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National breeding strategies for cattle and sheep

Key external stakeholders:

Irish sheep, beef and dairy farmers, Irish Cattle Breeding Federation (ICBF), Sheep Ireland, consultancy agencies, international genetic evaluation bodies

Practical implications for stakeholders:

- Revised the national dairy cattle, beef cattle and sheep breeding objectives
- Revised the statistical models for sheep genetic evaluations of traits such as lambing ease and live weight gain
- Developed a stochastic budgetary simulation bio economic model for the Irish sheep industry
- Investigated the role of alternative growth functions fitted to animal live-weight data
- Generated novel phenotypes such as ewe mature weight
- Investigated the role of early predictors of beef cows fertility traits for use in the national genetic
- Validated maternal breeding values generated as part of the national beef breeding objectives
- Validated individual breeding values used as part of the national sheep breeding objectives
- Estimated the rate of genetic gain achieved in the Maternal and Replacement sheep indices
- Estimated the genetic correlation between the Irish and New Zealand sheep breeding objectives
- Generated a strategic document outlining future research priorities for sheep genetics
- Revised the national dairy and beef fertility and survival evaluations

Main results:

- The heritability for ewe mature weight was 0.37 ± 0.03 and the repeatability of ewe weight was 0.65 ± 0.01 and this was incorporated as a goal trait into the national sheep breeding objectives

- Despite the low heritability of many of the maternal traits, genetic selection for improved maternal performance in beef animals resulted in improvements in phenotypic performance

- In beef cows the estimated heritability for age at first calving was 0.31, while the heritability of the remaining reproductive traits ranged from 0.01 to 0.06

- A stochastic budgetary simulation model of a sheep farm was developed to investigate the effects of changes in lamb production systems on farm profitability. To demonstrate an application of the Teagasc Lamb Production Model the two main lowland lambing systems in Ireland, early and mid-season lambing

- Heritability estimates for the Gompertz growth function parameters using live weight was moderate to strong, thereby facilitating the estimation of breeding values for inclusion in breeding objectives to aid in breeding and selection decisions

Opportunity / Benefit:

To increase the rate of genetic gain achievable across the beef, sheep and dairy sector through the implementation of a pertinent national breeding objectives

Collaborating Institutions:

Irish Cattle Breeding Federation, Sheep Ireland, UCD, LUKE (Finland) and DEPI (Australia)

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1. Project background:

Genetics is known to contribute approximately 50% to productivity gains across species. Key for sustainable national genetic gain is accurate genetic evaluations of traits pertinent to Irish production systems each, optimally weighted within a national breeding objective. Furthermore, the breeding objectives implemented need to be understood by the end-user. The national breeding objective in dairying (the Economic Breeding Index; EBI; Berry et al., 2007), beef (Beef €uro star indexes; Amer et al., 2011) and sheep (Sheep value index; Byrne et al., 2010) have been established in Ireland, but, these require constant re-evaluations, refinement and are reviewed annually. This can be achieved through the development, exploitation and dissemination of state-of-the-art tools to improve genetic gain in economically important traits in dairy cattle, beef cattle and sheep in a sustainable manner.

2. Questions addressed by the project:

- Are the weighting of traits in the national breeding objectives still relevant in light of changes in policy and future economic circumstances?
- Are the current genetic evaluations for a range of traits optimal and take cognisance of recent developments in statistical methodology?
- Can the rates of genetic gain achieved by the beef, sheep and dairy sectors be increased through the development and implementation of state of the art breeding programmes?
- Can farmers understanding and confidence in genetic evaluations be improved and, thereby, increase the use of genetically superior animals?

