* 1992. Gatton. pp.338-354.

HENSON, B. R. (1992). Dairy farmers and rural Zimbabwe. In: P*roceedings of* D*airy* M*arketing in* S*ub*-S*aharan* A*frica* S*ymposium*. . Brokken, R.F. and Seyoum, S. (eds.) ILCA, Addis Ababa. pp. 279-292.

HUNTER, R.A. and SIEBERT, B.D. (1985). Utilization of low quality roughage by B*os taurus* and B*os indicus* cattle. B*ritish* J*ournal of* N*utrition*, **53:** 637-648.

JINGURA, R. M. (2000). Fodder production and use of farm-grown foods in the smallholder dairy sector: A participatory approach to designing feeding systems in Gokwe South District, Zimbabwe. Ph.D. Thesis. University of Zimbabwe, Harare.

KHOMBE, T., MHLANGA, F. N. and MAKUZA, S. (in press). Evaluation of indigenous livestock genotypes in Zimbabwe. W*orkshop* (1999)D*epartment of* A*nimal* S*cience*. University of Zimbabwe, Harare.

MACHAYA, A.C. (1994). Some factors affecting smallholder dairy production in Zimbabwe. J*ournal of the* Z*imbabwe* S*ociety of* A*nimal production*, **6:** 61-67.

MULVANEY, P. (1981). D*airy condition scoring*, H*andout* N*o*.4468. National 1nstitute for. Research in Dairying. Shinfield, Reading, UK.

MUPETA, B. (1999). Studies on milk production: The potential of sunflower residue as a source of protein for moderate milk yield in cross-bred (*Bos taurus* x *Bos indicus*) cows in the smallholder dairy sector in Zimbabwe. PhD Thesis. University of Zimbabwe, Harare.

MUPUNGA, E. G. and DUBE, D. M. J. (1993). Smallholder dairy development programme in resettled and communal areas in Zimbabwe. In: *Proceedings of Future of Livestock Industries in East and Southern Africa Workshop*, *July* 1992. Kategile, J.A. and Mubi, S. (eds.). ILCA, Addis Ababa. pp. 165-176.

STATISTICAL ANALYSIS SYSTEMS (SAS) (1994). SAS *Guide for personal computers*. SAS, Northern Carolina, USA.

TITTERTON, M., ASHBELL, G., KIPNIS, T. ZEITZMANN, Z., MHERE, O and MAASDORP, B. V. (in press). Conservation of forages for dry -season feeding of livestock in the semi-arid areas of the tropics. In: *Proceedings joint* FAO-ZSAP *Workshop on Strategies for Dry Season Feeding of Animals in Central and Southern Africa*, 25-27 *October* 1999, *Harare*, *Zimbabwe*.

TOPPS, J. H. (1977). The relationship between reproduction and undernutrition in beef cattle. *World Review of Animal Production* 13. FAO, Rome. pp. 43-49.

WARD, H., RICHARDSON, F.D., DENNY, R.P. and DYE, P.J. (1979). Matopos Research Station: A perspective. *Rhodesian Agricultural Journal*, **76**: 5-18.

Questions and Answers

What was the mean nutritive value of the silage produced, in particular, crude protein and dry matter? Had wilting prior to ensiling been tried?

Crude protein was as high as legume maize silage, dry matter is 28%. Wilting did not have much effect due to the drought.

What is the time taken to harvest and process the silage?

This had been monitored since 1998: three hectares takes 8 days for 3 people to process. This is difficult to measure in relation to browse as the project used machinery. Also, increased labour is involved in stripping the trees although once the leaves are stripped they do not have to be chopped.

Has socio-economic analysis had been carried out?

Cost benefit analysis based on 1999 costs show the cost of 1 bag of silage is equal to the sale value of 7kg of milk.

How does the use of arable land for forage production affect the balance in the system?

This will be assessed at a later stage.

Is there more than one method of storing silage other than using plastic bags?

The use of plastic bags was due to feedback from the DDP. Plastic bags are easier for women to use.

Profit calculation

Care should be taken to make the silage well: adequate protein (i.e. not sugar alone) is required, which is why legumes were grown with the forage sorghum. There is an estimate of $5 profit per bag, this is worked out of as the average cost of buying the meal, minus the cost of the production of silage, and the cost of the bag. The project team are carrying out fuller cost investigations as part of the project.

Could silage be blended with dairy meal and other concentrates? In South Asia, the idea of making silage in bags is revolutionary.

Yes, but probably at the point of feeding to allow careful use of expensive concentrates.