



A review of Sheep Ireland strategy - October 2010

A Report prepared for the Sheep Ireland Board

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Executive Summary

Review of progress

Sheep Irelands' progress against the set of 20 recommendations put forward by the strategy team in 2008 has been excellent at a technical and operational level. A consolidation of technical progress to date is now required but with a new focus on broader engagement across the sheep industry and supporting sectors and organisations, as well as some provision for future genomics technologies.

Issues and Recommendations

Thirteen strategy recommendations have been identified by the review team.

The first four recommendations relate to industry engagement through breed societies and enhancement of a performance recording culture. More active engagement with breed societies and meat processors is also recommended.

Two recommendations deal with technical developments. The first of these relates to the development of farm services that would add value to performance information for use by commercial farmers at relatively low development and delivery cost. The second relates to partnered research with organisations in Ireland on development and enhancement of trait definition and performance recording.

Two recommendations deal with structural issues. The first of these involves identifying the most cost efficient structure(s) for Sheep Ireland to capture information required for genetic evaluation. The second relates to a restructure of the MALP program to reduce costs and target more intensive recording towards specific flocks.

A final set of 5 recommendations deals with provision for new genomics technologies. These involve ensuring that underpinning capabilities are in place in Sheep Ireland's partner research organisations in order to ensure future initiatives in genomics will deliver benefits to sheep farmers in Ireland.

Status of the report

This report will be presented to the Sheep Ireland Board on October 21st 2010. It has been modified and updated following feedback on a summary of a draft version tabled at the Sheep Ireland board meeting on September 16th 2010.

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Overview and Terms of Reference

Overview

In mid 2008, a strategy team was assembled following the formation of the Interim Sheep Board tasked with developing a broad strategy for genetic improvement initiatives for sheep in Ireland. An outcome of this strategy was the establishment of a set of 20 recommendations. These 20 recommendations have provided fundamental guidance to Sheep Ireland developments and initiatives over the past two years. It is now timely to review the original strategy.

Terms of reference

Progress is reviewed against the 20 recommendations in the original Sheep Ireland strategy, and then an updated set of recommendations is provided. Provision for potential future opportunities from new genomic technologies is also considered.

Performance against the original strategy

A summary of the original 20 strategy recommendations is presented below. A progress comment has been inserted beside each strategy. In summary, Sheep Ireland has been sufficiently well resourced, and progress over the past two years has been excellent. However, there is no room for complacency with much work still to be done to achieve potential rates of genetic progress for sheep farm profitability across the Irish sheep industry.

Progress against initial Sheep Ireland 20 strategy recommendations

No.	Title	Recommendations as adopted by Interim Sheep Board:	Progress as of September 2010
1	<i>Animal identification - the system</i>	The current NSIS sheep identification system be modified to include double tagging, the issue of an identical replacement for lost tags and no tagging on movement between flocks, to closely reflect the current successful cattle model; however this would only be a requirement for performance-recording breeders and producers, and not a mandated requirement across the industry.	Progress with animal identification has been sufficient, although different from originally envisaged. With the introduction of mandatory EID, the animal identification system should no longer be an issue for Sheep Ireland.
2	<i>Animal identification - Establishment of a Sheep Database</i>	A central database (the Sheep Database) is established.	Database has been established.

