

CONTRACT REVIEW

HIGH QUALITY, CONTAMINANT-FREE CASHMERE

INTRODUCTION

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Australia does not have a cashmere breed of goat (Couchman 1987) but relies on fibre produced as down on feral sourced goats. Since this fibre can be separated at the mill from the associated guard hair, shearing is the common method of harvesting. Overall production thus comes from the shearing of feral goats, feral derived goats (bush) involved in weed control, upgraded bush goats and specially selected improved goats. The difficulties/challenges posed by this heterogeneity are immense and it is a tribute to the Australian industry that having researched the product they are now exporting the technology and genes throughout the world.

High quality is paramount when dealing with a luxury product such as cashmere where desirable properties of softness, comfort and lightness are affected by fibre diameter; dye colour by fibre colour and louse casing contamination; pilling by fibre length; and lustre and 'life' by unexplained factors. In fibre from some overseas countries, quality can also include freedom from chemical and bacterial spore contamination and freedom from contamination by other animal fibres.

Australia exported 14 tonnes of cashmere in 1989. This small but significant amount (\$1.7m) is produced by an industry that is well organised with centralised selling, sale by objective measurement, price grids based on quality, breeding indexes and a small but effective research support. Indeed the market price of cashmere in Australia has always been structured on the quality factors of colour and diameter. The following papers discuss cashmere quality and what it means to the various sections of the industry. For a review of cashmere fibre structure and identification read Tucker and Hudson (1989).

CASHMERE QUALITY, A GROWER'S POINT OF VIEW

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Background

Farming is a process of turning natural resources of the farm into dollars in the bank via product sales. Profit maximisation of the farm enterprise does not always emphasise quality but is generally a compromise between quality, quantity and the cost of production.

The decision to have a goat enterprise can be related to the various products, perhaps to weed control and usually to the relative gross margins of other livestock, e.g., sheep. If the primary purpose of the goat enterprise is weed control, then any extra benefit from fibre production is a bonus, but doesn't mean the farmer will devote energies into improving fibre quality.

Cashmere quality

Cashmere is regarded as the most luxurious of natural fibres, and the highest quality product is sold into a market that regards price as irrelevant, Cashmere production should be market driven, rather than production led.

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Quality objectives set for the producer by the marketing organisation and supported by price mechanisms include:-

1. Fibre diameter - finer the better e.g. <16.5 μm = \$158/kg down; >16.5 μm = \$109/kg.
2. Colour - white is preferred to coloured - values being \$158/kg for white and \$136/kg for coloured.
3. Fibre length - objective is 50-60 mm average; not accepted if <35 mm.
4. Ease of dehairing product from guard hair ie. no intermediate fibres or low fibre yields.
5. Yield of cashmere to total fleece to be greater than 25%. Mean yield currently 28%.
6. Minimum contamination including stain, vegetable matter, other animal fibres, louse casings and cots.
7. Clip preparation - follow ACGA recommendations.

Some of these objectives are related to breeding and some are managerial. The degree to which a breeder commits himself to breeding or to management is related to whether he runs a stud breeding herd or is purely commercial.

Product quality will largely be dictated by adequate rewards and price differentials that compensate for effort. In an industry that is beset by problems relating to the feral resource used, namely low production, fibre colour, and various fibre types; breeding and management decisions have not been made necessarily in the interest of quality. Lack of knowledge and poor communication of market requirements, of sound breeding principles, and of goat management techniques have led to quality setbacks. As with most new industries there have been theories that have been unsound and detrimental to the industry. For example:-

1. Angora infusion made at the recommendation of a few industry leaders, despite the warnings of some scientists, have had a significant effect on the quality of much of Australian cashmere. Selection of suitable young bucks is difficult as the full effects are not seen until bucks are older, and progeny have been generated. There is an urgent need for sire progeny test data to be available to growers (probably the key to industry progress).
2. The misconception that bucks are phenotypically about 2 microns coarser that does.
3. A poor understanding and control of fibre shedding (moulting) which affected fleece quality and quantity.

An analysis of hogget doe production in 35 herds represented in the group breeding scheme (Cashmere Group Breeders P/L) is revealing. Although these herds have all been using recognised stud sires, little or no genetic progress has been made compared with the analysis of production of unselected feral goats at Wollongbar (Pattie and Restall 1987a). Many of the top producing does were characterised by high fibre diameter (>17 μm at first shearing) and incorrect fibre type (cashgora).

