A survey of cashmere production from indigenous goats in KwaZulu-Natal

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Introduction

KwaZulu-Natal, with 13.2% of the national goat population, ranks third after the Eastern Cape (48.9 %) and Northern Province (13.8%), in terms of goat numbers (Directorate: Agricultural Statistics, 1999). In August 1995, KwaZulu-Natal had 113 198 goats in commercial areas, mainly Boer goats, and 710 493, approximately 85%, in the less developed areas, the majority of these being of the indigenous type ("Zulu" goats). Goats in less developed areas fulfil multiple roles that can hardly be equaled by other ruminant species and this valuable resource should be explored. Despite their apparent importance to agriculture, in less developed areas in particular, there is a lack of basic information regarding the potential performance of goats. There is an awakening of interest in the role of goats in rural development in KwaZulu-Natal.

Goats are generally kept for their meat, milk, skins, for controlling bush encroachment and in developing areas, mainly for ceremonial purposes. There is, however, a potential for obtaining additional income ("adding value") by making use of the fine, soft undercoat (cashmere) produced by some breeds. Worldwide there are many goat breeds which possess the ability to produce a fleece consisting of two distinct fibre populations (fine and coarse - Photo 1) of which the South African Boer goat and Savannah goat and other indigenous goats are good examples.

What is cashmere? Cashmere is the fine (4 to 30 micron), soft unmedullated undercoat (down/cashmere - Photo 2). This component is retained after removing (dehairing) the coarse outer coat or guard hair component (31 to 200 micron) from a combed sample. Combing is carried out with the goat standing up (Photo 3). The combing is done in a downward direction following the pattern of the hair (Photo 3). Colour ranges from white to brown (Photo 4). Good quality cashmere is white in colour and has a maximum fibre diameter of 18.5 micron (Braun, 1996) and a minimum length of 4 cm (Braun, 1999 - personal communication). Goats that produce cashmere possess the inherent ability to respond to changing

Photo 1 Fleece consisting of two distinct fibre populations - fine and coarse.

Photo 2 Combed sample. Soft unmedullated undercoat (cashmere) and the coarse outer coat or guard hair.

Photo 3 Combing is done in a downward direction following pattern of the hair.

day length and climatic conditions causing an active fibre growth and fibre shedding period. Cashmere-producing goats grow fibre between the longest and the shortest day after which it is shed (Sumner & Bigham, 1993). Down grows actively from December to June for protection against the cold winters and the fibre is shed during spring (July to September). Overcoming the challenges to goat production includes addressing the lack of baseline information, such as the potential for cashmere production in KwaZulu-Natal and the possible income to be generated. The objectives of the study were firstly to determine the quality and quantity of cashmere produced by goats in KwaZulu-Natal and secondly to determine the possible income to be generated from this fibre by communal and commercial goat farmers.

Photo 4 Cashmere colour ranges from white to brown.

Materials and Methods

The Farming Systems Research Section, Extension staff, and other researchers of the KwaZulu-Natal Department of Agriculture and Environmental Affairs, in cooperation with Mr Albie Braun from the CSIR, Division of Textile Technology in Port Elizabeth, embarked upon a project to determine the quality and quantity of cashmere produced by goats in KwaZulu-Natal. During 1997 and 1998 goats with visual evidence of possessing cashmere were combed at the following sites (number of goats combed in brackets); Pongola (16), Wasbank (21), Bartlow Combine (6), Kranskop (18), Estcourt (42), Colenso (15), Cedara (6), Mpophomeni (4), Impendle (35), Bergville (8) and the Kokstad area (17). 87% of the goats combed during the two seasons were "Zulu" goats. Goats combed were from communal small-scale farmers (Photo 5), commercial farmers (Photo 6), a stud and research stations. Goats possessing cashmere were combed at 2-weekly intervals from mid-July onwards until no more sample was obtained. The combing of goats was terminated towards the end of September. At each combing session goats were combed until all the loose down fibres were combed out. If an insufficient quantity of fibres was obtained from the first couple of

Table 1 The mean December and June temperatures, mean sunshine hours and mean rainfall for the areas where goats were combed

