The establishment of cashmere production in the European Union

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Contents

Summary

The European textile industry is experiencing increasing difficulty in securing supplies of raw cashmere from China. The technical feasibility of producing high quality cashmere in diverse climatic and topographic conditions within the EU has been amply demonstrated, and it is considered that cashmere produced in the EU would find a ready domestic market. Cashmere production constitutes an avenue for livestock diversification, well suited to marginal areas, and accords with many of the objectives of the EU's Common Agricultural Policy.

The establishment of new cashmere goat enterprises from the importation of embryos or animals, or by the grading-up of native goats using imported cashmere bucks or semen, is considered. Information is presented on the rate of growth and cashmere production, over ten years, of national herds based on a common starting point of a 250 doe herd, comprising imported animals or native goats used as recipients for imported embryos or for grading-up. The genetic potential for the production of high weights of quality cashmere is likely to be greater in herds established from embryos than in those based on animal imports. Although national herds comprising substantial numbers of breeding does are likely to be established more quickly from animal imports, the physical outputs and monetary income of individual cashmere enterprises are likely to be significantly greater if they are based on livestock established from embryos or by grading-up, than if they originate from imported live animals.

Five production systems, in which surplus stock are sold at different ages, are also considered, and estimates of the physical and monetary outputs from the sale of cashmere and animals slaughtered for meat and sold as breeding stock are used, with estimates of the variable costs attaching to each system, as the basis for gross margin analyses. In general, these indicate that systems in which the surplus stock are retained for the longest periods are likely to be the most profitable. Estimates of gross margins range from about 45 ECU per breeding doe in a system in which surplus kids are sold at approximately six months of age and from which there are no sales of breeding stock, to almost 220 ECU per doe where the surplus juvenile stock are sold at approximately 18 months of age after the harvesting of a second cashmere fleece, and from which sales of breeding stock constitute a major source of income.

One of the production systems considered is based on castrates maintained on poorer land resources which are not well suited to breeding does. Estimated gross margins range from about 8 to 36 ECU per head, depending on the weight and quality of cashmere produced. Herds of cashmere goats, and particularly of castrates, can be used as grazing tools to bring about changes in botanical composition, including the control and eradication of undesirable plant species. It is estimated that the use of goats to eradicate gorse and bracken can result in benefits worth 29 to 36 ECU per goat per year; these figures comprise savings in herbicide costs and take into account the anticipated additional herbage dry matter production resulting from the eradication of the 'weed' species. Grazing by goats can also be used to reduce the risk of fire in forested areas and of underutilised vegetation on hill and marginal land.

The economics of incorporating cashmere production as an output from dairy goat enterprises is also briefly considered.

Introduction

Cashmere is one of the most luxurious natural fibres and is increasingly sought after, particularly in the affluent western world where living standards and expectations continue to rise and where consumers are becoming ever more demanding as regards product quality.

The world's principal cashmere manufacturing industries are located in Europe - notably in the UK and Italy - and in the US. Virtually all the cashmere used by these countries is imported. The top quality cashmere (the fine 14-15 micron cashmere used to make knitted garments) comes from China (including Inner Mongolia) and (Outer) Mongolia, while the second quality cashmere (17-18 micron fibre, used principally for weaving cloth) is imported mainly from Iran and Afghanistan. China and Mongolia have traditionally dominated the market and currently produce annually an estimated 3500 tonnes of cashmere (i.e. of dehaired fibre, although not all of this production is dehaired in the country of origin). This represents approximately 85% of world production.

In recent years China has started to manufacture knitted garments and cloth from its own cashmere, often in joint ventures financed by partners in the US, Japan, and most recently, the UK. In 1995 it was estimated that China processed about 500 tonnes of dehaired cashmere. Of this, 400 tonnes were exported as finished goods and 100 tonnes were sold as garments within the country. This latter figure may appear small in relation to the total quantity of cashmere produced, but the Chinese economy is growing at an estimated 10% per annum and the domestic market for cashmere sweaters and cloth has been doubling each year for a number of years. This trend is expected to continue.

European textile manufacturers have been experiencing increasing difficulties in purchasing sufficient quantities of either raw or dehaired cashmere to meet their needs. Quality has also been a major problem, with suppliers adulterating cashmere with other fibres, such as yak and wool, to dilute the consignments of cashmere exported to Europe. One of the consequences of these problems is that the major UK cashmere processor, Dawson International, has recently relocated its dehairing plant from England to China, to be better able to secure supplies of raw cashmere fibre and to have control over the quality of the dehaired product.

A recently concluded EC-funded research contract[1] on cashmere production in the EU, including a study of its economic potential and competitiveness, concluded that, despite these recent developments in China, the future demand for cashmere is likely to continue to exceed available supplies, and that high quality cashmere produced in Europe would find a ready market.

The technical feasibility of producing high quality cashmere in diverse climatic and topographic conditions in the EU has been amply demonstrated by work initiated in the UK in the early 1980s, and more recently by studies in two contrasting areas of Spain. Cashmere has also been produced successfully in Italy. Cashmere production in these three member states is based on a new breed developed in the UK - the Scottish Cashmere goat. This breed has been selected from an exceptionally widely based genepool, comprising genetic material from Scotland, Iceland, Tasmania, New Zealand and Siberia.

Cashmere production accords with many of the objectives of the EU's Common Agricultural Policy in that:

- it constitutes an avenue for agricultural diversification, particularly in the hills and uplands where opportunities for livestock diversification are confined to ruminant species.
- it is well suited to the development of extensive systems of production and is particularly appropriate to the Less Favoured Areas.
- cashmere is a high value non-food product.
- there is a strong internal market for the product.
- it has the potential to achieve substantial import savings.

[1] Research on the production of high quality cashmere from goats and its potential for agricultural diversification. (Macaulay Land Use research Institute, 1998)

Establishment of cashmere goat herds

In countries where there are no indigenous cashmere goats there are two main means of establishing new herds, *viz.* by importing either live animals or frozen embryos. Both methods are considered below.

In the following analyses it is assumed that the importations are made from the UK. Exports of livestock are not permitted from China, and even if dispensation from this ban were granted, it is unlikely that the EU veterinary authorities would permit the importation of ruminant livestock from this source. The importation of goats to the EU from Australia and New Zealand is relatively straightforward, but adverse comments from European textile manufacturers regarding the quality of Australasian cashmere indicate that this option should not be considered.

In considering options for the establishment of new cashmere enterprises a common starting point of a herd of 250 breeding does has been adopted. The three options considered comprise:

- 250 native does, serving as recipients for 500 imported embryos
- 250 imported breeding does and 7 bucks
- 250 native does, used in a grading-up programme with imported bucks or semen.

In the first option the initial objective is to establish an Elite Herd of 250 breeding cashmere does plus followers. A breeding programme designed to improve the weight and quality of cashmere produced would be pursued within this herd, and animals not required as herd replacements would be sold to establish other herds. For the purposes of this study these other herds are considered collectively, and are termed the Regional Herd. The Elite Herd plus the Regional Herd constitute the National Herd.

In the second option the National Herd is based wholly on the natural increase of the imported animals.

In the third option the imported bucks or semen are used in a 'grading-up' programme for crossing with indigenous dairy or meat goats. Additional bucks or semen are imported every second year over a period of 10 years to meet the requirements of the expanding National Herd. Imported bucks are likely to be less expensive than semen and are therefore used as the basis of herd improvement in this particular option.

These options are not, of course, mutually exclusive. In practice the starting point for the establishment of a cashmere production industry could well involve an initial importation of both live animals and embryos. Likewise, there is no reason why an initial importation of live animals could not be supplemented with an importation of bucks or embryos at a later date. It is not possible within the scope of this study to consider all possible options, but sufficient information is presented to enable the likely outcome of different establishment strategies to be predicted and costed.

In considering the establishment of a National Herd the following assumptions have been made:

- the success rate for the transfer of frozen embryos is 65%.
- the annual kidding rate is 1.4 kids weaned per doe mated. This will vary according to the standard of nutrition and body condition (fatness) of the goats prior to mating. In the UK kidding rate varies between 1.0 and 1.8, depending on the quality and quantity of available grazing and on inputs of supplementary feeding.
- does and bucks are both mated for the first time at 1.5 years of age. In conditions of good quality grazing, where high kid growth rates are achieved, it may be possible to mate animals for the first time at seven months old.
- to achieve a short generation interval and a rapid rate of genetic improvement in cashmere weight and quality, does are kept in the Elite Herd and in the 'grading-up' National Herd for only three kid crops.
- to maximise the rate of expansion of the National Herd based on the importation of live animals, does are kept in this herd for six kid crops.
- the annual rate of mortality is 3%. In practice a lower level of mortality should be achieved without difficulty.
- the ratio of bucks to breeding does is 1:40

Establishment from embryos

The structure and growth of an Elite Herd, established from the importation of 500 frozen embryos in Year 0, is shown in Table 1. The establishment starts with 250 native dairy or meat-breed does to act as recipients for the embryos, with the kids being born in Year 1. The full complement of 250 breeding cashmere does is achieved in Year 4. Thereafter, surplus yearling does, 3-crop adult does and a small number of yearling bucks are sold for breeding to establish the Regional Herd. Adult bucks and surplus juvenile bucks are sold for meat.

