



Crossbred lamb production in the hills

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Executive Summary

1. In order to maintain farm incomes farmers must increase/improve the productivity of their sheep. A number of options are available including changing to a bigger hill ewe, improving the genetic basis of their current stock, introducing crossbred ewes or switching to crossbred lamb production.
2. Over a three year period the physical performance of crossbred lambs produced from Welsh Mountain ewes has been monitored at ADAS Pwllpeiran. Over the same three year period the physical performance of pure bred Welsh Mountain lambs reared under traditional management was also monitored.
3. Over the three year period 1,800 Welsh Mountain ewes were mated to either Cheviot, Dorset, Lleyn or Texel rams. Lambs were weighed at birth, 5, 10 and 16 weeks of age. Lambs were weaned at 16 weeks. From 16 weeks of age male lambs were assessed fortnightly for those that had reached a finished condition of fat class 2/3L.
4. Over the three year period 1,800 matings were achieved with 1343 ewes lambing (2043 lambs) with an overall conception rate of 0.75.
5. Over 90% of all births required no assistance at lambing. 15% of Texel X, 11% of Dorset X, 9.5% of Cheviot X and 8% of Lleyn X births were categorised as incurring moderate lambing difficulties.
6. Dorset X (3.6 kg) and Texel X (3.6 kg) lambs were significantly heavier ($P < 0.05$) at birth compared to Lleyn X (3.4 kg) lambs. Cheviot X lambs were of intermediate birth weight (3.5 kg). Average birth weight of pure bred Welsh Mountain lambs was 3.3 kg.
7. At 5 weeks of age Dorset X (14.6 kg) and Texel X (14.8 kg) lambs were significantly heavier ($P < 0.01$) than Cheviot X (13.9) and Lleyn X (13.5 kg) lambs.



8. This difference in growth rate was also apparent at 10 weeks of age when Dorset X (22.6 kg) and Texel X (22.8 kg) lambs were significantly heavier ($P < 0.001$) than Cheviot X (21.5 kg) and Lleyn X (20.8 kg) lambs. The average 10 week weight for pure bred Welsh Mountain lambs was 19.4 kg.
9. At sixteen weeks of age Dorset X (27.9 kg) and Texel X (28.1 kg) were significantly heavier ($P < 0.01$) than Cheviot X (26.5 kg) and Lleyn X (26.1) lambs. The pure bred Welsh Mountain lambs were weaned 3 weeks later (19 weeks of age) than the crossbred lambs and weighed on average 25.7 kg.
10. Dorset X and Texel X lambs had significantly greater ($P < 0.001$) daily liveweight gains from birth to sixteen weeks of age compared to Cheviot X and Lleyn X lambs (0.215 kg and 0.216 kg vs. 0.204 kg and 0.201 kg respectively).
11. There were significant differences between crossbred lambs in age at finishing ($P < 0.001$). Average age at finishing was 24 weeks, 26 weeks, 27 weeks and 28 weeks for Texel X, Dorset X, Lleyn X and Cheviot X lambs respectively. Average age at finishing for pure bred Welsh Mountain lambs was 32 weeks.
12. Texel X and Dorset X lambs were significantly heavier at finishing ($P < 0.001$) than Lleyn X lambs (39.5 kg and 39.4 kg vs. 37.8 kg respectively). Cheviot X lambs (38.7 kg) were not significantly different in weight at finishing to other crossbred lambs. Pure bred Welsh Mountain lambs were on average 32.4 kg at finishing.
13. Texel X lambs had significantly better ($P < 0.001$) conformation scores on the EUROP classification than other crossbred lambs. 83.6% of Texel X lambs were graded as R or higher. 70.3 % of Cheviot X lambs graded as R or higher. 53.6% of Dorset X and 52.0% of Lleyn X lambs graded as R or higher. 50% of pure bred Welsh Mountain lambs were graded as R or higher.



14. The financial performance of crossbred lambs was calculated using standard costings from the Farm Business Survey. The lamb value of finished crossbred lambs was £40.25, £40.98, £39.31 and £41.08 for Cheviot X, Dorset X, Lleyn X and Texel X lambs respectively. The lamb value for pure bred Welsh Mountain lambs was £32.72.
15. Gross margins (before forage costs) were calculated for Welsh Mountain ewes producing crossbred lambs by natural service. The gross margin (£/ewe) was £35.49, £33.90, £33.98 and £35.81 for ewes producing Cheviot X, Dorset X, Lleyn X and Texel X lambs respectively. The same calculation was carried out for Welsh Mountain ewes producing pure bred lambs and the gross margin (£/ewe) was £24.63.
16. The production of crossbred lambs from Welsh Mountain ewes can result in an increase in finished lamb output, both in terms of kilogram of finished lamb and in an improvement in carcass gradings.
17. The improvements in physical performance result in an increase in the gross margins (before forage costs) per ewe.
18. Other benefits include shorter time taken to finish crossbred lambs compared to pure bred lambs.
19. Switching to crossbred lamb production can maintain farm incomes where stock numbers are reduced overall.



Introduction

Incomes of hill farmers measured by gross margin have decreased by 45% over the last 20 years. This in turn has put increased constraints on labour available for specific tasks during the sheep year. Consequently, farmers must identify new avenues to maintain incomes and minimise labour inputs.