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3	<i>Data recording - Electronic Identification (EID)</i>	Performance-recorded flocks move as quickly as possible to use of EID animal identification subject to cost and practicality.	Progress will be accelerated with mandatory EID for breeding ewes.
4	<i>Data recording - Trait recording</i>	Performance recording protocols be adjusted to accommodate earlier, later, and more regular recording of lamb live weights, recording of lamb mortality, lambing difficulty, feet problems, faecal egg counts, dag scores, and mature ewe weights.	Data recording protocols well established for main traits, but there would be benefits from refinement and investigation for disease and maternal ewe traits.
5	<i>Data recording - Minimum recording of criteria</i>	The genetic evaluation system makes use of all recorded data that helps improve the accuracy of the evaluations.	The genetic evaluation system accepts all available data subject to quality audits. A highly comprehensive genetic evaluation system has been developed. The genetic evaluation module for health traits still needs development.
6	<i>Data recording - Recording systems</i>	That data recording systems be developed to minimise costs and minimise disruption to normal management, and the costs of all performance recording should initially be primed through Government support and move to a user-pays basis in a way that maintains and enhances participation in performance recording in response to demand for trait improvements by commercial producers.	Highly advanced state of the art data recording systems in place. Progress towards user pays challenged by need to build on adoption rates.
7	<i>Data recording - Data capture</i>	A range of data capture options be provided to performance recording flocks, with a view that over time these will migrate to widespread use of EID systems for performance recording.	Paper, web screen and hand held options for data recording are available.
8	<i>Data recording - Provision for new genomics technologies</i>	Blood samples be taken from selected animals (all sires of lambs recorded in the central progeny test and all lambs born in the central progeny test) and high-quality DNA extracted and stored.	High quality samples taken from MALP, but protocol needed for CPT and consideration for pedigree breeders.

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9	<i>Genetic evaluation - Timing of evaluations</i>	Evaluations be conducted on at least a weekly basis all year round.	A highly comprehensive genetic evaluation system has been developed. The genetic evaluation module for health traits still needs development. Evaluations are currently restricted to several runs per year.
10	<i>Genetic evaluation - Reporting of results</i>	A draft version of the breeding objective be prepared as soon as possible for further industry consultation and that the breeding objective be used to report sub-indexes for trait groups, along with overall indexes such as a Flock Replacement Index and a Terminal Index.	Work complete with scientific paper accepted for publication. Some future work on health traits and ewe longevity required.
11	<i>Breeding (and demonstration) schemes – the Central Progeny Test</i>	The Central Progeny Test (CPT) is established as outlined in this report to start with mating in 2009.	CPT successfully established.
12	<i>Breeding (and demonstration) schemes – the Maternal Lamb Producer group (MALP) scheme</i>	The MALP is established to start with mating in 2008.	MALP successfully established on a larger scale than originally envisaged.
13	<i>Breeding (and demonstration) schemes – CPT & MALP - emphasis on traits</i>	The emphasis within both the CPT and the MALP is on traits, not breed.	Genetic evaluation results so far only valid within breeds.
14	<i>Breeding (and demonstration) schemes – CPT location</i>	The CPT is spread over geographically diverse locations wherever possible.	Good dispersion of CPT flocks achieved.
15	<i>Breeding (and demonstration) schemes – operations of the MALP</i>	The Interim Sheep Board urgently commits to the MALP scheme recognising that the investment reflects its critical role in the dissemination of knowledge and understanding of the value of genetic improvement to breeders and producers.	Investment secured.

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16	<i>Potential impact of the proposed genetic evaluation scheme</i>	The Interim Sheep Board commissions a cost-benefit analysis of the proposed genetic evaluation scheme.	Preliminary cost-benefit analysis completed.
17	<i>Structure - The need for a collective support structure</i>	The Interim Sheep Board move towards the development of a permanent structure that pulls together and represents the interests of sheep processors, sheep producers and sheep breeders, including those sheep breeders and producers that do not currently performance record.	In progress.
18	<i>Structure - Participation by processors</i>	The sheep breeding objective be developed to reflect future industry benefits from improved carcass characteristics under close consultation with the sheep processing sector.	Engagement with the processing sector has been limited and this area needs extra focus going forward.
19	<i>Structure - Participation by performance recording pedigree breeders</i>	The data of current PSBIP breeders needs to be migrated across to a new sheep database as a priority, and existing, improved and expanded services delivered to these breeders as soon as possible.	Data migration has been achieved and recording pedigree breeders now have access to a much broader, flexible and more powerful system
20	<i>Structure - Participation by breed societies</i>	Over time the Sheep Database should offer new systems and capability to facilitate highly cost effective delivery of services offered by breed societies to their members.	Successful for Belclare and Galway. Synergistic benefits for other societies yet to be exploited.