Table 1. Structure of Elite Herd of 250 breeding does established from embryos

Year	1	2	3	4	5	6	7	8	9	10
Does mated		157	152	250	250	250	250	250	250	250
Kids born: does	162		110	106	175	175	175	175	175	175
bucks	162		110	106	175	175	175	175	175	175
Juvenile does retained		157		106	90	90	90	90	90	90
Juvenile bucks retained		4		7	7	7	7	7	7	7
Sold to Regional Herd										
Adult does					77	77	77	77	77	77
Juvenile does				4	16	80	80	80	80	80
Juvenile males				1	3	7	12	17	27	32
Sold for meat										
Juvenile bucks				98	93	156	151	146	136	131
Adult bucks				4	7	7	7	7	7	7

The establishment of the Regional Herd begins in only a very small way in Year 4 with the purchase of 4 yearling does and 1 yearling buck which are surplus to the requirements of the Elite Herd. All juvenile does are retained for breeding and adult does are sold for meat after their sixth kid crop. Bucks are recruited as yearlings from the Elite Herd and all juvenile bucks are sold for meat as yearlings. The growth and structure of the Regional Herd are shown in Table 2.

Table 2. Structure of Regional Herd established from surplus stock from the Elite Herd

Year	1	2	3	4	5	6	7	8	9	10
Does mated				4	97	254	469	641	1025	1254
Kids born: does					3	68	178	328	449	717
bucks					3	68	178	328	449	717
Juvenile does retained						3	66	173	318	436
Sold for meat:										
Juvenile bucks						3	66	173	318	436
Adult does							72	72	76	86
Adult bucks					1	3	7	12	17	26

The National Herd based on the importation of embryos is made up of the Elite Herd plus the Regional Herd and its growth and structure are shown in Table 3.

Table 3. Structure of National Herd established from embryos

Year	1	2	3	4	5	6	7	8	9	10
Does mated		157	152	254	347	504	719	891	1275	1504
Kids born: does	162		110	106	178	243	353	503	624	892
bucks	162		110	106	178	243	353	503	624	892
Juvenile does retained		157		110	96	173	236	343	488	606
Juvenile bucks retained		4		8	10	14	19	24	34	39
Sold for meat										
Juvenile bucks		153		99	96	159	217	319	454	567
Adult does							72	72	76	86
Adult bucks				4	8	10	14	19	24	34

Establishment from imported does and bucks

In the second option the National Herd is established from the importation of 250 3-crop does and 6 adult bucks. The objective is to build up the herd quickly, and all does are retained until they have produced their sixth kid crop. The growth and structure of the herd is shown in Table 4.

Table 4. Structure of National Herd established from the importation of live animals

Year	0	1	2	3	4	5	6	7	8	9	10
Does mated	250	243	405	330	596	801	1181	1689	2299	3239	4475
Kids born: does		175	170	284	231	417	561	827	1182	1609	3124
bucks		175	170	284	231	417	561	827	1182	1609	3124
Juvenile does retained			170	165	275	224	404	544	802	1147	1561
Juvenile bucks retained			5	9	15	20	30	43	58	81	112
Sold for meat											
Juvenile bucks			165	275	16	397	531	784	1124	1528	3012
Adult does			236					146	142	236	192
Adult bucks			6	5	9	15	20	30	43	58	81

Establishment by the grading-up of native goats

The third option for the establishment of a National Herd is to import only bucks, and to use them to ‘grade-up’ native dairy or meat goats by a system of repeated cross-breeding. In the example illustrated in Table 5, the starting point is 250 native does and 7 imported cashmere bucks. As in the previous example, all female kids are retained within the National Herd. In this case, however, the original does are kept for only two kid crops and the subsequent cross-bred female progeny for only three kid crops, as it is desirable to maintain a short generation interval, particularly in the early years when the cashmere production of the crosses is low. It is also assumed that a sufficient number of new bucks are imported every two years to maintain the programme of cross breeding. The growth in size of the National Herd established by this strategy is shown in Table 5.

Table 5. Structure of National Herd established by the grading-up of native goats

Year	0	1	2	3	4	5	6	7	8	9	10
Does mated											
Native	250	243									
1st cross			170	329	319	155					
2nd cross					116	335	542	526	306	99	
3rd cross							78	304	663	929	901
4th cross									53	258	700
5th cross											36
Total	**250**	**243**	**170**	**329**	**335**	**490**	**620**	**830**	**1022**	**1286**	**1637**
Bucks imported	**7**		**9**		**13**		**16**		**26**		**41**
Kids born: does											
1st cross		175	170								
2nd cross				119	231	224	109				
3rd cross						81	235	380	368	214	69
4th cross								55	213	464	650
5th cross										37	180
Total		**175**	**170**	**119**	**231**	**305**	**344**	**435**	**581**	**678**	**899**
Kids born: bucks											
1st cross		175	170								
2nd cross				119	231	224	109				
3rd cross						81	235	380	368	214	69
4th cross								55	213	464	650
5th cross										37	180
Total		**175**	**170**	**119**	**231**	**305**	**344**	**435**	**581**	**678**	**899**
Sold for meat											
Juvenile bucks			170	165	115	224	296	334	422	564	658
Adult does			236		154	150	105	204	270	304	384
Adult bucks			7		9		3		16		26

Growth of National Herds established by different strategies

The growth in numbers over ten years of National Herds established from the importation of embryos and live animals, and by the grading-up of native does using imported bucks, is illustrated in Figure 1. It can be seen that, in the strategies considered above, the importation of live animals results in approximately three times as many breeding does in Year 10 as are achieved through the importation of embryos or by the grading-up of native does using imported bucks. This is mainly a consequence of the differing objectives of the different strategies. In the case of the live animal starting point, the objective is to increase the number of breeding does in the National Herd as quickly as possible; to achieve this end the does remain in the herd until they have produced their sixth kid crop. In the other strategies there is greater emphasis on breeding for individual animal performance; in the Elite Herd based on embryos and in the grading-up option the does are sold after producing only three kid crops to shorten the generation interval and increase the rate of genetic improvement in cashmere production.

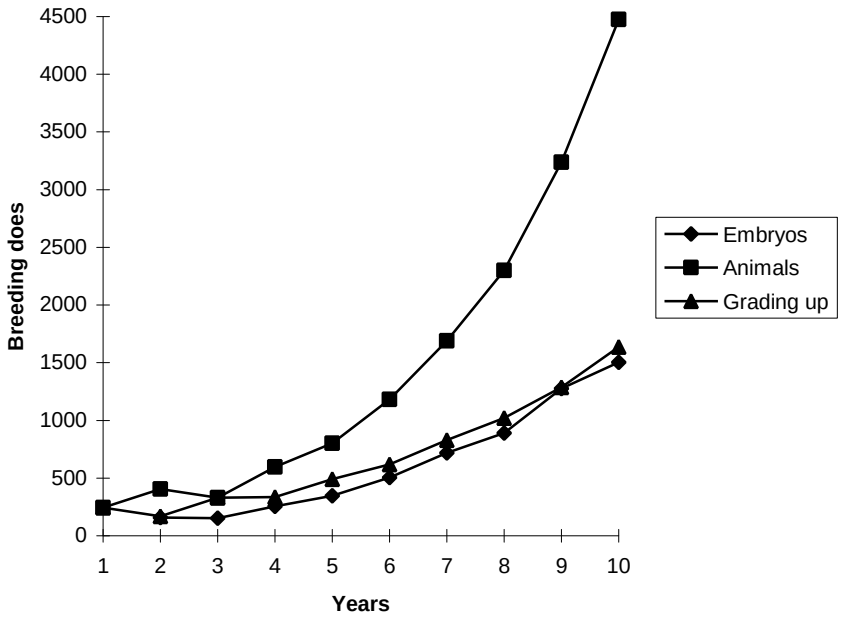

Figure 1. Comparison of increase in numbers of breeding does in National Herds established by different strategies

Cashmere production

In estimating the cashmere production of the three National Herds established from different starting points it is recognised that, because no vendors will sell their best animals, the quantity and quality of the cashmere from imported live animals will be substantially less than those from animals derived from frozen embryos collected from superior breeding stock.