In order to maintain incomes, farmers must increase/improve the productivity of their sheep. This could be done by changing to a bigger hill ewe, improving the genetic base of their current stock or by introducing crossbred ewes.

Using a bigger hill breed would increase kg of lamb produced per ewe but would not necessarily meeting market requirements in terms of conformation or fat class. Improving the genetic base of a flock is a long term investment even when part of a group breeding scheme. Although hill farmers do produce crossbred lambs, traditionally the female lambs are sold to farmers in the uplands or lowlands for crossing with a terminal sire breed and the male lambs become part of the slaughter generation. The hybrid vigour associated with a crossbred ewe is then capitalised by the upland or lowland farmer rather than the hill farmer. Switching to a crossbred ewe could offer advantages in that kg of lamb per ewe would be increased; and using crossing sires with desirable conformation traits and lean:fat ratios, lambs produced would be nearer to market requirements. However, the question remains as to whether the hybrid vigour of the crossbred ewe can be exploited in the hills, and whether traits such as hardiness are comprised.

Objectives of the Project

The overall objective of the project is to monitor the physical performance of crossbred ewes under a hill management system. The project has two phases, Phase 1 was the production phase with Phase 2 being the evaluation phase.



During Phase 1 the objective was to monitor the physical performance of crossbred lambs produced from pure bred Welsh Mountain ewes under a hill management system.

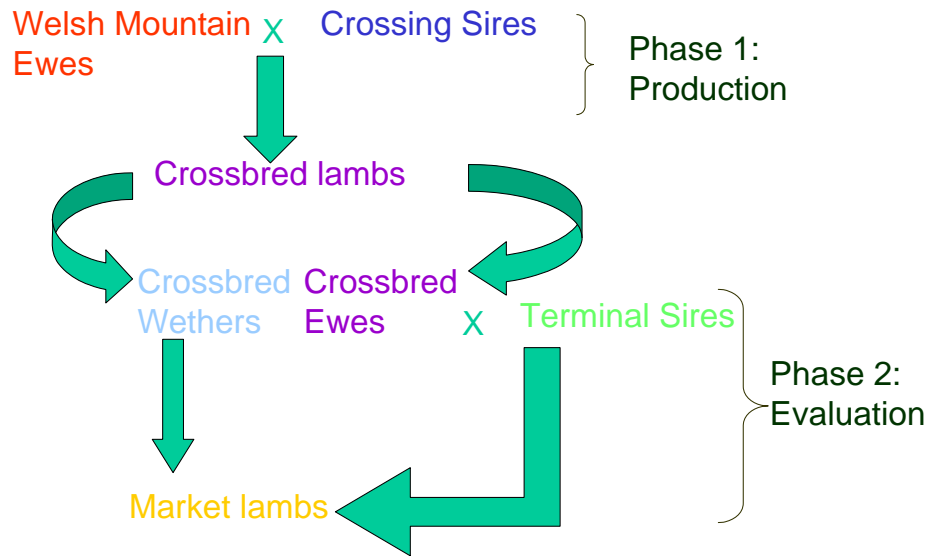
This report will deal only with the results of Phase 1 – the production phase and will focus on the potential of crossbred lambs for maintaining farm incomes.

Methodology

In order to produce crossbred ewes for evaluation in the hills, a stepwise approach was taken to the project. In Phase 1, crossing sires were mated to Welsh Mountain ewes. The breeds used were Cheviot, Dorset (Poll), Lleyn and Texel. Each breed was chosen for a particular trait. The Cheviot was chosen for the increase in size of frame whilst maintaining hardiness. The Dorset was chosen for reproductive performance in terms of a wider breeding season and earlier maturity. The Lleyn was chosen for its maternal characteristics and finally the Texel was chosen for its terminal sire qualities. 50 ewe lambs from each breed and in each of 3 years were retained for breeding. All male lambs were finished and sent for slaughter. During phase 2, which is on-going, crossbred ewes are being mated to a terminal sire and all lambs will be finished and sent for slaughter. The overall scheme is shown diagrammatically below in Figure 1.



Figure 1: Diagrammatic representation of the stepwise breeding programme





Experimental Protocol

Over a 3 year period (2000 – 2002), a total of 1,800 matings were achieved. In October of each year, 600 Welsh Mountain ewes were selected and allocated to mating groups balanced for age, liveweight and condition score. The four breeds of crossing sires were used in each year. In year 1, two rams of each breed were mated with 75 ewes each and in years 2 and 3, three rams of each breed were mated to 50 ewes each. Over the course of the three years 8 rams of each breed were used as crossing sires. All ewes underwent laproscopic intra-uterine insemination.

All rams were sourced from sire reference schemes. In year 1, all rams were brought to Pwllpeiran and semen was collected and used on the day with the exception of one Cheviot sire where frozen semen was used. However, in year 2 only frozen semen was used and in year 3 fresh chilled semen was used. This was as a result of biosecurity measures put into place post Foot and Mouth Disease.

All lambs were weighed at birth, 5, 10 and 16 weeks of age. Lambs were weaned at 16 weeks of age. From 16 weeks of age, male lambs were assessed fortnightly for those that had reached a finished condition of fat class 2/3L. Fifty ewe lambs of each cross in each year were selected in September of each of the 3 years and retained as crossbred ewes for phase 2 of the project. Ewe lambs retained for breeding were away-wintered. Female lambs not retained for breeding were finished on farm and sent for slaughter when a finished condition of 2/3L had been reached.

