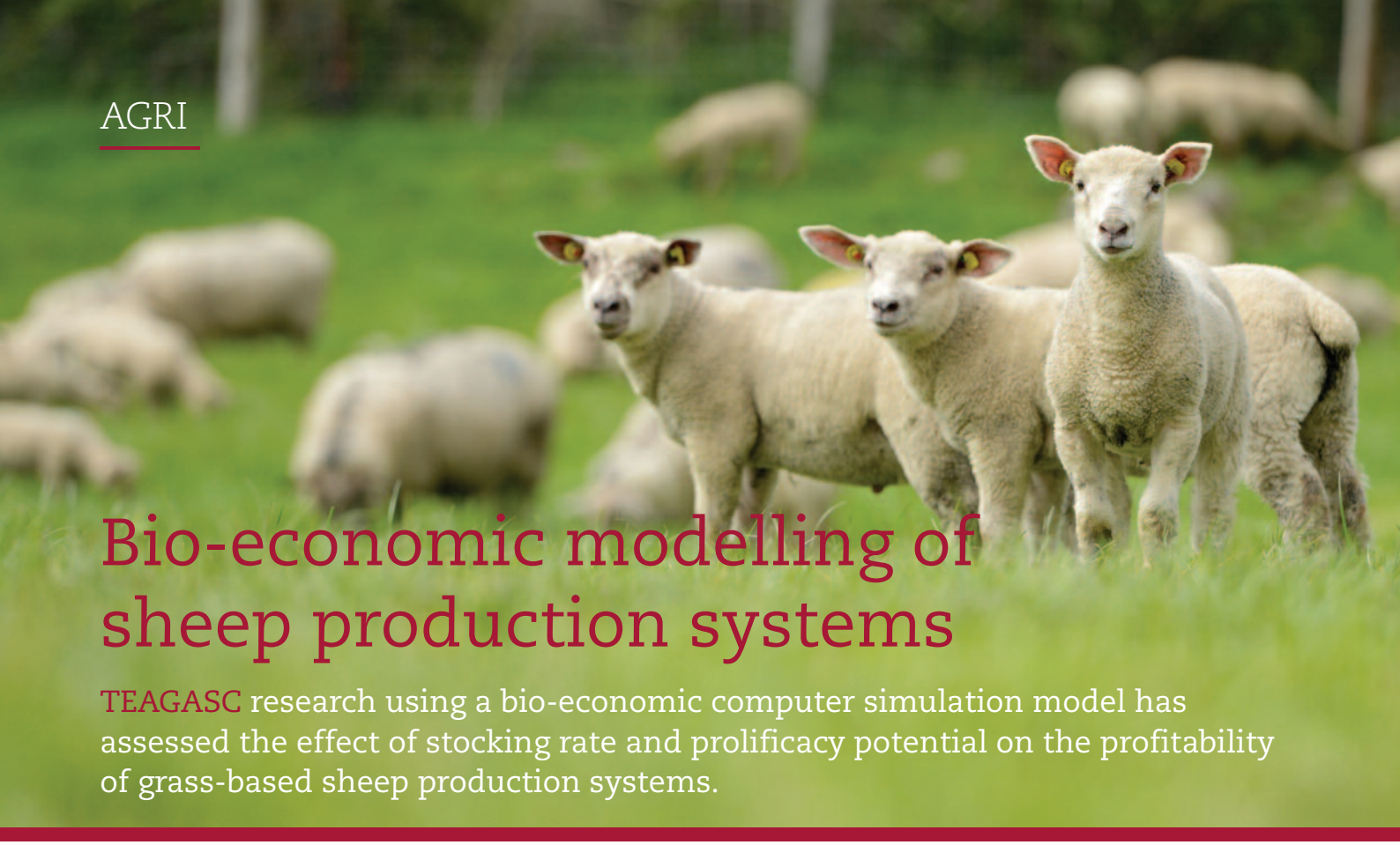

Bio-economic modelling of sheep production systems

TEAGASC research using a bio-economic computer simulation model has assessed the effect of stocking rate and prolificacy potential on the profitability of grass-based sheep production systems.

Stocking rate and ewe prolificacy are key drivers of flock productivity and output across both Irish and international sheep production systems (Keady and Hanrahan, 2006; Ho *et al.*, 2014). Stocking rate and ewe prolificacy have a major effect on profit, with greater numbers of lambs weaned per hectare resulting in greater profit (Teagasc, 2017). Research to date has assessed the effect of stocking rate and ewe prolificacy on flock performance and lamb output (Earle *et al.*, 2016); however, the economic effect was not assessed. The objective of this study was to assess the profitability of Irish grass-based sheep production at varying stocking rates and ewe prolificacy levels using a bio-economic model.