Industry requirements

For the industry to achieve status with product quality and stability, it requires:-

1. A large number of quality commercial goats behind fences. To achieve this the rewards must be sufficient to warrant the capital expenditure required - fencing, yards, shed upgrading, etc.
2. Promotion of the product. Cashmere has a high profile as the most luxurious of fibres, but a goat is regarded as 'the poor man's cow'. Many farmers will not run goats because of the image and many who use them for weed control- set their management strategies on that basis.
3. Promotion of the by-products, such as meat and skins. Goat meat is not traditionally eaten by Australians and for a goat enterprise to compete economically there must be a market for meat both internally and for export.
4. Sound breeding programs that include:-
 - (i) group breeding; and
 - (ii) extensive commercial sire referencing and evaluation.
5. High levels of communication and education within producer groups as well as between farmers and processors.
6. Low cost objective measurement and in particular greater accuracy in fibre yield tests.
7. Research in the areas of management, nutrition, parasitology and genotype x environment interaction.

The development of an industry in Australia and New Zealand gives us the opportunity to apply our existing managerial skills to provide an end product that will be markedly superior in appearance as well as wearability to a world that is increasing its demand for product excellence. We can also offer stability of supply as a result of our economic and political system,

CASHMERE QUALITY - THE ROLE OF THE MARKETING ORGANISATION

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Cashmere is a high value fibre used to manufacture quality fashion garments that have international appeal. The fibre is associated with fine, soft knitted garments such as the original Kashmir shawl. Traditional suppliers include China, Mongolia, Afghanistan and Iran which together supply an estimated 4,500 tonnes of cashmere.

Australia is a recent exporter of cashmere and together with New Zealand is aggressively studying the goat and its product. For example the definition and identification of cashmere (Couchman 1987; Tucker and Hudson 1989) has yet to be fully resolved but it is known that we can produce high quality fibre that has some additional superior qualities such as strength and length, which may provide a marketing advantage.

Growers organisation

New industries need the strength of grower organisations to survive and for that reason the Australian Cashmere Growers Association (ACGA) and the

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Australian Cashmere Marketing Corporation (ACMC) were established. The objectives of these organisations are:- ,

- (a) to promote the production of cashmere fibre in Australia.
- (b) to establish and maintain the standard of cashmere fibre.
- (c) to promote the use of cashmere fibre.
- (d) to support research and undertake marketing, research and promotion of goat fibres and products.

Quality

There are price incentives that operate through the ACMC for aspects of fibre quality. Disincentives, through increased handling charges, also operate for factors such as poor fleece preparation.

The highest value cashmere (\$158/kg) is fine <16.5 μ m, white with white guard hair, 50-60 mm long and free of stain, vegetable matter and wool fibre contamination. When white cashmere is associated with coloured guard hair, its value is reduced by 10%. Price penalties for fleece contamination can also be severe (Table 1). Contaminants include wool, vegetable matter, synthetic fibres, paper, skin and urine. In this country we do not have a serious louse egg casing nor bacterial spore (e.g. anthrax) problem but there is the opportunity of reducing our other contaminants.

Table 1 The proportion of cashmere contaminated by vegetable matter and cotts in 1989 (ACMC data)

Code	Description	% of total cashmere fibre*	Value (\$/kg)
CV	Cashmere with vegetable fault, cotts	1.3	35.0
CS	Cashmere with heavy stain	0.5	40.0
LCV	Cashmere of low commercial value (<30 mm and/or low 5-15% fibre yield)	9.1	0.6

* Underestimate because contaminated fibre not always submitted for sale.

In the quest for high quality contaminant free cashmere Tables 1 and 2 clearly indicate that it is being achieved. However, Table 2 does not include another 1 tonne (2.2%) of fibre <20 μ m classed as cashgora where the fibre diameter and type were not acceptable as cashmere.

Table 2 The composition of the cashmere clip in 1989

Code	Description	% of total
WW1	White, <16.5 μ m, white guard hair	8.8
WW2	White, >16.5 μ m, white guard hair	7.3
WC1	White, <16.5 μ m, coloured guard hair	15.7
WC2	White, >16.5 μ m, " " "	13.4
GY1	Grey <16.5 μ m, " " "	27.2
GY2	Grey >16.5 μ m, " " "	16.6
BR1	Brown <16.5 μ m, " " "	7.3
BR2	Brown >16.5 μ m, " " "	3.5

Marketing

The principal objective is to ensure a fair return to growers based on the world price for cashmere presented to a similar standard of preparation, or with a premium if there is no similar standard, i.e., contract and fax tender system.