Prior to being sent to slaughter, all lambs were weighed on-farm to obtain a final liveweight and were ultrasonically scanned to measure eye muscle depth and fat depth at the third lumbar vertebra. Hot carcass weights and gradings were obtained on the day from the abattoir.

Over the same three lambing years, physical performance data was also collected for pure bred Welsh Mountain lambs. Although the pure bred group



was not a strict control group the data gathered does allow for some comparisons to be made.

Data relating to the crossbred lambs were analysed as two data sets. The first data set contained all lambs that had complete records for liveweights at birth, 5, 10 and 16 weeks of age and the second data set contained all male lambs with complete records at slaughter.

The data were tested for deviations from normality using the Maximum Likelihood Method of Box and Cox (1964) to identify the most suitable power transformation to apply to the data, if needed, and were subsequently analysed using the REML algorithm of Genstat (Lawes Agricultural Trust). The following fixed effects were tested in the analysis of growth data: sire breed (Cheviot, Dorset, Lleyn and Texel), Year (1,2 and 3), age of dam (2,3,4,5, and 6 years), litter size (single, twin and triplet), sex of lamb (male or female) and grazing type (rough grazing, semi-improved and improved). Sire was fitted as a random effect in all models. For significant effects, differences between levels of the effect were evaluated using a test of least significance difference (LSD). All two way interactions were evaluated and excluded from the model when not significant ($P > 0.05$). A similar range of effects was evaluated in the analysis of the slaughter data, with the exclusion of sex effects and the inclusion of a term to adjust for the variation in fat class.

All results are shown as the adjusted (predicted) means calculated from the models.



Results

Reproductive performance

Over the three years of the production phase, 1800 ewes were artificially inseminated resulting in 1343 ewes lambing (2043 lambs) with an overall conception rate of 0.75. The reproductive performance is summarised in Table 1 below. There were differences between years. Ewes artificially inseminated in year 2 had a much lower conception rate. In year 2 only frozen semen was available due to biosecurity restrictions in place due to the Foot and Mouth Disease outbreak earlier in the year. The low conception rate in year 2 had an impact with fewer lambs reared per ewe in year 2, however the proportion of lambs reared compared to number of lambs born was similar for each year.

Table 1: Reproductive performance of Welsh Mountain ewes during the production phase.

	Year 1	Year 2	Year 3
Number of Ewes inseminated	600	600	600
Number of Ewes lambing	492	354	497
Conception rate to AI	0.82	0.59	0.83
Number of lambs born (alive/dead)	756	515	772
Number of lambs born/ewe lambing	1.54	1.45	1.55
Number of lambs reared (10 weeks)	702	487	713
Proportion of lambs reared	0.93	0.94	0.92
Number of lambs reared/ewe lambing	1.43	1.37	1.43

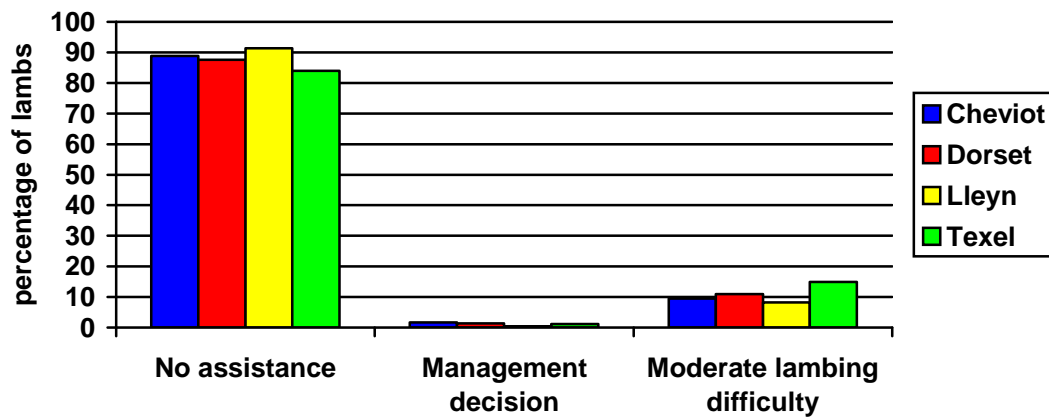
Lambing difficulties

Using different crossing sires can lead to lambing difficulties. In this phase of the project, all ewes were lambed indoors in order to monitor lambing difficulties. The percentage of crossbred lambs requiring assistance at birth is depicted in Figure 2. In the majority of births, no assistance was required.



However, a small number of lambs did require assistance. In the case of the Texel X lambs 15% of all births were classified as incurring moderate lambing difficulties. For all Dorset X births, 11% were classified as being of moderate lambing difficulty, with 9.5% of Cheviot X and 8% of Lleyn X births in the same category. Less than 2% of births in each sire category were assisted as a management decision. Where this did occur, it was generally a decision made where the first born lamb required assistance.

Figure 2: Percentage of crossbred lambs that were assisted at birth



Of the Texel X lambs requiring assistance at birth over half were due to lambs being categorised as oversized. All other crossbred lambs requiring assistance were due to lambs presenting either with back legs first or legs back.