Area	Mean temperatures (°C)		Mean sunshine (h)	Mean rainfall (mm)
	December	June		
Pongola	25.4	17.1	7.6	588
Bartlow	23.7	16.1	7.1	661
Kranskop	19.5	11.8	6.6	836
Wasbank	20.8	11.2	7.2	778
Colenso	20.7	11.1	7.4	708
Estcourt	19.5	10.5	7.2	714
Bergville	20.2	9.7	6.5	971
Impendle	18.8	11.0	6.7	967
Mpopomeni	19.1	11.4	6.9	838
Kokstad	18.1	10.4	7.1	751

strokes it was assumed that the goat was not yet shedding, and it was left until the next visit. After each combing the material obtained was weighed to measure raw yield per combing. Material from individual animals was kept separate and marked according to the age and sex of the goat. At the end of the combing period total production per goat was measured. The combed material was sent to the Textile Division (TEXTEC) of the CSIR in Port Elizabeth for micron and clean yield analysis.

Regression analysis (Genstat 5, 1998, Lawes Agricultural Trust) was used to describe the effect of (1) mean sunshine hours for June and December, (2) annual rainfall, (3) minimum temperature and (4) maximum temperatures for June and December in the areas where goats were combed on cashmere yield (y) and fibre diameter (y). The climate information was supplied by the Natural Resource Section of the KwaZulu-Natal Department of Agriculture and Environmental Affairs (Table 1).

Results and Discussion

The number of goats combed, mean sample weight combed/goat, fibre diameter and clean yield of goats combed at the different sites are summarized in Table 2. Goats combed in the Bergville area (Obonjaneni community) and in the Impendle area (Photo 7) tended to produce more cashmere than the goats combed in the other areas. The mean fibre diameter of the samples was finer than the 18.5 micron required for the fibre to qualify as cashmere (Braun, 1996). The down (cashmere) fibre diameter tested between 12.79 and 18.79 micron, with an average diameter of 15.76 micron.

Photo 5 “Zulu” goats in a communal small-scale system.

Photo 6 Boer goats in a commercial system.

Photo 7 "Zulu" goat combed in the Impendle area.

Table 2 Number of goats combed per site, mean weight of material combed per goat, fibre diameter and clean yield of combed samples from goats combed during 1997 & 1998.

Area	Parameters			
	Number of samples analysed (goats combed)	Average weight combed/goat (g)	Fibre diameter (micron)	% Clean yield
Pongola (Zulu goats)	7	7.12 ± 4.27	15.2 ± 0.846	76.3 ± 7.32
Bartlow Combine (Zulu goats)	6	3.9 ± 2.45	14.7 ± 0.23.	83.0 ± 8.19
Wasbank (Zulu goats)	19	6.29 ± 6.42	15.5 ± 1.39	69.9 ± 12.56
Obonjaneni (Zulu goats)	8	19.8 ± 11.67	15.9 ± 0.63	68.3 ± 8.23
Colenso (Zulu goats)	14	9.1 ± 5.59	15.3 ± 1.35	84.9 ± 10.93
Kranskop (Zulu goats)	19	5.0 ± 4.72	15.8 ± 1.4	69.7 ± 14.64
Estcourt (Zulu goats)	33	8.04 ± 11.24	15.3 ± 1.54	68.9 ± 12.9
Estcourt (Boer goats)	5	10.2 ± 3.48	16.4 ± 1.34	74.4 ± 6.72
Cedara (Saanen x Zulu)	13	3.55 ± 7.11	14.9 ± 3.06	60
Mpopomeni (Zulu goats)	4	12.98 ± 8.7	15.2 ± 1.22	84.7 ± 8.6
Impendle (Zulu goats)	32	29.29 ± 17.85	16.1 ± 1.39	74.9 ± 9.88
Kokstad (Zulu goats)	16	6.77 ± 10.26	16.1 ± 10.26	74.2 ± 9.73

The variation in annual cashmere yields obtained from goats combed during 1997 and 1998 (n = 188) is summarized in Table 3. Results indicate that goats in KwaZulu-Natal show a huge variation in annual cashmere production. Cashmere yields varied from 0.04 to 70.65 g/goat. The current survey show that 68% of goats combed produced less than 10 g per season. Results obtained by Braun (1998) showed that Boer- and Savannah goats produced an average down weight of approximately 25 g/goat and traditional goats an average of approximately 12 g/goat, with a coefficient of variation as high as 55%, indicating a considerable variation in down weight within breeds as was found in the current investigation.