Background to new genomic technologies

Genomic technologies are having a major impact on dairy cattle breeding programs in Ireland and internationally, and much government and private research effort is being devoted to this topic for sheep and other species. The technologies include genome-wide selection techniques that rely on statistics with limited knowledge of specific genetic variants, and marker assisted selection which relies on knowledge of the effects of specific genetic variants.

There is no guarantee that genome-wide selection will have a positive impact on sheep breeding in Ireland in the future. Factors counting against it include the high cost of testing for a relatively low (relative to dairy cattle) per animal value, small population sizes and fragmented breeds. However, technology costs are dropping fast, and there is a large amount of research under way internationally that is likely to improve its effectiveness.

Marker-assisted selection is a somewhat more mature technology and there are commercial products on the international market with variable efficacy.

Because of the future potential of genome-wide selection, because marker assisted selection based products are likely to be marketed in Ireland, and because gene discovery using SNP markers and new technologies is becoming more effective, it is recommended that Sheep Ireland take active consideration of these technologies in its future strategy development.

The following recommendations incorporate the outcomes of a meeting to discuss implications of new genomic technologies for Sheep Ireland which was held at Highfield House, Bandon on September 13th 2010. Meeting attendees included: Peter Amer (AbacusBio), Stephen Bishop (Roslin Institute), David Cottle (UNE), Brian Wickham, Pat Donnellan, Andrew Cromie and Thierry Pabiou.

New recommendations

Recommendation 1: Industry engagement - Enhancement of performance recording culture

While technical progress against the original strategy has been very positive, Sheep Ireland needs to promote a positive attitude among sheep farmers and sheep breeders towards performance recording. Better availability of genetic evaluation results to ram buyers has been recommended in the recent Graham Potterton report and this is endorsed by the review team.

This could be reinforced through development of a code of conduct that defines best practices for performance recording sheep breeders. This should be carried out in close consultation with existing performance recording sheep breeders. Ideally, it would be promoted by performance recording sheep breeders, both among themselves, and to their clients.

Sheep Ireland should also look to encourage the formation of groupings of performance recording sheep breeders, and arrangement of meetings of these breeders. Assistance could be provided to these groups to prepare and disseminate information about performance recording (e.g. for inclusion in a client newsletter). Often innovative farmers and breeders are the most convincing advocates of, and effective communicators of new technology ideas.

It is recommended that:

Sheep Ireland strive to increase the awareness of commercial sheep farmers and sheep breeders as to the value of and opportunity from performance recording in sheep, both for genetic improvement and farm management purposes.

Recommendation 2: Industry engagement - Breed societies

Lack of pedigree data availability from flock books creates a barrier to new Lambplus breeders. Pedigree breeders and breed societies may be motivated to engage constructively with Sheep Ireland through the provision of inbreeding monitoring and management tools, and potential opportunities for discovery and development of tests for recessive disorders.

It is recommended that:

Sheep Ireland investigates opportunities to develop services of interest to pedigree breeders and breed societies.

Recommendation 3: Industry engagement - Focus on MALP results in industry publicity

There is a need to leverage the investment in the MALP program into a higher profile of the importance of sheep breeding and ram selection decisions among sheep farmers in Ireland. This requires an analysis of MALP data, close engagement with Teagasc farm consultants, and a series of open days.

It is recommended that:

Sheep Ireland develops and implements a plan with a concrete timeframe for promotion of Sheep Ireland based around the MALP flocks.

Recommendation 4: Industry engagement – meat processors

Sheep Ireland needs to achieve a wider engagement with the meat processing industry. This is best achieved by identifying a progressive meat processor and creating an arrangement whereby information from the meat processor at an individual animal and/or slaughter cohort level can be passed back to commercial farmers participating in Sheep Ireland commercial farm services. This should be expanded to engage other meat processors as soon as possible. This opportunity was identified as a valued option by many commercial farmers in a recent study by Graham Potterton.

It is recommended that:

Sheep Ireland actively engages with as many meat processors as practical in the development of commercial farmer services.