Physical performance of crossbred lambs

The mean liveweights of crossbred lambs at birth, five weeks, ten weeks and sixteen weeks of age are given in Table 2 and depicted graphically in Figure 3. Lleyn X lambs were significantly lighter at birth ($P < 0.05$) than the Dorset or Texel X lambs (3.4 kg vs. 3.6 kg and 3.6 kg respectively). The Cheviot X



lambs were on average intermediate between Lleyn X and the Dorset X and Texel X. By five weeks of age the Dorset X and Texel X lambs were significantly heavier ($P < 0.01$) than the Cheviot X or Lleyn X lambs (14.6 kg and 14.8 kg vs. 13.9 kg and 13.5 kg respectively).

The mean liveweights of pure bred Welsh Mountain lambs are given in Table 3. Welsh Mountain lambs were lighter at birth (3.3 kg) and at 10 weeks of age (shearing weight, 19.4 kg) than the crossbred lambs. Weaning was three weeks later for the Welsh Mountain lambs compared to the crossbred lambs (19 weeks vs. 16 weeks), however Welsh Mountain lambs were lighter at weaning (25.7 kg) compared to crossbred lambs.

Table 2: Mean liveweight (kg) of crossbred lambs at birth, five weeks, ten weeks and sixteen weeks of age

	Cheviot	Dorset	Lleyn	Texel	SED	Sig.
Birth weight	3.5 ^{ab}	3.6 ^a	3.4 ^b	3.6 ^a	0.08	*
5 weeks	13.9 ^a	14.6 ^b	13.5 ^a	14.8 ^b	0.35	**
10 weeks	21.5 ^a	22.6 ^b	20.8 ^a	22.8 ^b	0.41	***
16 weeks	26.5 ^a	27.9 ^b	26.1 ^a	28.1 ^b	0.46	***

Values in the same row not sharing common superscripts differ significantly ($P < 0.05$)

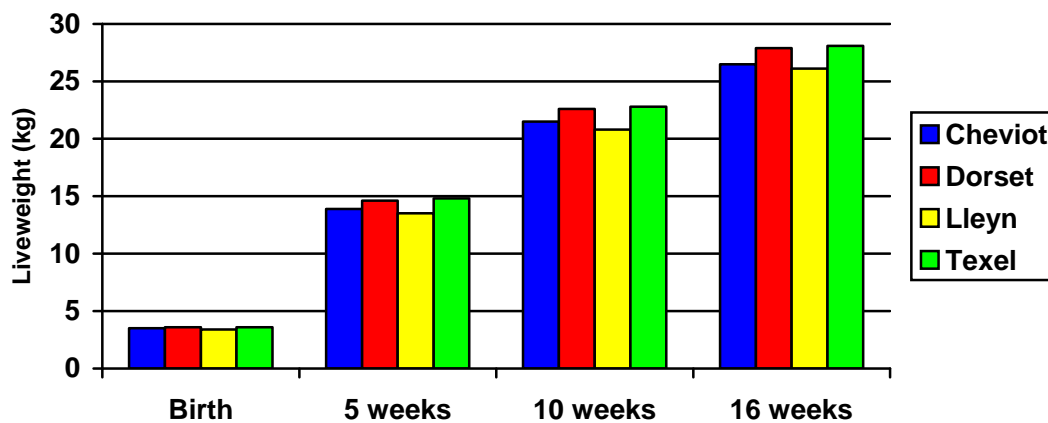
Table 3: Mean liveweight (kg) of Welsh Mountain lambs at birth, shearing and weaning

Birthweight	Shearing weight (10 weeks of age)	Weaning weight (19 weeks old)
3.3	19.4	25.7

At ten weeks and sixteen weeks of age, Dorset X and Texel X lambs were significantly heavier ($P < 0.001$) than Cheviot X and Lleyn X lambs. At sixteen weeks of age, Texel X lambs were on average 2 kg heavier than Lleyn X lambs (28.1 kg vs. 26.1 kg respectively). There were no significant

differences in liveweight at birth or five, ten or sixteen weeks of age between Cheviot X and Lleyn X lambs or between Dorset X or Texel X lambs.

Figure 3: Mean liveweight of crossbred lambs at birth, five weeks, ten weeks and sixteen weeks of age



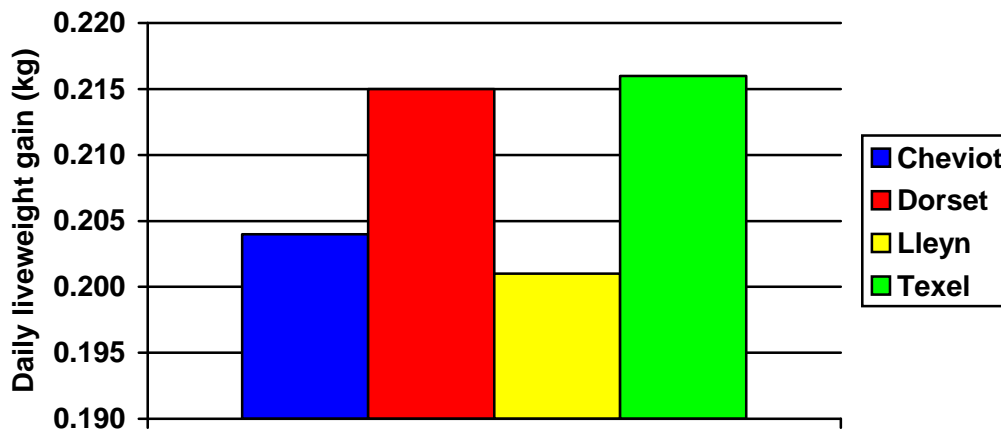
The mean daily liveweight gains (DLG) of crossbred lambs are given in Table 4 and DLG from birth to sixteen weeks of age is depicted graphically in Figure 4 below. Dorset X and Texel X lambs had significantly greater ($P < 0.001$) DLG than Cheviot X or Lleyn X lambs from birth to sixteen weeks of age (0.215 and 0.216 kg vs. 0.204 and 0.201 kg respectively). However there was no significant effect of sire breed on growth rate in the ten to sixteen week period.