3. The experimental studies:

- This study was desktop based and involved the analysis of datasets from ICBF, Sheep Ireland and Teagasc as well as a review on the available literature.
- Data on the validation of the sheep and beef breeding objectives was available through the Sheep Ireland and ICBF databases.
- Animal live-weight data was available through the ICBF database.
- Variance components were estimated using animal linear model which accounted for the genetic relationships among individuals.
- A comprehensive survey on the current management practices on Irish sheep farms was undertaken across 45 discussion groups geographically distributed throughout Ireland.
- The sheep bio economic model was developed using previous research from Teagasc Athenry, from the results from the survey on management practices on Irish sheep farms, as well as international data.
- Economic values were estimated using Teagasc bio economic models for beef, sheep and dairy
- Teagasc advisory service as well as the dairy, beef and sheep industry were strongly involved especially in guiding the national breeding objectives

4. Main results:

- Analysis of beef national database showed that selection for improved maternal performance will result in favorable improvements in performance. Age at first calving increased linearly by 0.32 ± 0.15 ($P = 0.03$) days per day increase in EBV for age at first calving. Weaning weight increased linearly by 1.74 ± 0.09 and 0.84 ± 0.16 kg ($P < 0.001$) per kg increase in EBV for direct and maternal weaning weight, respectively.
- Alternative growth functions fitted to animal live-weight data were heritable (0.40 to 0.69) and provide a useful tool to future predict live weight.

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- A review of the statistical models for lambing traits showed that many common flock- and animal-level factors are associated with lambing difficulty and lamb mortality; for example, first parity ewes experienced greater (P<0.001) lambing difficulty (1.56 ± 0.02) than older ewes.
- An investigation of alternative contemporary groups definition for lambing traits has shown that contemporary groups that are defined over a short time period provide high heritability estimates and greater predictive ability for lambing traits.
- The low heritability estimated for beef reproduction traits (0.01 to 0.06), coupled with the long time period to measure many of these traits, imply that predictor traits could be very useful to increase the accuracy of selection.
- Results from the application of the Teagasc Lamb Production Model, showed that early lambing flocks sold more lambs for greater prices but were less profitable (net profit -€4,862) compared to mid-season lambing flocks (net profit €11,045) because of the increased variable costs.
- Moderate to strong correlations were calculated between the sheep national breeding objectives in New Zealand and Ireland, with the strongest correlation (0.86) between the New Zealand and Irish maternal indexes.

5. Opportunity/Benefit:

The current project has shown the potential to increase the rates of genetic gain achievable across the beef, sheep and dairy sectors through the development state of the art statistical tools for implementation in the national genetic evaluations, increase farmers confidence and usage of the genetic evaluations. All research has been implemented into the national genetic evaluations for beef, sheep and dairy.

6. Dissemination:

Main publications:

McHugh, N., Cromie, A.R., Evans, R.D., and Berry, D.P. 2014. Validation of national genetic evaluations for maternal beef cattle traits using Irish field data. J. Anim. Sci. 92; 1423-1432.

Coyne, J.M, Berry, D.P., Mäntysaari E.A., Juga, J. and McHugh, N. 2015. Comparison of fixed effects and mixed model growth functions in modelling and predicting liveweight in pigs. Livestock Science177; 8–14.

McHugh, N., Berry, D.P., and Pabiou, T. 2016. Risk factors associated with lambing traits. Animal 1:89-95.
Bohan, A., Shalloo, L., Malcolm, B., Ho, C.K.M., Creighton, P., Boland, T.M., and McHugh, N. 2016. Description and Validation of the Teagasc Lamb Production Model. Journal of Agricultural Systems.148:124-134.

Berry, D.P. and Evans, R.D. 2014. Genetics of reproductive performance in seasonal calving beef cows and its association with performance traits. J. Anim. Sci. 92:1412-1422

International conferences

Presented results at numerous conferences such as the European Association of Animal Production, American Dairy Science Association Annual meeting, and the World Congress on Genetic Applied to Livestock Production.

National conferences and seminars

Presented at national dairy, beef and sheep conferences and at the Agricultural Research Forums throughout the duration of the project.

Open Days:

Presented at Moorepark, Athenry and Grange opendays.

Industry consultation

Project results were presented and discussed at numerous industry meetings with AI companies, breed societies, farming groups, farmers and the Teagasc extension service.

Farmer discussion groups

Results were presented and discussed at many farmer discussion groups and seminars.

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