The following assumptions have been made in estimating the cashmere production from the National Herds established from the three different strategies:

- the initial levels of cashmere production from animals imported as frozen embryos are 300 g from adults and 135 g (45%) from yearlings, and production will increase at a rate of 5% of the initial level per year as a result of the breeding programme pursued in the Elite Herd. (*Note:* a rate of increase in cashmere weight of 10% per year has been achieved in Scottish Cashmere goats over the past five years, but it is considered that this exceptionally high rate cannot be sustained indefinitely.)
- the quality (mean fibre diameter) of the cashmere from animals derived from embryos is 80% < 16.5 microns and 20% 16.5-18.5 microns.
- the initial levels of cashmere production from stock imported as live animals are 135 g from adults and 60 g (45%) from yearlings, and production will increase at a rate of 3% of the initial level of production per year as a result of selective breeding.
- the quality (mean fibre diameter) of the cashmere from stock imported as live animals is 50% < 16.5 microns and 50% 16.5-18.5 microns.
- the weight and quality of the cashmere produced by the bucks used in the grading-up strategy are comparable to that of the animals derived from the importation of embryos, and production of the imported bucks increases at a rate of 5% of the initial level of production per year.
- equal proportions of white, off-white and coloured cashmere will be produced in all herds.
- cashmere prices are as noted in Table 6 (based on the average prices paid to farmers by the Scottish Cashmere Producers' Association over the last three years).

Table 6. Cashmere prices (ECU per kg dehaired cashmere)

	Combed	Shorn
Diameter: <16.5 microns		
white	120	115
off-white	112	107
coloured	104	99
Diameter: 16.5-18.5 microns		
white	90	85
off-white	82	77
coloured	74	65

The estimated weights and income from the sale of cashmere from the three National Herds over Years 1 to 10 are presented in Table 7 and illustrated in Figures 2 and 3.

Table 7. Estimated cashmere production and value from the National Herds established by different strategies

Year	1	2	3	4	5	6	7	8	9	10
Established from embryos										
Cashmere weight (kg)										
Adults			54	55	95	135	204	301	386	571
Juveniles		47		35	34	61	86	130	191	246
Total		47	52	90	129	196	290	430	587	818
Value (‘000ECU)		4.8	5.4	9.3	13.4	20.3	30.0	44.5	59.8	84.7
Established from live animals										
Cashmere weight (kg)										
Adults	35	59	49	92	127	191	280	391	564	797
Juveniles		21	36	30	56	77	117	172	239	479
Total	35	80	85	122	183	268	397	563	803	1276
Value (‘000 ECU)	3.3	7.5	8.1	11.5	17.2	25.4	37.5	53.2	75.9	120.6
Established by grading-up										
Cashmere weight (kg)										
Adults	2	2	29	54	57	84	135	175	236	318
Juveniles		25	24	25	49	72	87	122	166	231
Total	2	27	53	79	106	156	222	297	402	549
Value (‘000ECU)	0.2	2.8	5.5	8.2	11.0	16.1	23.0	30.7	41.6	56.8

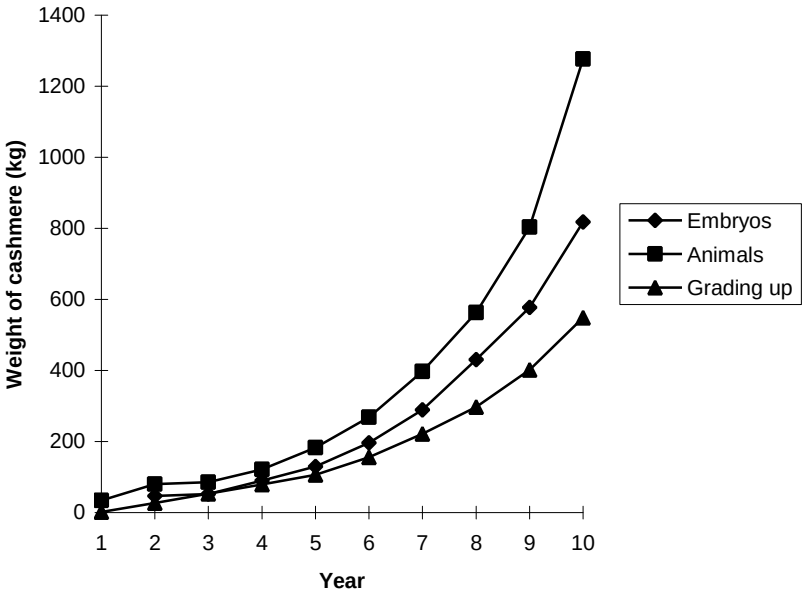

Figure 2. Estimated cashmere production from the National Herds established by different strategies

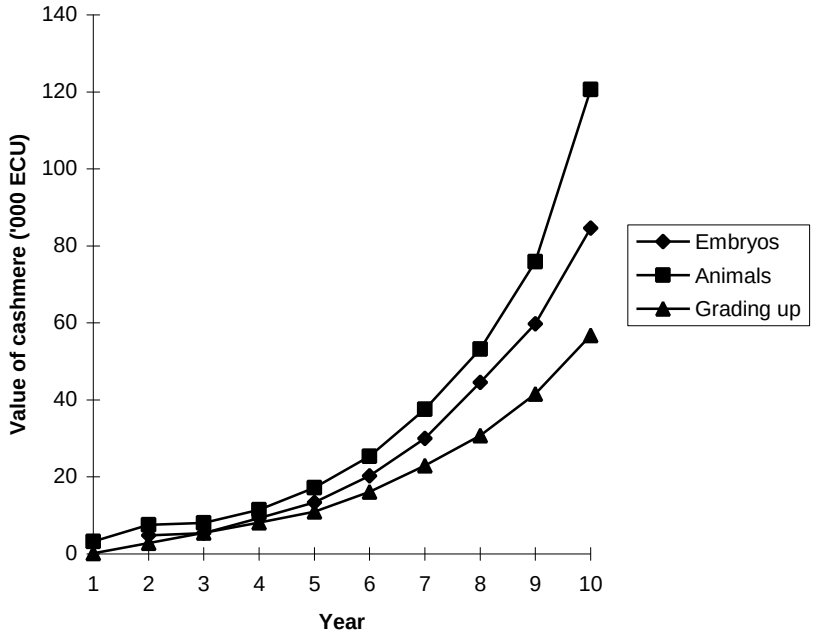

Figure 3. Estimated value of cashmere produced in the National Herds established by different strategies

Figures 4 and 5 illustrate respectively the estimated weights and values of cashmere produced per breeding doe in Year 10 in the National Herds established by the three different strategies. These values are calculated as the total weight of cashmere produced in Year 10 divided by the number of does present at the time of harvesting (i.e. the number of does mated in the previous year and after allowing for the standard 3% annual mortality).

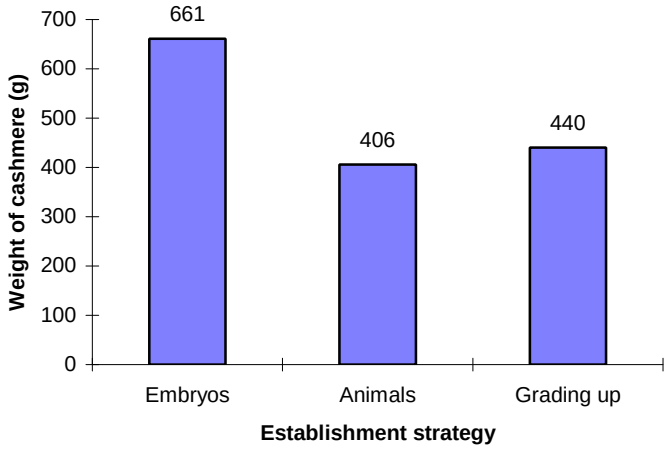

Figure 4. Year 10 weights of cashmere per breeding doe (i.e. including bucks and juveniles) in the National Herds established by different strategies

The data in Figure 4 show that the weight of cashmere produced per breeding doe in Year 10 in the herd established from embryos is 63% greater than that in the herd based on the importation of live animals and (Figure 5) has a 78% higher value. The corresponding figures for per doe cashmere weight and value in the herd established by the grading-up of native goats, relative to those in the herd based on live animals, are 11% and 18%.

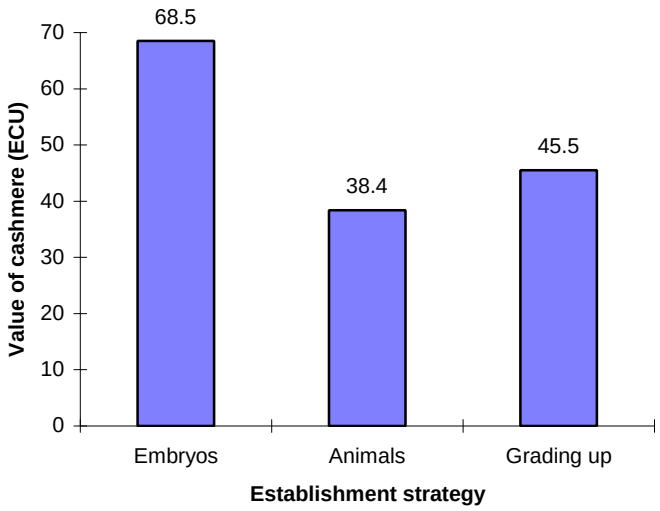

Figure 5. Year 10 values of cashmere per breeding doe (i.e. including bucks and juveniles) in the National Herds established by different strategies

The estimates presented above indicate that, on a national basis, the greatest weight and value of cashmere is likely to be produced by the importation of live animals, and by pursuing a policy of increasing stock numbers rapidly by retaining does in the herd for six kid crops. Although this strategy may benefit the country's textile industry or exports to a greater degree than the other strategies of establishing a national herd of cashmere goats, it is less likely to be of benefit to individual goat farmers. The National Herd in any country will comprise a number of units, each of a finite size and a limited stock carrying capacity. The physical outputs and monetary income of individual cashmere production enterprises are dependent to a large extent on levels of individual animal performance and are likely to be greater if these enterprises are based on a national herd established from embryos or by grading-up, than on one based on the importation of live animals.