Table 4: Mean daily liveweight (kg) gain of crossbred lambs

	Cheviot	Dorset	Lleyn	Texel	SED	SIG
Birth – 5 weeks	0.265 ^a	0.278 ^b	0.258 ^a	0.280 ^b	0.0047	***
Birth – 10 weeks	0.246 ^a	0.260 ^b	0.238 ^a	0.261 ^b	0.0042	***
Birth – 16 weeks	0.204 ^a	0.215 ^b	0.201 ^a	0.216 ^b	0.0035	***
5 – 10 weeks	0.227 ^a	0.240 ^b	0.218 ^a	0.240 ^b	0.0060	***
5 – 16 weeks	0.170 ^a	0.179 ^b	0.169 ^a	0.178 ^{ab}	0.0044	*

10 –16 weeks	0.132	0.137	0.136	0.136	0.0049	NS
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Figure 4: Mean daily liveweight gain (kg) of crossbred lambs from birth to 16 weeks of age



Finished lamb performance

Over the three years of the production phase, 879 male lambs went for slaughter along with 325 ewe lambs not retained for breeding. Of the wether lambs finished, 189 were Cheviot X, 200 Dorset X, 227 Lleyn X and 239 Texel X. Fewer ewe lambs were finished for the Cheviot X (79), Dorset X (89), Lleyn X (72) and Texel X (70).

The finished lamb performance of male crossbred lambs is given in Table 5. The mean age at finishing of crossbred lambs is depicted graphically in Figure 5. Texel X lambs finished significantly earlier ($P < 0.001$) than Cheviot X, Dorset X and Lleyn X lambs (170.1 days vs. 195.4, 182.2 and 192.8 days respectively). Dorset X lambs also finished significantly earlier ($P < 0.001$) than Cheviot X and Lleyn X lambs. There was no significant difference ($P > 0.05$) in age at finishing between Cheviot X or Lleyn X lambs. On average Texel X

lambs were 24 weeks old at finishing, Dorset X were 26 weeks old, Lley'n X lambs were 27 weeks old and Cheviot X lambs were 28 weeks old.

The finished lamb performance of pure bred Welsh Mountain lambs is given in Table 6. Welsh Mountain lambs were finishing later (32 weeks) than crossbred lambs at lighter finished weights (32.4 kg). Carcass weights of Welsh Mountain lambs (14.1 kg) were also lighter than crossbred lambs. Eye muscle depth (19.4 mm) and back fat cover (2.6 mm) of Welsh Mountain lambs was also less than that of crossbred lambs.

Table 5: Mean finished lamb performance of crossbred lambs

	Cheviot	Dorset	Lley'n	Texel	SED	SIG
Age at finishing (days)	195.4 ^a	182.2 ^b	192.8 ^a	170.1 ^c	5.14	***
Finished weight (kg)	38.7 ^{ab}	39.4 ^b	37.8 ^a	39.5 ^b	0.49	**
Carcass weight (kg)	16.9 ^a	17.0 ^{ab}	16.7 ^a	17.3 ^b	0.21	*
Killing out proportion (kg/kg)	0.436	0.433	0.443	0.438	0.0039	NS
Muscle depth (mm)	25.6 ^a	25.2 ^a	25.0 ^a	26.6 ^b	0.38	***
Fat depth (mm)	2.78	2.87	2.78	2.74	0.093	NS

Table 6: Mean finished lamb performance of Welsh Mountain lambs

Age at finishing (days)	Finished weight (kg)	Carcass weight (kg)	Muscle depth (mm)	Fat depth (mm)
223.4	32.4	14.1	19.4	2.6

There was a significant difference ($P < 0.01$) in finished liveweight of Texel X lambs and Dorset X lambs compared to Lley'n X lambs (39.5 and 39.4 kg vs. 37.8 kg respectively). Cheviot X lambs were not significantly different from

other crossbred lambs in terms of finished live weight (see Table 5 and Figure 6).