Recommendation 5: Technical - Development of commercial farm services

With the phased-in mandatory introduction of EID in ewes, there are new drivers emerging to provide commercial farm services with nil or partial levels of parentage identification. Graham Potterton has recently undertaken an exhaustive evaluation of potential farm service technologies and undertaken industry consultation on the preferred options. Two potential strands to a commercial farmer service are recommended including:

- Practical farmer recording systems primarily targeting maternal ewe performance and that facilitate more powerful culling and ewe flock replacement decisions
- Information capture and feedback from meat processors of information that will guide better on farm decision making including slaughter timing decisions, breed and sire choices and health management.

These services could provide a vehicle for broader integration of Sheep Ireland with industry sectors that are not currently focused on sheep breeding issues. These sectors include Teagasc extension (both sheep specialists and discussion groups), producer group structures, as well as meat processors.

It is recommended that:

Sheep Ireland develops commercial farm services over the next 2 to 4 years based on the Graham Potterton report in anticipation of demand from progressive farmers to capture spin-off benefits from their EID tagging investment.

Recommendation 6: Technical - Improved phenotypic recording methods

It is widely recognised that a lack of accurate phenotypes for hard-to-improve traits is a primary inhibitor for extracting value from genome-wide selection strategies, and for discovery and/or verification of specific genetic loci of moderate to large effect. Sheep Ireland should facilitate research into phenotypic recording of traits required to optimise value from genomic technologies including disease phenotypes (e.g. footrot, internal parasites, dag scores), maternal traits (culling reasons and ewe longevity) and feed traits (residual feed intake and methane yield). This research should involve developing and implementing recording protocols. There is an argument that this should be undertaken by research organisations, but ideally would make extensive use of Sheep Ireland animal resources including CPT and MALP flocks.

It is recommended that:

Sheep Ireland facilitates research by partner research organisations within Ireland and internationally into phenotypic recording of traits including disease traits as well as maternal (ewe) and feed efficiency (including methane yield) traits.

Recommendation 7: Breeding scheme structure - An evaluation of options for more extensive recording

A higher level (more animals and more accuracy) of recording of traits described under recommendation 1 is justified based on the potential impact of genome-wide selection within future sheep breeding strategies. Options for obtaining more phenotypes for these traits include:

- a. Increasing the level of recording in MALP flocks, in particular the recording of disease, maternal and survival traits in ewes with sires identified via DNA parentage testing. This can begin as soon as the first cohort of DNA matched ewe replacements enter the MALP ewe flocks.
- b. Increase the number of CPT flocks through direct partnership with Teagasc research and TET flocks, and any other available institutional flocks.
- c. Increase the number of CPT flocks through migration of large suitable MALP flocks with enthusiastic owners into the CPT structure.
- d. Capture of data on maternal ewe performance via on-farm recording whereby commercial farmers undertake recording in conjunction with compulsory EID tagging systems for ewes to exploit information services that deliver direct commercial benefit to the farm.

Under each option, it would be necessary to capture and store high quality tissue/DNA samples on recorded individuals, and their sires. Where the focus of recording is limited to ewe traits, it may be unnecessary to capture DNA on lambs, unless required for pedigree identification/verification.

It is recommended that:

Sheep Ireland undertake a study to evaluate the anticipated cost per phenotype captured through either more extensive MALP recording, more CPT flocks, or on-farm recording for commercial benefit.

Recommendation 8: Breeding Scheme Structure - Evolution of MALP flocks

The original 2008 Sheep Ireland strategies proposed MALP flocks for industry demonstration purposes. Specifically, they were intended to demonstrate to commercial farmers the differences in farm profitability that can be attributed to genetic differences between rams. The number of MALP flocks is large, and a large number of DNA parentage matched lambs have been recorded for terminal traits. Several year cohorts of DNA matched ewe lambs are starting to enter MALP flocks as replacement breeding animals. A key focus for the majority of MALP flocks needs to be a switch to the recording of maternal information, and this does not necessarily require the DNA matching of lambs. Although DNA matching of lambs from these ewes would be beneficial, a high proportion of the costs of running MALP flocks relates to DNA matching and the subsequent recording of lamb traits. These flocks could play an important role in the development of commercial farm services as they are already engaged with Sheep Ireland and all ewes have EID tags.