Meat production

In the preceding section on cashmere fibre production it was assumed, for the sake of simplicity, that all kids were kept in the herd until after their first fibre harvest at approximately 10-12 months of age. This may not always be the most profitable strategy. In many of the Mediterranean countries, for example, and notably in Greece, Italy and Spain, the meat from young kids, slaughtered before weaning, is regarded as a delicacy and commands a high price. In some cases, e.g. in herds established from the importation of live animals producing only moderate weights of cashmere, it may be more profitable to sell the buck kids and surplus doe kids for meat at a high price before weaning, and to forego the income from cashmere. In other cases, e.g. in herds producing greater quantities of high quality cashmere, it may be more profitable to keep the kids to an older age and heavier weight, foregoing the premium for milk-fed kid meat and taking a harvest of cashmere early the following year. The lower price per kg carcass weight might be compensated, at least to some extent, by the heavier ultimate carcass weight. One of the disadvantages of selling the male kids at a very early age is that it virtually precludes the possibility of breeding replacement bucks within the system; it is not possible to identify the individuals with superior fibre-producing potential until about five months of age or older. Where kids are sold at a very young age it would be necessary to purchase bucks from outwith the system.

In other situations, where there is no specialised meat market for very young kids, the surplus young stock would not normally be sold for meat until after their first fibre harvest. Where the climatic conditions dictate that at least this youngest age-group are in-wintered there are several options for the sale of surplus stock for meat. If no winter housing is available, the male and surplus female kids could be sold at the end of the grazing season, at 6-8 months of age. In such a system it could be worthwhile shearing the animals prior to slaughter. The evidence available to date indicates that there is little increase in the weight of cashmere produced by this age-group between October and the end of the year, and it is reasonable to assume that shearing in the autumn would yield at least 75% of the weight of cashmere if it were harvested in late winter or early spring.

Where kids are housed over winter their fibre is normally harvested at 10-12 months of age, by shearing in late January or early February, or by combing in late February or during March. In this situation there is again a choice of when to sell the surplus stock for meat. They could be sold immediately after the fibre has been harvested, thereby avoiding any further winter feeding costs, or they could be kept as yearlings for a further grazing season. This latter option would allow a substantial increase in live weight, and consequently in ultimate carcass weight, at minimal cost. In this option the yearlings could be shorn prior to slaughter in the autumn at approximately 18 months of age, thus yielding a full fleece and, say, 50% of an adult fleece within a period of 6-8 months.

In situations where one of the primary objectives of farming cashmere goats is to control biomass (e.g. to reduce fire hazards) or to bring about changes in vegetation (e.g. to control or eradicate certain undesirable plant species) herds comprising only males (in most cases castrates) may be more appropriate than herds of breeding does and their followers. Herds of castrates may also be well suited to some of the poorest land resources where the level of nutrition afforded by the available grazing is insufficient, even with some supplementary feeding, to meet the needs of does during pregnancy and lactation. Such castrate herds would be made up of perhaps five or six age-groups, with replacements being purchased as yearlings, and the oldest age-group being sold each year for meat.

Five production systems, in which surplus stock are sold for meat at different ages, are considered below. The names or titles attached to these systems are used only as a matter of convenience and, where they have a geographical connotation, are not intended to imply that they are the only system appropriate to that area, or that the system cannot be applied in other regions. The systems are:

1. the Mediterranean system, in which all male and surplus female kids are sold prior to weaning, and cast-for-age adult stock are sold later in the year.
2. the Alpine system, in which the climate dictates that all stock are in-wintered, but where there is sufficient housing for only the breeding stock and herd replacements. In this system the surplus kids are sold at the end of the grazing season at approximately 6-8 months of age at the same time as the cast-for age adults.
3. the Winter-housing system, in which the juvenile stock, but not necessarily the adults, are housed over winter and sold following their first cashmere harvest at 10-12 months of age. Cast-for-age adult stock are sold later in the year.

4. the Eighteen Month system, in which the surplus juveniles are sold are sold at approximately 18 months of age. Fibre harvests are taken at 10-12 months of age and again prior to sale for meat. Cast-for-age adult stock are sold at about the same time.
5. the Castrate system, in which no breeding stock are kept and which comprises six regular ages of castrate goats from which cashmere is harvested every spring. Replacement castrates are purchased at approximately 18 months of age from herds operating the Eighteen Month system, and the oldest age-group is sold for meat each year.

The following assumption have been made in calculating the output and income generated from the sale of animals for meat in the three National Herds established by different strategies:

- all female kids and yearlings are retained for breeding to expand the National Herds and consequently there is no income from the sale of this class of animals for meat.
- in the Mediterranean system the value of the milk-fed kid carcass is 45 ECU (the mean of the values quoted in Greece, Italy and Spain).
- in the Alpine system, in which kids are sold at 6-8 months of age, the average carcass weight is approximately 9 kg, valued at 4.5 ECU per kg, giving a value of 40 ECU per carcass.
- in the Winter-housing system, in which the kids are sold at 10-12 months of age, the average carcass weight is 12 kg, valued at 4.5 ECU per kg, giving a value of 54 ECU per carcass.
- in the Eighteen Month system the average carcass weight of the yearlings is 17 kg, valued at 4.0 ECU per kg, giving a value of 68 ECU per carcass.
- in the above four systems the average carcass weight of cast-for-age does is 20 kg, valued at 2.0 ECU per kg, giving a value of 40 ECU per carcass.
- in the above four systems the average carcass weight of adult bucks is 25 kg, valued at 1.6 ECU per kg, giving a value of 40 ECU per carcass.
- in each National Herd the Castrate system is an alternative to the selling of juvenile males for meat; instead, they are retained in herds comprising six age-groups. The number of castrates available for sale in Year 10 is therefore taken as the number of juvenile males in that herd in Year 5, adjusted for an annual mortality rate of 1%.
- the average carcass weight of the oldest castrate age group is 25 kg, valued at 1.6 kg per kg, giving a value of 40 ECU per carcass.

The numbers in each class of animal sold for meat in Year 10 from each of the National Herds established by different strategies, and the estimated income from these sales, are presented for each systems, in Table 8. The comparisons of income from meat sales between National Herds reflect the effect of animal numbers arising from the different establishment strategies (see Figure 6).

Comparisons between systems of management within the National Herds are also illustrated in Figure 6. These show that the income from sales of animals for meat is greater in the Mediterranean system, in which milk-fed kids are sold at a very young age, than in the Alpine system in which the kids are retained for longer and have a heavier carcass weight. The income in the Winter-housing system, in which the juvenile males are sold immediately after their first fibre harvest, is higher than in either the Mediterranean or Alpine systems, but the maximum income is achieved in the Eighteen Month system, despite a lower price per kg carcass weight. In each National Herd the income from sales of animals for meat is least in the Castrate system, in which only approximately one sixth of the animals are sold each year.