Figure 5: Mean age (days) at slaughter of crossbred lambs

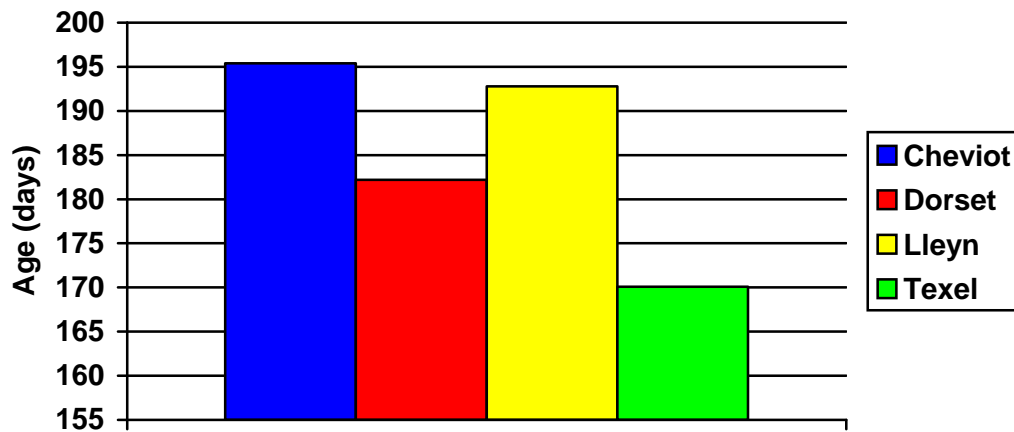
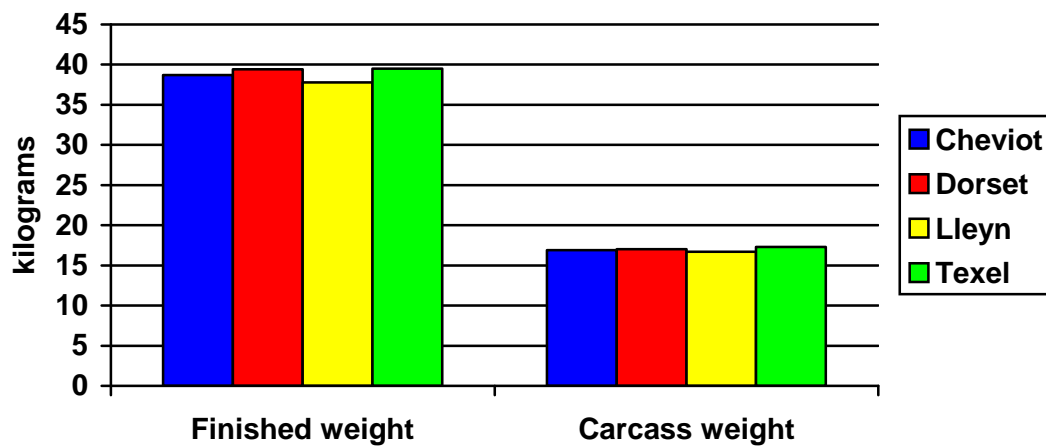


Figure 6: Mean finished weights (kg) and carcass weights (kg) of crossbred lambs



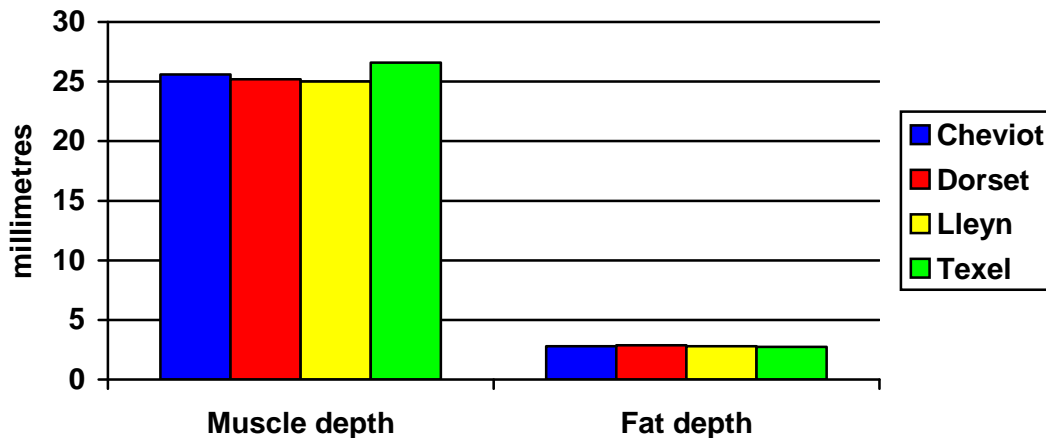
Killing out proportions were not significantly different between different sire breeds and averaged 0.44 kg/kg. Texel X lambs had significantly higher

($P < 0.01$) carcass weights than Cheviot X or Lleyen X lambs (17.3 kg vs. 16.9 and 16.7 kg respectively), however Dorset X lambs were not significantly different ($P > 0.05$) from the other sire breeds.

Prior to slaughter all finished lambs were ultrasonically scanned to measure eye muscle depth and fat cover at the third lumbar vertebra.

The mean muscle and fat depth are given in Table 5 and depicted graphically in Figure 7. Mean muscle depth was significantly greater ($P < 0.001$) in Texel X lambs compared to Cheviot X, Dorset X and Lleyen X lambs (26.6 mm vs. 25.6, 25.2 and 25.0 mm respectively). Fat depth was not significantly different between the different crossbreds.

