# VARIATION AMONG CROSSBRED EWES IN LAMB PRODUCTIVITY AND PROFIT ON A FEED UNIT BASIS

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## SUMMARY
Genetic evaluation of ewe productivity and profitability are usually expressed on a per ewe basis. Feed requirements in lamb production systems vary considerably due to differences in liveweight of ewes, lambing rate and growth of their lambs. The derivation of simplified equations to estimate feed requirements for ewe maintenance, gestation, lactation and lamb growth (pre and post weaning) is described. The equations were applied to data from the Maternal sire Central Progeny Test (MCPT) in which there are large differences in productivity of ewes by different sires. Variation in $ returns was slightly reduced and some minor changes in rankings of sire groups occurred when they were compared on a $ gross margin and feed requirement basis, although correlations between mean group values were all greater than 0.94.
**Keywords**: lamb production, ewe productivity, gross margin, feed requirements, genetic evaluation

## INTRODUCTION
Ewe productivity in lamb enterprises can be defined in terms of lamb (number of carcasses, weight and fat level) and wool (weight and fibre diameter) production, which are the major contributors to income. Considerable variation between genetic groups has been reported for ewe productivity (Fogarty *et al.* 2001), which is usually expressed on a per ewe basis. This only gives part of the story as ewes with varying levels of productivity have very different costs and feed requirements. Ewes vary in liveweight, lambing rate and lamb growth, which all contribute to variation in feed requirements. The feed resource is limiting and a major cost of grazing enterprises. The evaluation of ewes, genotypes and production systems needs to be made on a comparative feed requirement basis.

This paper outlines methodology developed to compare feed requirements for lamb production from ewes of varying liveweight, lambing rate and carcass weight of their lambs. Simple equations have been derived from Australian feeding standards (SCA 1990) to estimate feed requirements for ewe maintenance, gestation, lactation and lamb growth. These equations have been applied to data from the Maternal sire Central Progeny Test (MCPT) to examine the variation in productivity and gross margins of ewe groups when expressed on a feed unit basis and the change in rankings of sire groups.

## MATERIALS AND METHODS
**Feed requirements.** Total annual feed requirements for the ewe/lamb(s) unit can be partitioned into requirements for ewe maintenance, gestation, lactation and lamb growth (pre and post weaning). Approximate equations to estimate annual feed requirements for these components, that are applicable to lamb production systems and the MCPT in particular have been derived from the SCA (1990) equations based on metabolisable energy (ME) as outlined below.
*Ewe maintenance.* $ME_m$ (MJ/d) =[$0.26W^{0.75}$ exp(-0.03A)+ EGRAZE] / $k_m$ +0.09MEI *(SCA eqn 1.22)*

Where W is ewe liveweight, A is ewe age in years, EGRAZE is additional requirement for grazing, assumed to be 20%, $k_m$ is net efficiency of use of ME for maintenance, assumed to be 0.7 and MEI is total ME intake. Hence for a 3 year old ewe:
$ME_m$ (MJ/yr) = 365 [0.26 $W^{0.75}$ exp(-0.03x3) 1.1x1.2] / 0.7 = 163.5 $W^{0.75}$
The coefficients for ewes 1 to 6 years of age are: 173.7, 168.3, 163.5, 158.8, 153.9 and 149.4 respectively. Using this equation the annual requirements for maintenance for 3 year old ewes of 50, 60 and 70 kg liveweight are 3075, 3525 and 3957 MJ respectively. The 50 kg ewe (3075 MJ) is regarded as one dry sheep equivalent (DSE).

*Ewe gestation.* Total $ME_g$ requirements for litter sizes 1 to 5 were estimated from SCA Table 1.11, in which the total $ME_g$ was calculated as 182 MJ for 4 kg birth weight. Requirements are proportional to total birth weight, which ranges from an average of 5.5 kg for litter size 1 to 15.0 kg for litter size 5 in the MCPT. The estimated values for $ME_g$ based on average birth weight for litter size are 250, 410, 546, 637 and 683 MJ for litter sizes 1 to 5 respectively.