Table 8. Year 10 numbers of animals sold for meat and estimated income in the National Herds operating different management systems

System	Mediterranean	Alpine	Winter-housing	Eighteen Month	Castrate
Established from embryos					
Juvenile males (no.)	567	567	567	567	
Value ('000 ECU)	25.5	22.7	30.6	38.6	
Cast-for age does (no.)	86	86	86	86	
Value ('000 ECU)	3.4	3.4	3.4	3.4	
Adult males (no.)	34	34	34	34	91
Value ('000 ECU)	1.4	1.4	1.4	1.4	3.6
Total value ('000 ECU)	30.3	27.5	35.4	43.4	3.6
Established from live animals					
Juvenile males (no.)	3012	3012	3012	3012	
Value ('000 ECU)	135.5	120.5	162.6	204.8	
Cast-for age does (no.)	192	192	192	192	
Value ('000 ECU)	7.7	7.7	7.7	7.7	
Adult males (no.)	81	81	81	81	377
Value ('000 ECU)	3.2	3.2	3.2	3.2	15.1
Total value ('000 ECU)	146.4	131.4	173.5	215.7	15.1
Established by grading-up					
Juvenile males (no.)	658	658	658	658	
Value ('000 ECU)	29.6	26.3	35.5	44.7	
Cast-for age does (no.)	384	384	384	384	
Value ('000 ECU)	15.4	15.4	15.4	15.4	
Adult males (no.)	26	26	26	26	213
Value ('000 ECU)	1.0	1.0	1.0	1.0	8.5
Total value ('000 ECU)	46.0	42.7	51.9	61.1	8.5

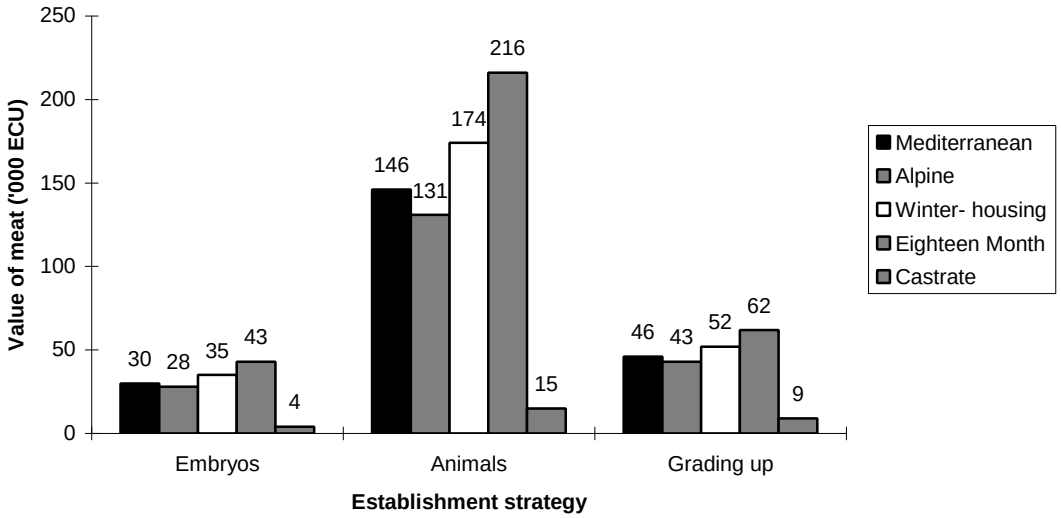

Figure 6. Year 10 estimated income from the sale of animals for meat in different systems operated in the National Herds established by different strategies

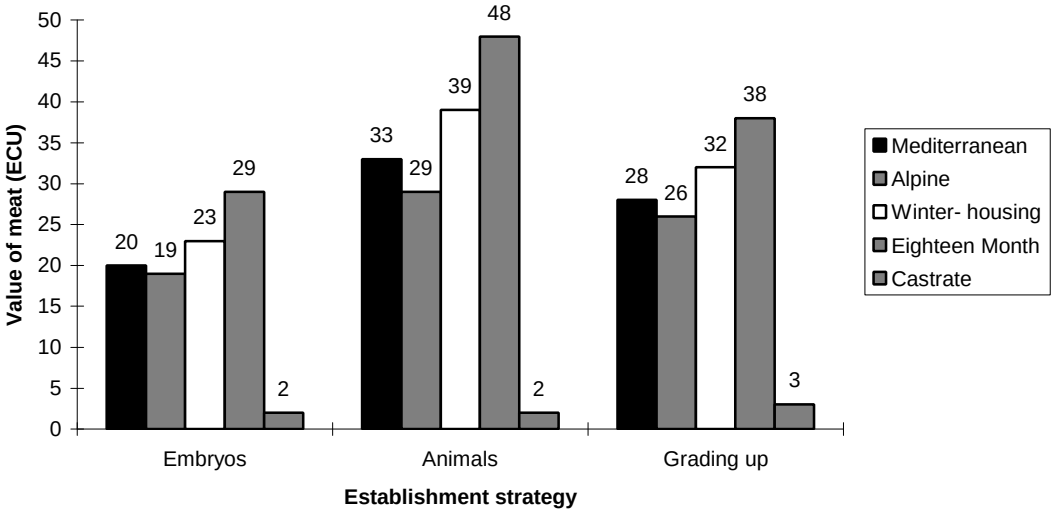

Figure 7. Year 10 estimated income, per breeding doe or adult castrate, from the sale of animals for meat in different systems operated in the National Herds established by different strategies

As argued above in relation to income from the sale of cashmere, the return per breeding doe (or in the case of the Castrate system, per animal in the herd) is more important from the perspective of the individual farmer than the value of sales from the National Herd. The data presented in Figure 7 show that, in comparisons between strategies of establishment, the Year 10 income per breeding doe from the sale of animals for meat is greatest in the National Herd based on the import of live animals.

Comparisons between the different management systems show that the greatest return is achieved from the Eighteen Month system, in which the additional carcass weight gained during the second grazing season more than compensates for the lower price per kg. In general it can be seen that, with the exception of the Castrate system, the income tends to increase with carcass weight; there is a slight advantage in the Mediterranean system of selling milk-fed kids for premium, rather than keeping them to 6-8 months of age, as in the Alpine system, but the margin is small. The very poor return shown for the Castrate system is unduly low, in that the number of animals in the oldest age-group (which entered the herd as yearlings in Year 5) is substantially less than one sixth of a regular-aged herd. In such a herd the income would be 6.5 ECU per head.

Sale of breeding stock

In the three National Herds considered above it is assumed that all female stock, other than cast-for-age does, are retained within the herd to achieve the desired rapid increase in numbers. With the exception of the Grading-up National Herd, in which replacement bucks are imported, breeding males come from within the herd and those surplus to requirements are sold for meat. Thus, no breeding stock are sold outwith the National Herd. In practice, however, the National Herds are made up of individual enterprises, some of which will specialise in breeding either or both yearling does and bucks for sale as breeding stock. It is therefore reasonable to consider the income generated from sales of breeding stock on the basis of a herd of 250 breeding does. The calculation of income from this source contains the following assumptions:

- does are retained in the herd for six kid crops
- the average kidding rate is 1.4 kids per doe
- the average mortality rate is 3%
- 45 yearling does are retained as herd replacements
- 125 yearling does are sold for breeding
- 17 (10%) of the yearling bucks are sold for breeding
- in Year 10 the value of breeding stock sold from the National Herds established from live animal imports has fallen to 50% of that of imported live animals
- stock from the National Herds established from embryos commands a premium of 50%
- the values of breeding stock are as presented in Table 9.

Table 9. Initial and Year 10 values of breeding stock

	Initial Value (ECU per head)	Year 10 values (ECU per head) National Herd established from		
		Embryos	Live Animals	Grading-up
Does	240	180	120	120
Bucks	700	525	350	350

Estimates of the income from the sale of breeding stock from the 250-doe herd are presented in Table 10 and illustrated on a per doe basis in Figure 8.

Table 10. Estimated income from sale of breeding stock (ECU)

	National Herds established from		
	Embryos	Live Animals	Grading-up
Does	22,500	15,000	15,000
Bucks	9,375	5,950	5,950
Total	31,875	20,950	20,950

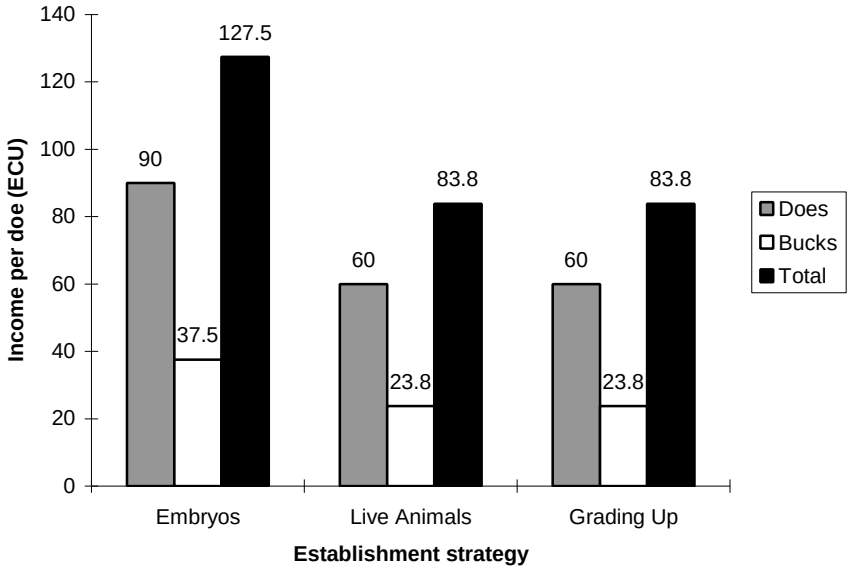

Figure 8. Estimated income per doe from sale of breeding stock

Gross margin analyses

The gross margin analyses are all based on estimates of output and variable costs in Year 10.

In the analyses, output is calculated as the income from the sale of cashmere from adult and juvenile stock, from adult and juvenile animals sold for slaughter for meat and, where appropriate, from the sale of male and female breeding stock, less the cost of replacement males (either breeding bucks or, in the case of the Castrate system, yearling castrates). The values used in calculating these outputs are those adopted in the sections on cashmere production, meat production and the sale of breeding stock.