The marketing operation, set up with large inputs from the processors, has been successful in each of the few years that it has been operating and has provided much needed stability to the industry. From this beginning the ACMC can foster the important objectives of increased supply of fibre, a regular supply of fibre and a consistent quality of fibre.

New products based on Australian fibre need to be developed but there are limitations. Firstly, 12.5 tonnes is a minimal quantity of cashmere for a commercial run and secondly, it may be two years from shearing of the goat to feedback from the garment purchaser. However the appeal of Australian cashmere to overseas buyers is the quality of the fibre and the potential long term expansion of the industry.

NEW MANAGEMENT TECHNOLOGY ASSISTING THE PRODUCTION OF QUALITY CASHMERE

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This review briefly discusses improvements in the assessment of superior cashmere goats and measurement of cashmere, nutrition and grazing management, photoperiod and harvest manipulation, handling of goats and information services.

Assessment and measurement of superior cashmere goats

In 1980 when the commercial cashmere industry was established in Australia there was no objective method available to growers for the measurement of cashmere production from individual goats. In research undertaken in 1981, Couchman and McGregor (1983) demonstrated that subjective assessment of cashmere length and density prior to shearing could be 60 to 80% as efficient as objective measurement obtained from commercial processing in estimating total cashmere production. Recently the accuracy of the direct measurement of only cashmere length in predicting cashmere production indicated r^2 of 0.45 to 0.75 (McDonald 1988). It was not until 1984 (Couchman 1984) that a readily available testing procedure was provided to cashmere growers. Since this time the Australian Wool Testing Authority has provided a testing service to growers and has improved the reliability of cashmere yield (% cashmere by weight in raw fleece) estimates. They recently published draft Australian Standards for the testing of cashmere fleeces, fleece lines and bales (Sommerville 1989) but were forced to increase testing fees 18.6% to \$18.50 per sample. Improvements in accuracy and potential cost reductions of cashmere yield testing are possible by using the Shirley Trash separator instead of the Shirley Analyser (Couchman 1989), and potentially, fibre image display and measurement or FIDAM, (McNally et al. 1987). To ensure good comfort properties, softness and handling of cashmere garments, processors prefer cashmere fibres to be <27 μ m. The technology of estimating cashmere fibre diameter (1000 accepted counts of a fibre diameter analyser, FDA, set to read up to 45 μ m) enables the % of cashmere fibre between 27 and 45 μ m ($F > 27$ urn) to be estimated. To assist producers in reducing coarse cashmere and intermediate

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fibres the >27 μm is listed on cashmere test reports. Since 1984 the >27 μm has been used in marketing bucks. The reliability of only 1000 FDA counts in estimating >27 μm has not been established. The effect of using the proposed standards to calibrate the FDA and alteration of the FDA cut off (max. 80 μm) on the measured incidence of cashmere >27 μm is not known.

Nutrition and grazing management

Improvements in nutrition over a limited range of feed intakes has not affected cashmere production (mean 57 g) or quality by yearling feral goats (Johnson and Rowe 1984; Ash and Norton 1984). With improved nutrition during summer and autumn (range -220 to 644 g DDM/day McGregor 1988a) increased cashmere production of adult goats from 146 g to 245 g and cashmere fibre diameter by 1 μm . Energy deprived goats preferentially diverted nutrients towards cashmere growth. Feeding goats *ad libitum* altered the partitioning of nutrients towards hair growth and they grew significantly more hair than all other treatments without a corresponding increase in cashmere growth. Thus McGregor (1988a) suggested that to achieve near maximal cashmere production, goats over summer should have small liveweight gains (1-2 kg) and maintain body condition over summer. Variation in cashmere production (from -10% to +40%) and fibre diameter (1.1 μm) caused by differences in pastoral conditions, liveweight and supplementary feeding have been observed (McGregor, unpublished data). These observations together with the effect of stocking rate on mohair production and fineness (McGregor 1988b) suggest grazing cashmere goats at high stocking rates on pasture will depress cashmere production and reduce fibre diameter. It is unlikely with current price schedules that supplementary feeding will be economical if fibre diameter moves outside its fibre diameter class (McGregor 1989). If diameter remains within its class returns could increase 30%. No cashmere production responses have been observed by supplying protected protein (Johnson and Rowe 1984; Ash and Norton 1984; McGregor 1988a) but potential harmful increases in cashmere fibre diameter have been detected (McGregor 1988a).