Table 3 Variation in cashmere yields exhibited by goats in KwaZulu-Natal combed in 1997 and 1998

Weight (g)	Number of goats combed	% of goats combed	Average weight (g)
≤10	128	68	3.86 ± 3.02
11 – 20	26	14	14.89 ± 2.65
21 – 30	14	7	25.15 ± 2.88
31 – 40	9	5	34.10 ± 2.71
≥41	11	6	51.97 ± 9.14

The variation in yield indicates a good genetic pool for future improvement through selection (Braun, 1998). Goats which are good cashmere producers generally exhibit an obviously wooly neck and such goats could be used as future breeding stock. The high genetic correlation (0.65 to 0.92) between down length and down weight (Sumner & Bigham, 1993) means that farmers can utilise down length as an indirect estimate of down weight. This will reduce the fleece testing costs associated with dehairing the fleece to estimate down yield. Down length could easily be measured on the animal prior to harvesting.

The selection for down weight in cashmere-producing goats will also result in an increase in both down length and down diameter and some reduction in live weight (Sumner & Bigham, 1993). The live weight and diameter responses are both undesirable. A reduction in live weight may lead to reduced fertility, and an increase in diameter will result in animals producing down outside the accepted cashmere diameter limit of 18.5 micron (Sumner & Bigham, 1993). According to Sumner & Bigham (1993) the principle non-genetic factors affecting fleece and fibre characteristics in both sheep and goats are age, nutrition, physiological status, disease and shearing regime. Norton (1998) also found patterns of cashmere growth to be affected by age, sex, pregnancy and lactation, as well as photo-period. All the goats in this survey were in grazing systems. During summer months the goats in the communal systems rely entirely on veld grazing. Some graze within the residential areas while others are taken further away to graze communal land and mountain slopes. The nutritive value of veld in sourveld areas drops from March onwards limiting animal performance over the winter period. According to Norton (1984) cashmere production appears relatively insensitive to the level of nutrition under grazing conditions although guard hair production may be responsive. There is no effect of increasing protein or energy intake on cashmere growth or fibre diameter of goats who are at maintenance level or are actively growing (Norton, 1984). Cashmere production is however depressed when goats lose weight for a significant period during the period of cashmere growth (Norton, 1998). Cashmere growth in does is maximised when kidding and lactation falls outside the growth period, when does are gaining weight and when they are harvested twice during the growth phase (Norton, 1998). Environmental factors such as location and winter temperatures seem to play an important role in the initiation and development of secondary follicles (Smuts, 1997).

The fleece characteristics of KwaZulu-Natal goats in different farming systems are summarized in Table 4. The cashmere from goats combed on Cedara and Bartlow Combine showed exceptionally fine fibre diameter. The mean percentage of down yield in the combed samples varied between 60 and 83% with high standard deviations. Indigenous goats combed in small-scale communal systems showed the highest yields of cashmere, but with a higher standard deviation compared to goats in the other systems. The boer goats in the commercial system showed on average the lowest cashmere yields. It is clear from the data that enough variation exists in all the fleece characteristics to allow for the identification of genetically superior animals to be used in breeding programmes to increase the quality and quantity of cashmere.

Table 4 Fibre characteristics of cashmere produced by goats in different farming systems in KwaZulu-Natal

	Farming system				Research station	
	Small-scale communal (Zulu goats)	Commercial (Zulu goats)	Stud (Boer goat)	Commercial (Boer goat)	Cedara (Saanen x Zulu goats)	Bartlow (Zulu goats)
n	99	24	5	17	10	6
Micron: Mean	15.7	15.5	16.4	15.8	14.7	14.7
SD	1.39	1.28	1.34	1.40	1.26	0.23
Unscoured (g)						
Mean	15.8	9.5	10.2	5.0	5.9	3.9
SD	16.36	8.23	3.48	4.71	8.99	2.45
% Down yiels						
Mean	72.7	77.0	74.4	69.7	60.0	83.0
SD	10.71	14.09	6.72	11.64	18.28	8.19
[1]Cashmere (g)						
Mean	11.3	6.6	7.6	3.6	4.38	3.1
SD	11.53	5.74	3.01	3.46	7.12	2.14

[1]Scoured weight x % down yield

The length of the fibres was not measured. According to the CSIR (A Braun, personal communication, 1999), the fibres of combed samples in South Africa are too short for a successful dehairing process and also influence the quality of cashmere products negatively.