In calculating variable costs, concentrate feeds are charged at 225 ECU per tonne. Hay is charged at 150 ECU per forage ha and grazing at 125 ECU per forage ha. Miscellaneous costs include commission on the marketing and grading of the cashmere, and therefore vary according to the level of fibre production, and the costs of haulage and marketing of stock sold for slaughter and for breeding.

All cashmere goat enterprises produce cashmere and sell surplus stock for slaughter for meat, but only some will specialise in the selling of breeding stock. Estimates of gross margins for the five production systems and for each of the three establishment strategies have therefore been calculated with and without the sale of breeding stock. It has been assumed that where breeding stock are produced for sale, these animals are marketed as yearlings. As shown in the following tables, the sale of breeding stock affects not only the number of animals available for slaughter for meat, but has implications for the number of animals kept over winter and from which cashmere is harvested.

The sensitivity analyses show the effects on estimated gross margins of changes (positive or negative) of 10% in cashmere, meat and breeding stock prices and in kidding rate. (*Note.* A change of 10% in kidding rate is defined as a change from 140% to either 130% or 150%, as not as 10% of 140%.) The effects of greater or lesser changes in product prices and kidding rate are readily calculated from the information presented. Changes in breeding stock prices have effects on the cost of replacement bucks as well as on the income from breeding stock sales. In the castrate systems no changes in the cost of replacements are shown against stock replacements, as these will be affected by meat prices rather than the price of breeding stock. Changes in kidding rate affect the numbers sold for both breeding and for meat.

Estimates of gross margins and effects of changes in product prices and kidding rate from enterprises not selling breeding stock are presented in Tables 11, 12 and 13, and are illustrated in Figure 9. Corresponding estimates for enterprises selling breeding stock are contained in Tables 14, 15 and 16 and are illustrated in Figure 10.

Table 11. Estimated gross margins (ECU per 100 does) from different production systems for National Herds established from embryos (with no sales of breeding stock)

	Mediterranean	Alpine	Winter-housing	Eighteen Month	Castrate
Output					
Cashmere: adults	4,774	4,774	4,774	4,774	4,658
juveniles	420	2,311	2853	4,281	
Total cashmere value	5,194	7,085	7,627	9,055	4,658
Sold for meat: adults	700	700	700	700	648
juveniles	5,400	4,800	6,377	8,030	
Total meat value	6,100	5,500	7,077	8,730	648
less Replacement males	1,313	1,313	1,313	1,313	1,156
Total output	**9,981**	**11,272**	**13,391**	**16,472**	**4,150**
Variable costs					
Concentrates: adults	560	560	560	560	
juveniles	60	120	430	225	
Total concentrate costs	620	680	990	785	
Forage (including hay)	910	1,225	1,025	1,400	50
Veterinary costs	300	400	400	450	150
Miscellaneous	360	450	480	550	300
Total Variable Costs	**2,190**	**2,755**	**2,895**	**3,185**	**500**
Gross margin	**7,791**	**8,517**	**10,496**	**13,287**	**3,650**
Sensitivity to changes of 10% (±) in:					
Cashmere price	519	709	763	906	466
Meat price	610	550	708	873	65
Replacement buck prices	131	131	131	131	
Kidding %	450	400	540	680	

Table 12. Estimated gross margins (ECU per 100does) from different production systems for National Herds established from imported live animals (with no sales of breeding stock)

	Mediterranean	Alpine	Winter-housing	Eighteen Month	Castrate
Output					
Cashmere: adults	1,695	1,695	1,695	1,695	1,654
juveniles	144	792	978	1485	
Total cashmere value	1,839	2,487	2,673	3,180	1,654
Sold for meat: adults	700	700	700	700	648
juveniles	5,400	4,800	6,377	8,030	
Total meat value	6,100	5,500	7,077	8,730	648
less Replacement males	875	875	875	875	1,156
Total output	**7,064**	**7,112**	**8,875**	**11,035**	**1,146**
Variable costs					
Concentrates: adults	560	560	560	560	
juveniles	60	120	430	225	
Total concentrate costs	620	680	990	785	
Forage (including hay)	910	1,225	1,025	1,400	50
Veterinary costs	300	400	400	450	150
Miscellaneous	190	225	235	260	150
Total Variable Costs	**2,020**	**2,530**	**2,650**	**2,895**	**350**
Gross margin	**5,044**	**4,582**	**6,225**	**8,140**	**796**
Sensitivity to changes of 10% (±) in:					
Cashmere price	184	249	267	318	165
Meat price	610	550	708	873	65
Replacement buck prices	88	88	88	88	
Kidding %	450	400	540	680	

Table 13. Estimated gross margins (ECU per 100 does) from different production systems for National Herds established by grading-up (with no sales of breeding stock)

	Mediterranean	Alpine	Winter-housing	Eighteen Month	Castrate
Output					
Cashmere: adults	2,652	2,652	2,652	2,652	2,588
juveniles	233	1,281	1,581	2,374	
Total cashmere value	2,885	3,933	4,233	5,026	2,588
Sold for meat: adults	700	700	700	700	648
juveniles	5,400	4,800	6,377	8,030	
Total meat value	6,100	5,500	7,077	8,730	648
less Replacement males	1,750	1,750	1,750	1,750	1,156
Total output	**7,235**	**7,683**	**9,560**	**12,006**	**2,080**
Variable costs					
Concentrates: adults	560	560	560	560	
juveniles	60	120	430	225	
Total concentrate costs	620	680	990	785	
Forage (including hay)	910	1,225	1,025	1,400	50
Veterinary costs	300	400	400	450	150
Miscellaneous	245	295	310	350	200
Total Variable Costs	**2,075**	**2,600**	**2,725**	**2,985**	**400**
Gross margin	**5,160**	**5,083**	**6,835**	**9,021**	**1,680**
Sensitivity to changes of 10% (±) in:					
Cashmere price	289	393	423	503	259
Meat price	610	550	708	873	65
Replacement buck prices	175	175	175	175	
Kidding %	450	400	540	680	

Table 14. Estimated gross margins (ECU per 100 does) from different production systems for National Herds established from embryos (including sales of breeding stock)

	Mediterranean	Alpine	Winter-housing	Eighteen Month	Castrate
Output					
Cashmere: adults	4,774	4,774	4,774	4,774	4,658
juveniles	1,614	2,610	2,853	4,281	
Total cashmere value	6,388	7,384	7,627	9,055	4,658
Sold for meat: adults	700	700	700	700	648
juveniles	2,844	2,528	3,310	4,168	
Total meat value	3,544	3,228	4,010	4,868	648
Sold for breeding: does	9,000	9,000	9,000	9,000	
bucks	3,570	3,570	3,570	3,570	
Total breeding sales value	12,750	12,750	12,750	12,750	
less Replacement males	1,313	1,313	1,313	1,313	1,156
Total output	**21,189**	**21,869**	**22,894**	**25,180**	**4,150**
Variable costs					
Concentrates: adults	560	560	560	560	
juveniles	225	430	430	225	
Total concentrate costs	785	785	785	785	
Forage (including hay)	950	1,325	1,025	1,400	50
Veterinary costs	350	450	400	450	150
Miscellaneous	420	470	480	550	300
Total Variable Costs	**2,505**	**3,235**	**2,895**	**3,185**	**500**
Gross margin	**18,684**	**18,661**	**19,999**	**21,995**	**3,650**
Sensitivity to changes of 10% (±) in:					
Cashmere price	639	738	763	906	466
Meat price	354	329	401	487	65
Breeding stock prices	1406	1406	1406	1406	
Replacement buck prices	131	131	131	131	
Kidding %	1508	1458	1598	1738	

Table 15. Estimated gross margins (ECU per 100 does) from different production systems for National Herds established from imported live animals (including sales of breeding stock)

	Mediterranean	Alpine	Winter-housing	Eighteen Month	Castrate
Output					
Cashmere: adults	1,695	1,695	1,695	1,695	1,654
juveniles	553	894	978	1,485	
Total cashmere value	2,248	2,589	2,673	3,180	1,645
Sold for meat: adults	700	700	700	700	648
juveniles	2,844	2,528	3,310	4,168	
Total meat value	3,544	3,228	4,010	4,868	648
Sold for breeding: does	6,000	6,000	6,000	6,000	
bucks	2,380	2,380	2,380	2,380	
Total breeding sales value	8,380	8,380	8,380	8,380	
less Replacement males	875	875	875	875	1,156
Total output	**13,297**	**13,322**	**14,188**	**15,553**	**1,146**
Variable costs					
Concentrates: adults	560	560	560	560	
juveniles	225	430	430	225	
Total concentrate costs	785	785	785	785	
Forage (including hay)	950	1,325	1,025	1,400	50
Veterinary costs	350	450	400	450	150
Miscellaneous	210	230	235	260	150
Total Variable Costs	**2,295**	**2,995**	**2,650**	**2,895**	**350**
Gross margin	**11,002**	**10,327**	**11,538**	**12,658**	**796**
Sensitivity to changes of 10% (±) in:					
Cashmere price	225	259	267	318	165
Meat price	354	323	401	467	65
Breeding stock prices	926	926	926	926	
Replacement buck prices	88	88	88	88	
Kidding %	1155	1105	1245	1385	