Photoperiod manipulation and melatonin therapy

McDonald and Hoey (1987) have demonstrated that photo translocation of cashmere producing goats could represent an opportunity to increase cashmere production. This may entail alternate exposure to continuous light and natural light for various cycles and may provide 5 fleece growth cycles in three years. Such a practice is dependent on economics and overcoming logistical problems. Using melatonin to increase cashmere production has resulted in benefits of approximately 30 g cashmere (Betteridge et al. 1987) and when used on non breeding goats has not affected cashmere diameter (McGregor unpublished data). Large intakes of melatonin can cause complete fleece shedding (Scheunmann et al. 1987). Recent research indicates that cashmere growth is refractory to melatonin treatment in winter (Lynch and Russel 1989) and early spring (McGregor unpublished data). Melatonin treatment can be used to alter reproductive management and increase kidding performance of goats (McPhee et al. 1987; Scheunmann et al. 1987) but adjustment of shearing time to fit the modified fibre growth cycle is necessary to ensure that the additional fibre growth is harvested (McGregor unpublished data). In addition increased kidding performance and lactation are likely to reduce fleece production and fibre diameter. A practical melatonin therapy and harvesting program has not yet been developed for commercial situations.

Harvest manipulation

In Asia, cashmere is traditionally harvested in late spring while in Australia harvesting usually occurs in mid to late winter. Observations in 1982 showing some Australian goats with cashmere of sufficient length to harvest in summer, led Couchman (1984) to suggest shearing twice annually as a method to increase

cashmere production. McDonald (1987) and Johnson (1988) observed that biannual shearing compared to shearing in July resulted in benefits of approximately 20 to 30 g. However as cashmere <30 mm results in pilling in garments and is classed as low commercial value, biannual shearings need to be spaced 100 days apart, preferably April and July (McDonald 1987) to enable another commercial fleece to grow, Shearing costs are also doubled.

Handling equipment and information services

The best methods for handling cashmere goats have been documented by experienced producers and researchers (ACGA 1985a,b). Third generation animal handling devices such as the Connell and the Down Under have been developed to minimise the agility of goats and enable the effective restraining of goats for general husbandry and fleece inspection. The Goat Notes Advisory package (ACGA 1985a), the ACGA quarterly magazine "Snippet", the commercial magazine "Australian Goat Farmer" and Elders videotext service provide market reports, advisory articles and advertisements of equipment. Programs designed for personal computers to assist record keeping by cashmere producers are now marketed.

RECENT DEVELOPMENTS IN CASHMERE BREEDING IN AUSTRALIA AND NEW ZEALAND

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The purpose of study on the breeding and genetics of cashmere goats is to acquire knowledge to enable the design of efficient breeding programs. A breeding program design involves the following five steps, undertaken in sequential order (Ponzoni 1982):-

- (i) definition of the breeding objective;
- (ii) choice of selection criteria;
- (iii) organisation of the performance recording scheme;
- (iv) use of the recorded information to make selection decisions; and
- (v) use of the selected animals.

Consideration of these steps allows an assessment of the current state of knowledge and of the application of scientific findings in industry, as well as the identification of areas deserving further research and development.

Definition of the breeding objective

The breeding objective is the combination of traits which we wish to improve genetically because of their influence on profitability or economic efficiency of the cashmere goat enterprise. Breeding objectives for cashmere goats have been proposed by a number of authors (e.g., Gifford 1988; MacLeod 1988; Nicoll 1987; Pattie and Restall 1984, 1987a,b). More recently Ponzoni and Gifford (1989) developed a comprehensive breeding objective based on a profit equation, Economic values of traits in the breeding objective were derived by numerical evaluation, after expressing the equation as a function of biological traits. The availability of a comprehensive model for the breeding objective enables an examination of the consequences of changes we may be forced to make in our assumptions due to new knowledge (e.g., genetic parameters) or to a changing economic environment (e.g., product values and costs). In addition, the consequences of selecting for a reduced objective can be assessed, leading to the development of "practical" or "working" breeding objectives for industry

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application. There may not be a unique breeding objective relevant to all commercial goat herds, so future developments could result in breeding objectives specific to particular production and marketing systems.