*Ewe lactation.* $ME_l$ (MJ/d)= [(0.0328F + 0.0025D +2.203) M] / $k_l$ *(SCA eqn 1.46, Table 1.15)*
Where F is fat in milk, assumed to be 80 g/kg, D is day of lactation, M is milk production (kg/d) and $k_l$ is net efficiency of use of ME for lactation, assumed to be 0.6. Hence $ME_l$ (MJ/d) = (8.045 + 0.00417D) M. Milk production (4h oxytocin method) from MCPT ewes at Cowra at 3, 4 and 12 weeks of lactation has been used to estimate total milk production over the lactation and $ME_l$ requirements using the above equation at peak (day 25) and at 90 days of lactation. These values were combined in a simple function [64 (25d) + 22 (90d)], derived to approximate total 90 day lactation yield. Total $ME_l$ requirements for 1, 2 and 3 lambs weaned are 1345, 1680 and 1925 MJ respectively.

*Lamb growth.* $ME_{gr}$ (MJ/kg EBG) = {(6.7 + R)+(20.3 – R)/[1+exp(-6(P-0.4))]}/ $k_{gr}$ *(SCA eqn 1.32A)*
Where EBG is empty body gain = 0.92 (live gain), P is proportion of standard reference weight (SRW = 70 kg), R = [(EBGg/d)/4$SRW^{0.75}$] – 1 and $k_{gr}$ is net efficiency of use of ME for growth.

*Lamb growth: birth to weaning.* Data from the MCPT have been used to assume average weaning weights and growth rates for various type of rearing categories of lambs. Linear growth rate from birth to weaning (90 days) has been assumed and $ME_{gr}$ calculated at 15, 45 and 75 days of age at the appropriate estimated live weights. The $k_{gr}$ values were assumed to be 0.7, 0.6 and 0.5 at 15, 45 and 75 days respectively to account for the reduced proportion of the diet being milk as the lamb grows and approaches weaning. The ME requirements for maintenance at 15, 45 and 75 days were also calculated, added to those for growth, multiplied by 30 and summed over the 3 ages to estimate the total requirements for the lamb from birth to weaning and multiplied by the number of lambs being reared by the ewe. The requirements supplied from milk (kg x 4.94 MJ) were then deducted to give the additional requirements for the ewe/lamb(s) unit to weaning ($ME_{gw}$).

*Lamb growth: weaning to slaughter.* $ME_{gs}$ requirements for growth from weaning to slaughter (90 days) were calculated as above for the range of carcass weights (17 to 29 kg) and growth scenarios from weaning (144 to 267 g/d) found in the MCPT data, with $k_{gr}$ assumed to be 0.42. The increase in feed requirements for lambs across this range of scenarios was very close to a linear function of carcass weight (CWT). It was approximated by the following equation:

Total $ME_{gs}$ (weaning to slaughter, 90 days) (MJ) = 77.5 CWT - 320

**Animals.** The $F_1$ ewe progeny of 12 maternal sires born in 1997 at Cowra in the MCPT project were joined to Poll Dorset rams in Feb/March 1998, 1999 and 2000 to lamb at 1, 2 and 3 years of age. In each year their lambs were weaned at approximately 3 months and slaughtered as a group when they reached a target average carcass weight of 22kg, at about 6 months of age (Fogarty *et al.* 2001). The $F_1$ ewes were shorn in October of 1998, 1999 and 2000, with greasy fleece weight and classing bin line recorded. In 1998 mid-side samples were also taken for measurement of yield and fibre diameter.

**$ returns and gross margins.** The base carcass price used was $3/kg, with discounts for low weight (-1.5 $/kg, <16kg) and fat outside 2-4 score specification (–0.75 $/kg, score 1; -0.5 $/kg, score 5). Trade weight carcasses (16-20kg) were only given a small discount (-0.15 $/kg) because they would normally be sold in the trade market or kept longer to reach heavier weights. Average skin prices were $9.75, $12.00 and $12.50 for <20.1, 20.1-24 and >24 kg carcasses respectively. The average 2001/02 wool prices for the various micron categories were used to estimate wool returns. In all years the individual ewe wool return was multiplied by 0.9 to account for the lower price of the non fleece portion. Gross margins were calculated using costs of $6.20 per ewe and 7.25% of wool returns and $3.66 per lamb slaughtered and 4.5% of lamb carcass and skin value (updated from Webster 1998).