Regression analysis

The regression equation describing the relationship between fibre diameter (x) and cashmere yield (mass) (y) was: y = -13.6 + 1.470 x ($S_{y.x}$ = 10.1; r^2 = 2.9; P = 0.027; n = 134). Although the percentage of variance accounted for is very low, the relationship shows that an increase in fibre diameter will increase the cashmere yield, as was found by Sumner & Bigham (1993). Bigham *et al*. (1993) found phenotypic and genotypic correlations between down weight and fibre diameter in New Zealand Cashmere goats yearlings to be 0.50 ± 0.03 and 0.81 ± 0.08 respectively, presenting an unfavourable relationship when selecting for heavier fleeces but finer down.

The regression equation describing the relationship between cashmere yield (y) and the mean sunshine hours (x), mean rainfall (x) and mean temperature for June (x) and December (x) are summarised in Table 5.

Analysis showed that cashmere yields decrease significantly with higher sunshine hours and with higher rainfall. Temperature, in this study, played no significant role in cashmere yield, but there is an indication that goats in areas with high temperatures produce less cashmere.

Table 5 The relationships between cashmere yield (mass) (y) and the mean sunshine hours, mean rainfall and mean temperature for June and December

Cashmere yield	Equation	n	r^2	P	S_{yx}
y =	135.5 – 17.75 x sunshine hours	134	0.31	0.001	8.51
y =	-30.25 + 0.05031 x rainfall	134	0.362	0.001	8.18
y =	27.9 – 0.968 x Dec temperature	134	0.049	0.261	5.49
y =	19.7 – 0.97 x June temperature	134	0.079	0.220	5.40

The regression equations describing the relationship between fibre diameter (y) and the mean rainfall (x) and December mean temperature (x) are summarized in Table 6.

Table 6 The relationships between fibre diameter (y) and mean rainfall and December mean temperature (x)

Cashmere yield	Equation	n	r^2	P	S_{yx}
y =	14.194 + 0.00198 x rainfall	134	0.027	0.027	1.30
y =	19.45 – 0.1845 x Dec temperature	134	0.053	0.004	1.29

Although significant relationships were found the percentage of variance accounted for is too small to read anything into these relationships.

Possible income to be generated from cashmere

TEXTEC, CSIR in Port Elizabeth currently pays R 105/kg for white cashmere with fibre diameter below 16.5 micron. At this price goat owners in KwaZulu-Natal would earn an average amount of R 1.17 per goat for cashmere harvested over a season, based on the annual cashmere yields given in Table 3.

For a 50 goat flock, the annual income from cashmere would be approximately R 60. In Impendle, the average flock size was found to be 13, resulting in a potential annual cashmere income of approximately R 15.21 per farmer. This is not a positive scenario for a future cashmere industry, especially when the potential industry relies on the cashmere produced by approximately 710 500 goats in the less developed areas of KwaZulu-Natal.

A woman's jersey uses 400 to 500 grams of cashmere (down) fibre. Results from the survey show that cashmere from approximately 60 goats is required for one jersey. The farmer (goat owner) will receive only R 70 for this quantity of cashmere, while in the main centres of South Africa, the finished product will retail at between R 750 and R 1000.

Conclusion

A large global market exists for the finer and higher quality textile fibres and therefore it is imperative for South Africa to utilise the potential of the indigenous goats to the fullest (Braun, 1998). The fibre diameter and clean yield results of the study indicate that goats in KwaZulu-Natal produce good quality cashmere but whether the quantity of down warrants harvesting is questionable.

The amount of cashmere needed to justify combing is debatable. If the goats are handled daily and kraaled, it would be fairly simple for small-scale farmers to comb them. Results showed, however, that in order to establish a cashmere industry in KwaZulu-Natal, higher yields will have to be obtained (neither the down fibre weights nor the fibre lengths are commercially acceptable). Data show that enough variation exists within the goat population in the Province to be able to improve yields through a goat selection and breeding programme. The negative correlation found between down weight and live weight needs to be taken into consideration. At present, goat owners require an infrastructure and an easily accessible market to be in place for their cashmere in order to stimulate any interest in this product.

Acknowledgments

The authors thank Steve Goetze, Iona Stewart, Ron Bennett, Extension staff, Staff on the Bartlow Combine Research Station, Albie Braun, CSIR -Textile Division, Port Elizabeth and all the small-scale and commercial farmers who participated in this survey for their cooperation and inputs.

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