Choice of selection criteria

In the definition of the breeding objective, mainly economic considerations are relevant. By contrast, mainly genetic considerations are relevant in the

choice of selection criteria, that is, the characters measured or assessed on individuals in order to estimate their breeding values. Phenotypic and genetic parameters for the traits in the breeding objective and for the characters used as selection criteria are required to allow:

1. Estimation of the worth of different selection criteria in an index.
2. Combination of selection criteria in an optimum way for the estimation of breeding values of traits in the objective and of breeding value for economic merit.
3. Prediction of the consequences of selection.

Estimates of phenotypic and genetic parameters for down and live weight characters are now available (Couchman and Wilkinson 1987; Gifford et al. 1989; Nicoll 1987; Pattie and Restall 1989), as are repeatability estimates for some reproduction traits (Saithanoo et al. 1988). However, no such information is available for important traits such as reproduction, feed intake and disease resistance.

Organisation of a performance recording scheme

Following the choice of selection criteria, it is necessary to organise a performance recording scheme. Data collection is usually the responsibility of the breeder, with the records collected often being corrected for known environmental factors, such as type of birth and rearing, age of dam and day of birth. Estimates of the effects of such factors on production characters are now available (Gifford et al. 1989; Restall and Pattie 1989). Individual animal performance records are then used to calculate:

- (i) estimated breeding values for each trait in the breeding objective;
- (ii) an index score for overall genetic merit in economic units.

Other animal industries have National performance recording schemes (e.g., Breedplan for beef cattle breeds, Woolplan for wool sheep breeds), but no such scheme presently exists for Australian cashmere goats. Parnell and Hammond (1985) outlined the performance recording requirements of the Australian cashmere goat industry. Goat breeders in New Zealand have access to Animalplan, the National performance and pedigree recording system. The feasibility of introducing the goat option of Animalplan into Australia is currently being investigated. Some selection criteria of cashmere goats are measured in the laboratory (e.g., down yield) and it seems logical that a performance recording scheme should be integrated with laboratory services. Woolplan offers an example of how it could be done. The costs of recording some selection criteria (e.g., down yield and down diameter) are high. Couchman and McGregor (1983), Pattie and Restall (1987a) and MacLeod (1988) indicate that some form of two-stage selection could assist in reducing costs. Ponzoni and Gifford (1989) confirmed that this was so, but found that the particular two-stage selection strategy studied could result in a 'type' of goat cutting heavier, but coarser fleeces.

Making selection decisions

A National performance recording scheme should present the relevant information (estimated breeding values, index scores) in such a way that it can be readily used by buck breeders in making selection decisions and by buck buyers in purchasing their replacement sires. Since most goat producers are also sheep producers, an output form similar to that of Woolplan could be of benefit. Initially, a performance recording scheme may enable comparisons of animals strictly within a buck-breeding herd. The comparison of sires in different herds is possible and desirable, and it can be accomplished through central performance tests or sire reference schemes. Both of these initiatives for cashmere goats were adopted in New Zealand in 1987 (Baker and Parratt 1987).

Use of selected individuals

Conceptually the whole cashmere goat population could be under selection. However, the conduct of such a breeding program would be very expensive due to high performance recording costs. Near maximum genetic improvement in an industry population can be achieved by concentrating selection programs in a small proportion of the population (James 1982). Thus, any future large-scale cashmere industry is likely to be based on commercial herds, with buck-breeding herds constituting only a small proportion of the total population. Commercial herds would purchase replacement sires from buck-breeding herds. In the Merino sheep industry, for example, ram-breeding flocks comprise 2-3% of the total breeding ewe population but supply 70-80% of sires to industry. No such industry structure exists in the cashmere goat industry at present, but it is essential that it does develop. Few group breeding schemes involving cashmere goats are presently operating (Read 1989; Winter 1989).

CONCLUSIONS

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While cashmere producers have a clean, natural fibre and have been paid on the quality factors of colour and diameter, some producers may have sacrificed premium fine fibre in their quest for greater weight of fibre; and adequate length by double shearing. My experience in an industry where cashmere is often a by-product to weed control, supports that of Doug Winter who states that "product excellence will largely be dictated by adequate rewards and price differentials that compensate for effort". With centralised selling this should be reflected in the price grid as tendered for by the international processors. The final return may be further assisted by the development of new premium products made from Australian fibre.

The cashmere industry has benefited from the close contact between processors, researchers, advisory personnel and producers. This liaison should continue and thus ensure that the high quality of our cashmere is maintained or even improved. It is of interest to consider that the original cashmere sold from Australia was considerably finer (but not necessarily white) than that of today but the low weights per head were not remunerative to producers.

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