Table 16. Estimated gross margins (ECU per 100 does) from different production systems for National Herds established by grading-up (including sales of breeding stock)

	Mediterranean	Alpine	Winter-housing	Eighteen Month	Castrate
Output					
Cashmere: adults	2,652	2,652	2,652	2,652	2,588
juveniles	894	1,446	1,581	2,374	
Total cashmere value	3,546	4,098	4,233	5,026	2,588
Sold for meat: adults	700	700	700	700	648
juveniles	2,844	2,528	3,310	4,168	
Total meat value	3,544	3,228	4,010	4,868	648
Sold for breeding: does	6,000	6,000	6,000	6,000	
bucks	2,380	2,380	2,380	2,380	
Total breeding sales value	8,380	8,380	8,380	8,380	
less Replacement males	1,750	1,750	1,750	1,750	1,156
Total output	**13,720**	**13,956**	**14,873**	**16,524**	**2,080**
Variable costs					
Concentrates: adults	560	560	560	560	
juveniles	225	430	430	225	
Total concentrate costs	785	785	785	785	
Forage (including hay)	950	1,325	1,025	1,400	50
Veterinary costs	350	450	400	450	150
Miscellaneous	280	305	310	350	200
Total Variable Costs	**2365**	**3,070**	**2,725**	**2,985**	**400**
Gross margin	**11,355**	**10,886**	**12,148**	**13,539**	**1,680**
Sensitivity to changes of 10% (±) in:					
Cashmere price	355	410	423	503	259
Meat price	354	323	401	487	65
Breeding stock prices	1013	1013	1013	1013	
Replacement buck prices	175	175	175	175	
Kidding %	1155	1105	1245	1385	

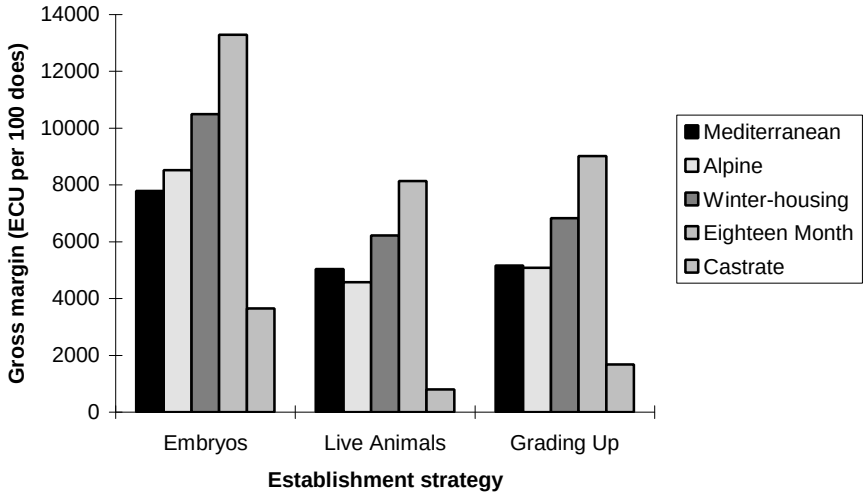

Figure 9. Estimated gross margins from five production systems established by different strategies and with no breeding stock sales

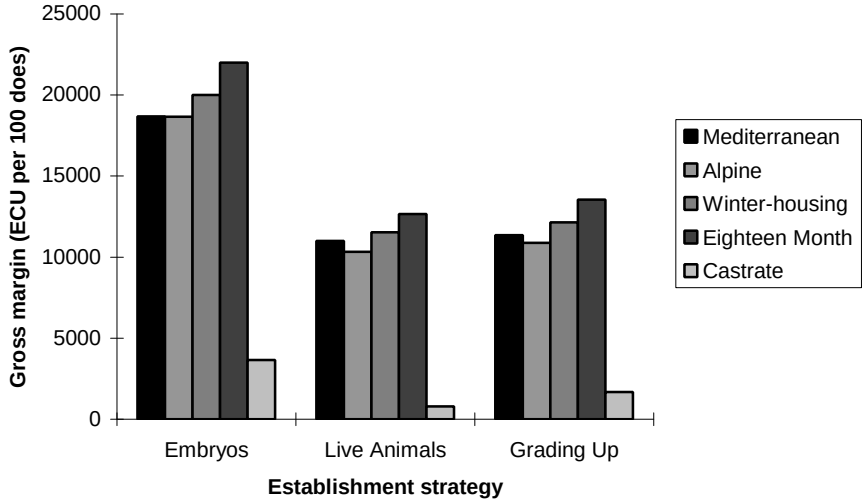

Figure 10. Estimated gross margins from five production systems established by different strategies and including breeding stock sales

The gross margin analyses show clearly the advantage of National Herds established from the importation of embryos as opposed to live animals. This advantage is attributable in part to the higher returns accruing from their greater weights of higher quality cashmere, and in part to the premium which the superior breeding stock commands. The gross margins from herds established by the grading-up of native goats are also consistently higher than those of herds based on imported live animals, although the advantage is small. Overall, the gross margins from herds established from embryos, and from which no breeding stock are sold, are 76% greater than those established from live animals and 57% greater than those established by grading-up; the corresponding advantages in gross margins from herds selling breeding stock are 79% and 67%.

Another major feature of the analyses is the substantially greater gross margins achieved in herds selling breeding stock. This advantage varies from 76% in herds established by grading-up to 90% in herds

established from embryos. In most livestock systems the sale of breeding stock is generally confined to a minority of enterprises, but in an expanding new industry, such as cashmere production, the opportunities to sell quality breeding stock of both sexes are greater and, as the analyses indicate, can bring substantial rewards.

Comparisons of the five management systems considered indicate that, in general, gross margins increase with the age at which the surplus juvenile stock are sold. The exception to this generalisation is the Alpine system in which, despite higher outputs, the gross margins are, in five of the six examples presented, lower than in the corresponding Mediterranean system. In the Mediterranean system the higher price achieved in the speciality market for the very young kid meat is more than offset by the loss of income from cashmere, and the total value of the outputs is less than in the Alpine system. The higher variable costs of the latter system, however, result in lower gross margins, except in the case of herds established from embryos and from which no breeding stock are sold.

The values of the outputs from the Winter-housing and Eighteen Month systems are substantially higher than those from the systems in which surplus stock are sold at earlier ages. This arises in part from the greater weights of cashmere harvested - a full juvenile fleece plus half an adult fleece in the case of the Eighteen Month system - and in part from the heavier weights of the prime juvenile carcasses. In all cases the Eighteen Month system yields the highest gross margins.

The gross margins from the castrate system are, as would be expected, substantially lower than those from systems based on breeding does. Comparisons of the gross margins from castrate herds originating from different establishment strategies illustrate the importance of ensuring that such herds comprise stock producing high levels of high quality cashmere. The estimated gross margin from herds originating from stock based on embryos is more than four times that from herds established from live animal imports, and indeed is less than 30% lower than that of a herd of breeding does in a Mediterranean system from which no breeding stock are sold.

Direct comparisons of breeding and non-breeding systems are, however, scarcely valid, as castrate goats are generally kept only on the poorer land resources which cannot support the higher nutritional requirements of pregnant and lactating does. In some cases castrate herds are maintained not only for their fibre and meat outputs, but as tools to control biomass or bring about certain desirable vegetational changes (see page 28).

The sensitivity analyses included in Tables 11 - 16 indicate the effects on estimated gross margins of changes, both positive and negative, in the prices of cashmere, animals sold for meat and as breeding stock, and in kidding rate.

These analyses indicate that in herds established from embryos and not selling breeding stock, changes in cashmere prices have the greatest effects on gross margins in most management systems. However, in herds with lower levels of fibre production, i.e. those established from live animals and by grading-up, changes in goatmeat prices have a greater effect than changes in cashmere prices.

In those herds selling breeding stock, changes in kidding rate, which determine the numbers of animals available for sale at high prices for breeding, have greater effects on gross margins than changes in the price of either cashmere or animals slaughtered for meat.

The largest changes in gross margins as a result of changing product prices and kidding rate are observed in the Eighteen Month system, which has the highest level of cashmere production and the highest carcass weights.

Support payments

The above gross margin analyses do not include any subsidy payments. Levels of support vary widely between countries and between areas within countries, and are not applied uniformly throughout the EU (although in most cases the major part of the support is paid by the European Commission) or to any of the particular systems considered in this study.