**RESULTS AND DISCUSSION**

Total annual feed requirements (MJ) for lamb carcass production from the ewe and lamb(s) unit is the sum of the following equations incorporating ewe liveweight (W), number of lambs born (LB), number of lambs reared to weaning (LW) and carcass weight (CWT) of slaughtered lambs:

*Ewe maintenance:* $ME_m$(MJ) = $AxW^{0.75}$ (A=173.7, 168.3, 163.5, 158.8, 153.9, 149.4 for 1 to 6 years)
*Ewe gestation:* $ME_g$ (MJ) = 250, 410, 546, 637, 683 for LB 1 to 5
*Ewe lactation:* $ME_l$ (MJ) = 1345, 1680, 1925 for LW 1 to 3+
*Lamb growth: birth to weaning (excluding milk)/ewe:* $ME_{gw}$ (MJ) =209, 645, 988, 1430 for LW 1 to 4
*Lamb growth: weaning to slaughter:* $ME_{gs}$ (MJ) = $?_i$ (77.5 $CWT_i$ - 320)

Total $ returns and $ gross margins per ewe per year from the $F_1$ ewe groups for their lamb carcasses and skins and the ewe wool production over three years are shown in Figure 1. The top sire group (BL2) returned an average of $127/ewe over three years, which was over $54/ewe more than the lowest group. Overall, lamb carcasses contributed 66% of returns, lamb skins 12% and ewe wool 22%. Inclusion of costs reduced the average total returns ($100.24) to $83.13 for average gross margin of the groups. The range in gross margins was almost $50/ewe and the coefficient of variation of the means was increased slightly from 17% to 20 %. There was little change in ranking of the sire groups.

Feed requirements for the ewe and lamb are included in Figure 2, with $ returns and $ gross margins expressed on a DSE basis. The range in $ returns was almost $15/DSE, with a mean of $40.01 and CV of 11%. There were some minor changes in the ranking of sire groups between per ewe and per DSE, although the correlations between mean values for the ewe groups were high (range 0.940 to 0.998).

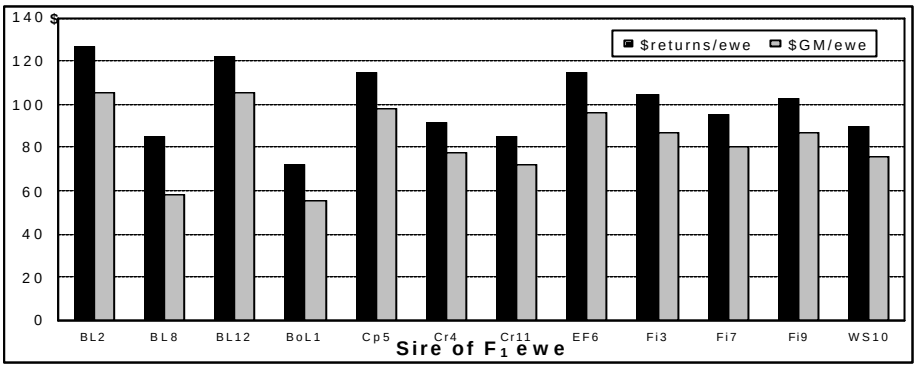


**Figure 1. Annual $ returns and gross margins per ewe for 1997 drop $F_1$ ewes mated in autumn 1998, 1999 and 2000 at Cowra.**

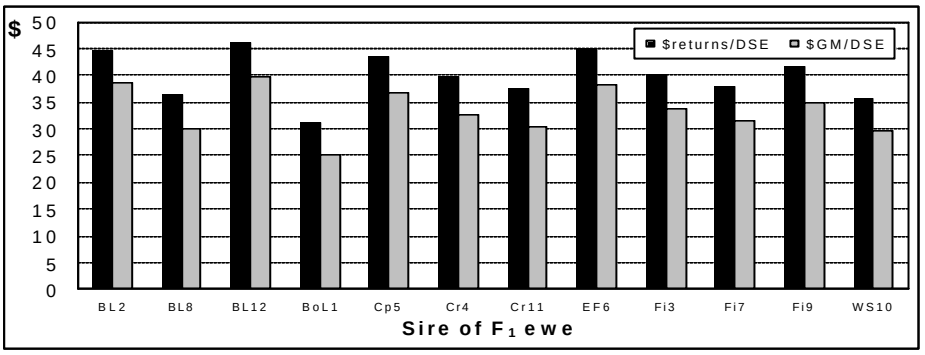


**Figure 2. Annual $ returns and gross margins per dry sheep equivalent (DSE) for 1997 drop $F_1$ ewes mated in autumn 1998, 1999 and 2000 at Cowra.**

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