MALP flocks where there is a high level of farmer motivation to continue recording offer an opportunity to expand high level recording and contribute to linkage in genetic evaluation without incurring costs associated with AI etc in the CPT flocks.

It is recommended that:

Sheep Ireland undertakes a restructure of the MALP program, with a view to dividing flocks into second generation MALP flocks which perform a linkage and genetic evaluation role, plus a set of test flocks for commercial farm services.

Recommendation 9: Provision for Genomics - Sampling and inventory of DNA

Relevant DNA needs to be sampled and stored for animals with suitable phenotypes. This occurs automatically for MALP flocks, but sires, ewes and lambs participating in CPT flocks need to have samples stored.

A service could be provided to pedigree breeders participating in Sheep Ireland for collection, storage, and an inventory of tissue samples and or DNA. The stored DNA would be useful for genome-wide selection training, and in the future for imputation (the process of inferring dense SNP genotypes for animals with sparse SNP results using dense SNP information from ancestors). It could also be useful for homozygosity mapping purposes to identify recessive traits with binary phenotypes, and for testing industry gene frequencies of specific genetic loci being considered for validation studies.

It is recommended that:

Sheep Ireland develops a tissue sample and DNA inventory for sheep, along with a protocol and calendar to ensure that all relevant DNA is collected and stored.

Recommendation 10: Provision for Genomics - International co-operation on genome wide selection

Many other European countries share the same challenges as Ireland for implementation of genome-wide selection in small ruminants. The primary limitations include the cost of collecting phenotypes and genotypes, coupled with small numbers of recorded individuals and a diverse breed base. Research networks are developing within Europe, and these seek to engage with New Zealand and Australian research initiatives which have much larger numbers of animals with suitable phenotypes. New Zealand and Australian researchers could benefit from validation of discoveries in terminal-sire breeds (Texel and Suffolk) common to both countries. This might lead to international commercialisation of products that might be useful in Ireland; however these products will have commercial profit margins incorporated into test costs.

It is recommended that:

Sheep Ireland encourages and engages in international research collaboration efforts in partnership with relevant research institutions in Ireland.

Recommendation 11: Provision for Genomics - Genomics research direction

New tools for application of genomics in livestock breeding programs are constantly evolving. While a genomic evaluation system currently exists for dairy cattle in Ireland, there is a high probability that this system would not capture all potential benefits from genomic selection in sheep. For example, homozygosity mapping techniques can very quickly and efficiently identify markers for recessive disorders with clear phenotypes. Furthermore, genome-wide selection evaluation techniques that fully exploit the presence of genetic variants of moderate to large effects on traits need to be considered through partnerships with research organisations in Ireland and internationally. In particular, methods which exploit genetic variants of moderate effects could facilitate a broader prediction base to distant relatives of training animals. There is considerable evidence of genetic variants with moderate to large effects on prolificacy and meat yield in sheep. Prediction of genetic merit of animals relatively unrelated to training population animals is also likely to be important because of the population structure of sheep. Similar issues may arise for the application of genome-wide selection for beef cattle populations in Ireland.

It is recommended that:

Sheep Ireland encourages and engages in research efforts that are of specific relevance to development of options and tools for implementation of genomic technologies in sheep.

Recommendation 12: Provision for Genomics - Gene test validation

A number of gene test commercial products are available internationally for sheep. The integrity of these products across countries, populations and genetic backgrounds has a history of variability, although this history is not always taken account of in the marketing and promotion of these tests by commercial interests. Having a resource of accurately phenotyped and genotyped animals of known genetic background is of considerable value for testing and validating claims by commercial companies around test efficacy and value.

Where phenotypes and genotypes are readily available, this validation process can be undertaken quickly and retrospectively. In some cases, the necessary phenotypes for validation may need to be collected in addition to those available historically. Collecting new phenotypes from an existing, well phenotyped, resource has advantages in that the population structure is well understood, and unfavourable side effects on traits of economic importance can be tested for. There are further advantages in that the sheep industry in Ireland can have full confidence in the integrity of results and subsequent commercial implications.