Figure 7: Mean muscle depth (mm) and fat depth (mm) of crossbred lambs

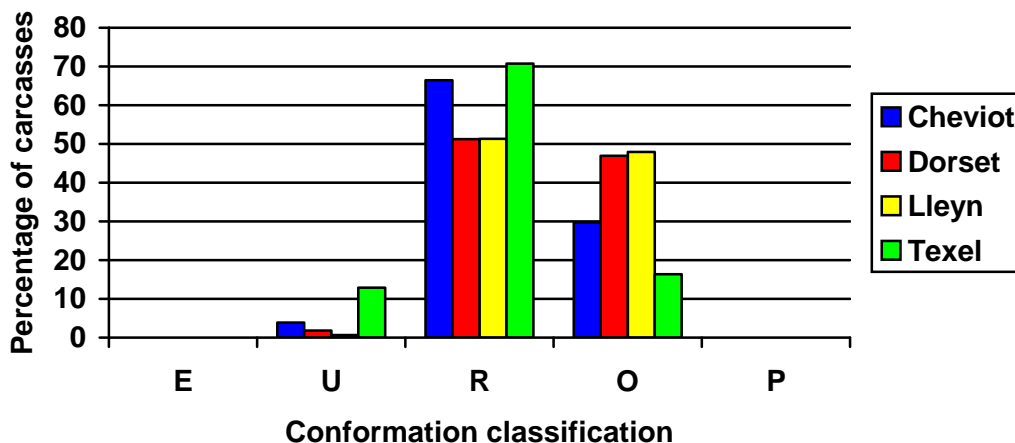


Lambs were selected for finishing at a fat class of 2/3L. The percentage of finished lambs in each EUROP conformation class is shown in Figure 9 below. In order to analyse the data statistically each class was assigned a numerical value (E=1 and P=5). Texel X lambs had significantly better ($P < 0.001$) conformation scores than the other crossbreds. This is reflected in the percentage of lambs categorised as R or better. Cheviot X lambs also

had significantly better ($P < 0.001$) conformation scores than Lleyn X lambs with Dorset X lambs being intermediate.

Pure bred Welsh Mountain lambs were categorised as R or O grades with 50% of finished lambs in each category.

Figure 8: Percentage of crossbred lamb carcasses in each EUROP



conformation class

Ewe lamb selection

In September of each lambing year, ewe lambs from each cross were selected for the evaluation phase. Ewe lambs were selected on conformation, growth rates, soundness and type. Over the three years of production, 150 Cheviot X, 149 Dorset X, 146 Lleyn X and 151 Texel X were selected and retained.

After selection, the ewe lambs were away-wintered. The ewe lambs were then weighed on their return from away-wintering (approximately 20 weeks)



and they were also back fat scanned for eye muscle and fat depth. Ewe lambs were then returned to the hill at Pwllpeiran until shearing time. At shearing the crossbred yearlings were then weighed. Fleeces were also weighed and graded.



Financial Performance

The financial performance of the crossbred lambs has also been calculated using standard costings from the Farm Business Survey. The price comparison of a pure bred Welsh Mountain finished lamb with a Welsh crossbred finished lamb is given in Table 7 below. A Texel X lamb, on average was worth £8.36 more than a pure bred Welsh Mountain lamb (£32.72). The price differential between a Welsh Mountain and Dorset X, Cheviot X and Lleyn X was £8.26, £7.53 and £6.59 respectively. The price differential between the cross bred lambs was much less with the greatest differential between Texel X lambs and Lleyn X lambs. A Texel X lamb was worth £1.77 more than a Lleyn X lamb.

Table 7: Price comparison of finished crossbred lambs to finished pure bred Welsh Mountain lambs.

	Cheviot X	Dorset X	Lleyn X	Texel X	Welsh Mountain
Finished Weight (kg)	38.7	39.4	37.8	39.5	32.4
Lamb price (£/kg)*	1.04	1.04	1.04	1.04	1.01
Lamb value (£)	40.25	40.98	39.31	41.08	32.72

* assumes a hill lamb classed at a light livestock weight for the Welsh Mountain lamb and assumes a upland lamb classed as a medium livestock weight for the crossbred lambs.

Gross margins (before forage costs) for a hill flock producing crossbred lambs are calculated in Table 8 below. The gross margins for a Welsh Mountain ewe producing a Texel X lamb are greater than for a Welsh Mountain ewe producing a pure bred lamb (£30.96 vs. £24.63 for Texel X lamb vs. Pure bred Welsh Mountain lamb respectively). This improvement amounts to an increase in gross margins (before forage costs) of £6.33 per ewe producing a



Texel X lamb. On average there was an increase of gross margins (before forage costs) of £5.28 per ewe producing a crossbred lamb.

Table 8: Gross margins (before forage costs) for Welsh Mountain ewes producing crossbred lambs from AI service compared to pure bred lambs (£ per ewe basis)

	Cheviot	Dorset	Lleyn	Texel	Welsh Mountain
Lambs reared*	1.43	1.38	1.41	1.41	1.09
Lamb sales	£57.56	£56.55	£55.43	£57.92	£35.66
Other sheep sales	£9.12	£9.12	£9.12	£9.12	£9.12
Wool	£1.13	£1.13	£1.13	£1.13	£1.13
Less sheep purchases	£5.21	£5.21	£5.21	£5.21	£5.21
	£62.60	£61.59	£60.47	£62.96	£40.70
Variable Costs					
Feed	£10.47	£10.47	£10.47	£10.47	£10.19
Vet & Med	£2.88	£2.88	£2.88	£2.88	£2.55
LAI costs**	£14.55	£14.55	£14.55	£14.55	
Other costs	£4.10	£4.10	£4.10	£4.10	£3.33
	£32.00	£32.00	£32.00	£32.00	£16.07
Gross margin	£30.60	£29.59	£28.47	£30.96	£24.63

* only includes lambs resulting from LAI.