Teagasc Lamb Production Model

The Teagasc Lamb Production Model (Bohan *et al.*, 2016), a bio-economic computer simulation model that simulates sheep production systems, was used to simulate six stocking rate and prolificacy scenarios. The six scenarios simulated included three different stocking rates of 10 (LS), 12 (MS) and 14 (HS) ewes/ha, at two different prolificacy levels: 1.5 (LP) and 1.8 (HP) lambs weaned per ewe joined. All input data was obtained from the Sheep Research Demonstration Flock, Athenry, Co. Galway, Ireland (Earle *et al.*, 2016). Each scenario was simulated on a 20ha farm with a self-replacing March lambing flock. Flock size ranged from 213 to 299 ewes joined to the ram. Grass growth was increased in line with stocking rate and prolificacy, ranging from 10,071kg DM/ha to 14,374kg DM/ha. Grass utilisation was 80%, 85% and 90% for 10, 12 and 14 ewes/ha, respectively.
A final scenario was modelled to investigate the effect of grass growth on stocking rate and prolificacy potential, whereby grass growth was maintained at the level achieved by the lowest output system (i.e., 10,071kg DM/ha) while stocking rate and prolificacy were increased, with the additional energy requirements of the flock being supplied in the form of concentrate supplementation. Risk analysis was conducted using the @Risk programme to assess the effect of variation in key input variables (lamb and ewe mortality, grass growth, fertiliser and concentrate costs, lamb and mutton price) on the profitability of each scenario investigated.

High prolificacy more profitable

Results from the bio-economic model showed that the number of lambs weaned per hectare increased as stocking rate and ewe prolificacy increased, and ranged from 16 to 27 lambs/ha. Increasing the number of lambs weaned per hectare reduced the individual lamb growth rate; however, total carcass produced per hectare increased from 272-474kg/ha. Lamb sales increased from €1,299/ha to €2,219/ha, with variable costs rising from €774/ha to €1,224/ha. The average cost of producing a lamb at low prolificacy was €75 but decreased to €65 per lamb at high prolificacy. This translated into an average net profit of €23/lamb and €35/lamb at the low and high prolificacy potentials, respectively. As the number of lambs weaned per hectare increased from 16 lambs/ha to 27 lambs/ha, net profit increased from €361/ha to €802/ha (**Figure 1**). The greatest net profit was achieved when weaning 1.8 lambs per ewe at 14 ewes/ha (HS, HP), with €2,219/ha in lamb sales, a gross margin of €1,210/ha and a net profit of €802/ha.
Increasing prolificacy increased net profit on average by €336/ha, while stocking rate increased net profit on average by €84/ha and €19/ha for an increase from 10 to 12 ewes/ha and from 12 to 14 ewes/ha, respectively.
In general, the bio-economic model showed that increasing the number of lambs weaned per hectare increased net profit per hectare, but the greatest increase in profitability per hectare was achieved at the higher prolificacy level. Increasing the number of lambs weaned without increasing grass growth and utilisation was economically counterproductive. Across all stocking rates, the high prolificacy scenarios were more profitable and had a greater capability to cope with fluctuations in key variables.

Conclusion

The bio-economic model demonstrated that the number of lambs weaned per hectare, along with increased grass production and utilisation, increases net profit. Increasing the number of lambs weaned per hectare reduces the cost of production per lamb and in turn increases net profit per lamb. Increasing the number of lambs weaned per hectare without increasing grass growth and utilisation is economically counterproductive.

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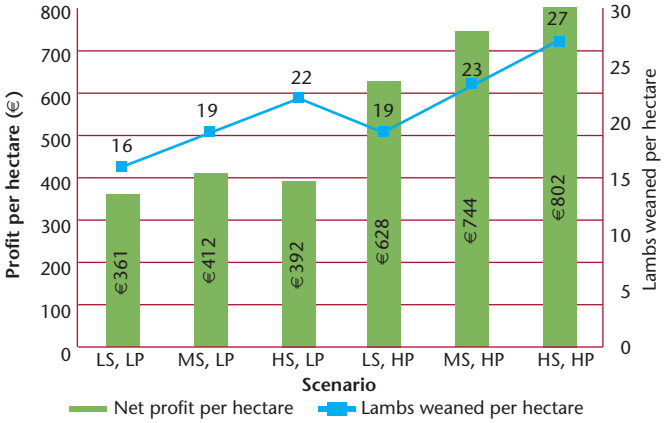

FIGURE 1: The effect of number of lambs weaned per hectare on profit.

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