It is recommended that:

Sheep Ireland recorded sheep resources be the preferred source of phenotyped individuals for validation of potential commercial tests, and Sheep Ireland closely monitor claims made by commercial interests in relation to test efficacy prior to testing within Ireland.

Recommendation 13: Provision for Genomics - Genomic breeding strategies

Because of high test costs relative to animal value, and population structure, genomic breeding strategies that are specific to sheep will need to be formulated. There are two likely applications. The first application is via the incorporation of test results for specific genetic variants into animal evaluation results as well as their use in improved selection and mating decisions. The second application is via use of genome-wide selection for improvement of disease resistance and maternal traits. Two stage selection strategies that reduce the total testing requirements while retaining the majority of benefits through more accurate selection of elite sires within breeder flocks need to be considered.

It is recommended that:

Sheep Ireland keep a watching brief on implementations of genomic technologies in New Zealand and Australia and encourage a research project at post graduate student level to model suitability of options for use within Ireland.

Summary of new recommendations

No.	Title	Draft recommendations:
1	<i>Industry engagement - Enhancement of performance recording culture</i>	Sheep Ireland strive to increase the awareness of commercial sheep farmers and sheep breeders as to the value of and opportunity from performance recording in sheep, both for genetic improvement and farm management purposes.
2	<i>Industry engagement - Breed societies</i>	Sheep Ireland investigates opportunities to develop services of interest to pedigree breeders and breed societies.
3	<i>Industry engagement - Focus on MALP results in industry publicity</i>	Sheep Ireland develops and implements a plan with a concrete timeframe for promotion of Sheep Ireland based around the MALP flocks.
4	<i>Industry engagement - meat processors</i>	Sheep Ireland actively engages with as many meat processors as practical in the development of commercial farmer services.
5	<i>Technical - Development of commercial farm services</i>	Sheep Ireland develops commercial farm services over the next 2 to 4 years based on the G Potterton report in anticipation of demand from progressive farmers to capture spin-off benefits from their EID tagging investment.
6	<i>Technical -Improved phenotypic recording methods</i>	Sheep Ireland facilitates research by partner research organisations within Ireland and internationally into phenotypic recording of traits including disease traits as well as maternal (ewe) and feed efficiency (including methane yield) traits.
7	<i>Breeding Scheme Structure - An evaluation of options for more extensive recording</i>	Sheep Ireland undertake a study to evaluate the anticipated cost per phenotype captured through either more extensive MALP recording, more CPT flocks, or on-farm recording for commercial benefit.
8	<i>Breeding Scheme Structure -Evolution of MALP flocks</i>	Sheep Ireland undertakes a restructure of the MALP program, with a view to dividing flocks into second generation MALP flocks which perform a linkage and genetic evaluation role, plus a set of test flocks for commercial farm services
9	<i>Provision for Genomics -Sampling and inventory of DNA</i>	Sheep Ireland develops a tissue sample and DNA inventory for sheep, along with a protocol and calendar to ensure that all relevant DNA is collected and stored.

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10	<i>Provision for Genomics - International co-operation on genome wide selection</i>	Sheep Ireland encourages and engages in international research collaboration efforts in partnership with relevant research institutions in Ireland.
11	<i>Provision for Genomics -Genomics research direction</i>	Sheep Ireland encourages and engages in research efforts that are of specific relevance to development of options and tools for implementation of genomic technologies in sheep.
12	<i>Provision for Genomics -Gene test validation</i>	Sheep Ireland recorded sheep resources be the preferred source of phenotyped individuals for validation of potential commercial tests, and Sheep Ireland closely monitor claims made by commercial interests in relation to test efficacy prior to testing within Ireland.
13	<i>Provision for Genomics -Genomic breeding strategies</i>	Sheep Ireland keep a watching brief on implementations of genomic technologies in New Zealand and Australia and encourage a research project at post graduate student level to model suitability of options for use within Ireland.