** costs based on 100 ewes undergoing LAI and includes cost of sponges & PMSG.

The figures used to calculate the gross margins are based on the results from the study and it should be noted that laproscopic artificial insemination (LAI) was carried out on the ewes with the exception of the ewes bred pure to Welsh Mountain rams. The use of LAI generally results in higher conception rates and consequently the numbers of lamb reared can be higher compared



to natural service. In Table 9 the gross margins have been calculated for ewes producing lambs from natural service. A number of assumptions have been made which include number of lambs born to be the same as for ewes serviced naturally by a Welsh Mountain ram. The losses incurred between lambing and weaning for crossbred lambs has been assumed to be the same as for crossbred lambs produced from LAI. All other assumptions are the same as for Table 8.

Table 9: Gross margins (before forage costs) for Welsh Mountain ewes producing crossbred lambs from natural service compared to pure bred lambs (£ per ewe basis).

	Cheviot	Dorset	Lleyn	Texel	Welsh Mountain
Lambs reared	1.19	1.13	1.18	1.17	1.09
Lamb sales	£47.90	£46.31	£46.39	£48.22	£35.66
Other sheep sales	£9.12	£9.12	£9.12	£9.12	£9.12
Wool	£1.13	£1.13	£1.13	£1.13	£1.13
Less sheep purchases	£5.21	£5.21	£5.21	£5.21	£5.21
	£52.94	£51.35	£51.43	£53.26	£40.70
Variable Costs					
Feed	£10.47	£10.47	£10.47	£10.47	£10.19
Vet & Med	£2.88	£2.88	£2.88	£2.88	£2.55
Other costs	£4.10	£4.10	£4.10	£4.10	£3.33
	£17.45	£17.45	£17.45	£17.45	£16.07
Gross margin	£35.49	£33.90	£33.98	£35.81	£24.63

Although under natural service conditions the number of crossbred lambs reared would potentially be lower than under LAI conditions, overall gross margin (before forage costs) per ewe are improved compared to ewes



producing pure bred lambs and compared to ewes producing crossbred lambs from LAI. On average, the gross margin per ewe was increased by £10.16 for ewes producing crossbred lambs compared to ewes producing pure bred lambs.



Discussion

The stratified nature of the sheep industry to date has resulted in hill farmers keeping smaller hill breeds to produce crossbred ewes, out of longwool crossing sires, for the uplands and lowlands. The resultant male lambs going for the slaughter generation have not always met with the market requirements resulting in a poorer return for farmers. The use of indexed longwool sires can result in significant improvement in both the crossbred ewe produced and the male wether lambs. The removal of direct subsidies for sheep however, gives hill farmers the opportunity to produce lambs directly for the slaughter generation.

Table 10: Summary of results

	Cheviot	Dorset	Lleyn	Texel	Welsh Mountain
No. of lambs born/ewe	1.52	1.53	1.51	1.52	1.28
Lamb birth weight (kg)	3.5	3.6	3.4	3.6	3.3
Proportion of lambs born without assistance	0.89	0.88	0.91	0.84	
No. of lambs reared/ewe	1.43	1.38	1.41	1.41	1.09
Weight of lamb weaned/ewe	38.3	38.6	36.9	40.1	28.0
Age of lamb at finishing (weeks)	28	26	27	24	32
Lambs sales (£ per ewe)	£47.90	£46.31	£46.39	£48.22	£35.66
Gross Margin (£ per ewe)	£35.49	£33.90	£33.98	£35.81	£24.63



As well as the improvements in gross margins (before forage costs) by producing crossbred lambs from Welsh Mountain ewes, there are also a number of other benefits. Time taken to finish lambs was considerably shorter for crossbred lambs compared to pure bred lambs (5.5 weeks less). This in itself could mean a big difference in the autumn months when grass can be in short supply, which could result in pure bred hill lambs taking longer to finish or costs increasing as supplementary feed is introduced. Finishing lambs sooner should also result in decreased costs by saving labour costs and potentially reducing drenching costs whilst hopefully realising a better return with increased lamb price.

For hill farmers who sell store lambs, the improvement in growth rate for crossbred lambs should also see improved return as heavier store lambs should command a higher market price.

Other potential benefits include the increase in grass available for ewes pre-tupping as a result of lambs finishing sooner. This should increase the reproductive performance of the ewes, as they would be in an improved condition going into tupping.

The switch to crossbred lamb production could also result in reduced stock numbers without reducing gross margins. This is outlined in Table 11 below. The assumption has been made that all lambs not kept for breeding replacements are sold for slaughter and that all ewes rear lambs.

Table 11: Impact of crossbred lamb production on overall stock numbers

	Crossbred flock	Pure bred flock
Total number of ewes	500	645
Number of ewes bred pure for replacement purposes	150	645
Number ewes bred to	350	



produce crossbred
lambs

Gross margin for flock	£15,871	£15,886
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Reduction in stock levels are generally encouraged under agri-environment schemes. A switch to crossbred lamb production when entering an agri-environment scheme could result in improved returns.



Conclusions

The production of crossbred lambs from Welsh Mountain ewes can result in an increase in finished lamb output, both in terms of kg of finished lamb and in an improvement in carcass gradings. This in turn results in an increase in the Gross margins (before forage costs) per ewe. Other benefits include time taken for lambs to reach a finished condition with crossbred lambs reaching a finished condition quicker than pure bred Welsh Mountain lambs.

Switching to crossbred lamb production in the hills can maintain farm incomes whilst reducing stock numbers overall.



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