In those countries and regions within countries where goats are recognised as eligible for support under the Sheep and Goat Meat Regime, the main subsidy is paid as an Annual Premium. The level of this support has varied widely in recent years, but is currently valued at 12 ECU per doe. In addition, goat enterprises in the Less Favoured Areas of those regions paying Annual Premiums on goats are eligible for a supplement currently worth 4.6 ECU per doe.

Hill Livestock Compensatory Allowances are also paid on goats in certain countries, including some, but not all, of those in which goats are eligible for Annual Premium payments. The level of these HLCA payments varies between regions.

It is not possible in this study to consider in detail the effects of Annual Premium payments, Less Favoured Area supplements and Hill Livestock Compensatory Allowances on the gross margins of cashmere goat enterprises operating under different management systems in the many regions of all the EU member states. It is, however, a simple matter to add subsidy payments, which will range from 0 to about 3,200 ECU per 100 does depending on the location of the enterprise, to the gross margin estimates presented above.

Value of goat grazing

The grazing preferences of goats are very different from those of cattle and sheep. Research results from New Zealand, the UK, and more recently from Spain, have demonstrated that the grazing by goats of certain plant communities can bring about significant desirable changes in botanical composition, which can lead to improvements in the nutrition and hence the productivity of other ruminant livestock, as well as that of the goats themselves.

It has been amply demonstrated that goats can be used to control and, if desired, eradicate what are generally regarded as undesirable plant species, such as rushes (*Juncus spp.*) gorse (*Ulex spp.*), bracken (*Pteris aquilina),* thistles (*Cardus spp.*) nettles (*Urtica urens*) blackberry or bramble (*Rubus fructicosus),* docks (*Rumex spp.*) and many other species. The control of such species by grazing is more environmentally and ecologically acceptable than the use of expensive herbicides, which are frequently hazardous to those using them and to wildlife in the area.

The use of the goat's grazing preferences to bring about changes in botanical composition of sown or indigenous pastures has a significant monetary value which should be quantified and considered as an output in calculating the gross margin of a cashmere goat enterprise. The degree of infestation of pastures with the plant species mentioned above varies widely from country to country and between regions within countries, and it is therefore difficult to attach precise values to the benefits of improvements brought about by goat grazing. The following figures are intended only as an approximate guide to likely values.

Infestations of rushes in sown pasture can be controlled by grazing with goats, and can be eradicated by mob stocking at a rate of about 30 goats per ha for three months per year for two to three years. Severe defoliation in the late summer is likely to be most effective. Eradication using herbicides costs about 135 ECU per ha, and it can thus be calculated that the value of achieving the same end result by grazing is some 2 ECU per goat per year.

Gorse can be controlled and effectively eradicated over a period of three to four years by stocking the area with goats at a rate of about five adults per ha. The green shoots of gorse have a relatively high nutritive value, particularly in winter, and the stocking can be with either castrates or breeding does and juveniles. The cost of eradicating gorse with the recommended herbicide is of the order of 180 ECU per ha. If this cost is apportioned over, say, four years to goats stocked at five per ha, this can be regarded as equivalent to an output of 9 ECU per goat per year. It is reasonable to assume an increase in herbage dry matter production, as a consequence of the gorse eradication, of some 1500 kg per ha. This has a value of approximately 0.15 ECU per kg, and assuming an efficiency of utilisation of 45%, is equivalent to more than 100 ECU per ha per year, or some 20 ECU per goat per year. Adding this to the above 9 ECU per goat per year gives a total annual value of some 29 ECU per goat.

Goats have also been shown to have the ability to eradicate bracken. This plant species can be toxic and care should be taken to avoid excessive grazing pressures, particularly with lactating does. A stocking rate of about five goats per ha over a period of four to five years has again been shown to provide effective control. The cost of bracken eradication with herbicides is similar to that for gorse at, say 180 ECU per ha. As bracken is generally found on somewhat richer soil types, an increase in herbage dry matter production of 2000 kg per ha is assumed. Again assuming a value of 0.15 ECU per kg herbage dry matter and an efficiency of utilisation of 45%, it can be calculated that this is equivalent to some 36 ECU per goat per year.

Fires in forests and of undergrazed vegetation on hill and marginal land are a serious problem, not only in the drier Mediterranean countries, but throughout the EU. The costs of such fires are substantial, in terms of their control, the biomass destroyed and the ecological damage which they cause. In many cases the grazing attributes of goats could be harnessed to reduce fire hazard. For example, herds of castrate cashmere goats could be used profitably to graze hill pastures from which sheep and dairy goats have been removed because of the marginal economics of milk production enterprise from these poorer land resources. Similarly, the grazing by goats of fire breaks in and around forests could do much to lessen the risk and severity of forest fires.

The gross margin analyses presented above indicate that cashmere goat enterprises based on castrate herds could be potentially profitable, particularly if these herds comprise animals producing heavier weights of high quality cashmere. Where such herds are also used to control biomass, either by eradicating undesirable plant species or to reduce a potential fire hazard, the economics of cashmere production from castrate goats are even more attractive. For example, adding a value of, say, 30 ECU per goat used to control gorse or bracken to the output from a castrate herd based on embryos (see Table 11) gives a gross margin of some 66 ECU per goat from an enterprise suited to marginal land resources. Such enterprises merit serious consideration.

The control of undesirable plant species by goat grazing can be used with advantage to benefit other ruminant species, and particularly sheep and cattle. The grazing preferences of goats can also be used to benefit other livestock by other means. In mixed swards, goats tend to discriminate against clover, particularly in its vegetative growth stage, and it has been shown that, as a consequence of higher proportions of clover, weaned lambs grazing swards of ryegrass and white clover previously grazed by goats gain weight more rapidly than those grazing swards previously grazed by sheep.

The goat's dietary preference for grass seedheads also affords opportunities for enhanced performance from sheep and cattle in mixed grazing systems with goats.

Cashmere production from the dairy herd

Dairy goats are double-coated and produce small quantities of fine fibre in their undercoat. Although these fibres fall within the range of cashmere as regards diameter, they are generally very short and present in insufficient quantity to make them worthwhile harvesting. The energy and protein requirements for fibre production are small, relative to those of milk production, and there would appear to be possibilities of combining the production of milk and cashmere within one genotype without making excessive physiological demands on the animal. The limited information available on the production and composition of milk from cashmere-type goats indicates that, in the suckling situation, they produce comparable quantities of milk fat, but less milk protein, than dairy goats[1].

The development of a triple-purpose goat, producing significant quantities of milk and cashmere, as well as meat, would arguably be best achieved by simultaneous selection for fibre and milk within a crossbred population. In a recent study[2] of the economics of fibre and meat production in Norwegian dairy goats it is argued that the incorporation of increased fibre production from dairy goats would help to reduce the present surplus of goat milk production. The economics of a variety of management systems, involving kidding at different seasons and retaining the progeny for varying lengths of time, are considered, and it is concluded that cashmere production from dairy goat herds could be practicable and has the potential to improve the profitability of dairy goat enterprises by more than 20%.

[1] Russel, A. J. F. and Adkins, J. E., 1990. *Animal Production* **50:** 565 (Abstract)

[2] Asheim, L. J. and Eik, L. O., 1998. *Small Ruminant Research* (in press)

Conclusions

Cashmere production has been demonstrated to be technically feasible in a wide variety of climatic and topographic conditions in different regions of the UK, Spain and Italy, and is likely to be practicable in most, if not all, EU member states.

There is a strong internal market, particularly in the UK and Italy, for high quality cashmere fibre produced in the EU.

The results of this study indicate that cashmere production is likely to be economically viable and that it constitutes a potentially valuable avenue for livestock diversification. It is well suited to a wide range of management systems, including extensive and semi-extensive systems of production on the more marginal land resources of the Less Favoured Areas. It has the potential to make a significant contribution to the economy of rural areas by providing a less demanding, and therefore more attractive, system of management than sheep or goat milk production enterprises.

In establishing cashmere production enterprises in regions which currently have no indigenous cashmere goats, it is important to acquire stock with a genetic potential for the production of high weights of quality cashmere. This will ensure high returns not only from the sale of cashmere, but also from the premium which superior breeding stock are likely to command. Superior stock are more likely to be based on embryos than live animals, as breeders are generally unwilling to sell their best breeding does, although they are prepared to use them as donors of embryos.

Cashmere production enterprises would be expected to have a positive environmental impact through the grazing of currently underutilised vegetation, thereby enhancing landscape and reducing the risk of grass and forest fires. The use of goats to control undesirable plant species is more ecologically acceptable than the use of selective herbicides. Their discriminative grazing can also be harnessed to improve the nutrition of other species of ruminant livestock in complementary grazing systems.

On the poorer land resources which cannot support herds of breeding does, an extensive, low-cost management system based on adult castrates offers a potentially profitable use of such areas.

It is concluded that cashmere production would constitute a viable alternative to traditional forms of livestock farming throughout the EU, and would also bring substantial benefits to the European textile industry.

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