# A DECADE OF SHEEP IMPROVEMENT LIMITED (SIL)

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## SUMMARY

In the decade since its commencement SIL has continued to develop as a performance recording service, expanding the range of traits able to be recorded and improving the range of analyses and selection indices available. There has been increased focus on identifying sources of superior genetics, with the SIL-ACE analysis including data from over 300 flocks and 6 million animals from a range of breeds. Ongoing research is reflected in the addition of new goal trait groups including disease traits such as facial eczema, resistance and resilience to internal parasites and dag score. On-farm production system changes have lead to the inclusion of new reproductive traits such as hogget lambing and twinning rates and processing industry developments such as yield grading of carcasses are also offering new opportunities. A major change has been the introduction of DNA technologies for defining pedigree and for gene tests of productive traits.

## INTRODUCTION

The New Zealand sheep industry has had access to genetic evaluation systems for over 40 years (Callow 1985). However by the 1990s there were a number of schemes offering differing systems for analyzing and presenting information which caused confusion within the sheep breeding industry.

Geenty (2000) stated the aim of Sheep Improvement Limited (SIL) was to facilitate effective genetic improvement across the New Zealand sheep industry in cooperation with the previously existing sheep genetic improvement schemes. The database was also seen as a vehicle for transfer of research technology to the industry and to allow extensive breeding data to be used for further research.

The introduction of SIL provided breeders with routine BLUP analysis under a full animal model providing the ability to rank animals across sexes and ages using information from relatives, including ancestors and descendants. SIL provided on-demand access to across flock analyses, something previously only available in a limited manner to a small number of breeding groups.

## USAGE

Use of SIL has grown dramatically to over 1000 active flocks, of which three-quarters are performance recording. There are close to 10 million animals on the SIL database, with about 400 thousand more added each year, making SIL the largest genetic database for sheep in the world. The median number of new animals added each birth year is 630 per flock for dual purpose sheep and 240 per flock for terminal sire sheep (Young and Wakelin 2009).

The number of animals included in genetic analyses has increased as depth of reliable data has increased, with 10 years data typical for analyses when SIL commenced, increasing to 18-20 years data in current analyses. The number of flocks in an analysis has also increased with more than one third of analyses having more than one flock in the analysis. There are more than 25 across-flock groups, with the number of flocks in the groups ranging from 5 to 70 and an average of 23 flocks. The number of analyses undertaken by across-flock groups is determined by the individual group and varies from weekly to annually, although most flocks run 3 or 4 official group analyses for reporting each year.

Increases in analysis sizes have been matched by improvements in processing capability to maintain rapid turnaround times for users. A typical BLUP evaluation for 2000 ewes over 12 years of data for Growth, Wool and Reproduction took about 25 minutes to run in 1999 but now takes only 5 minutes.

**NEW GOAL TRAIT GROUPS**

SIL has a unique role in delivering research outcomes to the wider sheep industry. Over the last decade SIL has added further genetic evaluation modules for traits of economic importance to the New Zealand sheep industry including resistance to facial eczema (Morris *et al.* 1994), resilience to internal parasites (Morris *et al*. 2001), dag score (McEwan 1992), hogget lambing and twinning rate (increased twinning rate at same lambing percentage) (Amer & Bodin 2006), as well as revision of existing modules to reflect industry, market and technical developments.

Implementation of these goal trait groups in SIL means they can be readily accessed by breeders. Some, such as facial eczema and resistance or resilience to internal parasites, require registration of the breeder where protocols must be followed to ensure valid data is collected for analysis.

Historically, genetic evaluations for meat production within SIL were designed to reflect the criteria on which payments were made to commercial farmers and as such focused on the weights of lean and fat in the whole carcass. Individual meat processors are now developing or purchasing carcass grading systems which not only give better estimates of the weight of fat and lean but also give indications of retail yield within individual cuts as well as overall, and these companies will reward for high yielding carcasses in their payment system. SIL has recently developed a new "MEAT YIELD" goal trait group which is designed to use data from carcass grading systems to estimate BVs for lean weight in the shoulder, loin and hind leg primal cuts, along with total carcass lean and fat (Jopson *et al.* 2009a, 2009b).

Currently SIL is collaborating in work across on a wide range of issues of current or developing importance to the sheep industry. These include revision of lamb survival (Kerslake *et al.* 2005), easy care fleeced sheep (bare breech and belly) (Scobie 1997), ewe longevity and efficiency (Sise *et al.* 2009) and reduction in green house gas emissions.

**SIL-ACE**

Although by the early 2000s there were a number of group breeding schemes routinely undertaking across flock analyses, there were few links between these groups even where groups were of the same breed. Genetic connections between different breeding groups were greatly improved with the establishment of the Meat & Wool New Zealand Central Progeny Test (formerly Alliance Central Progeny Test). One hundred and forty three rams from different breed groups have been used as sires at one or more of the three CPT sites since 2002, establishing good genetic connections between many groups.

SIL now routinely undertakes a large across-flock evaluation, known as SIL-ACE. This is an across-flock, across-breed genetic evaluation that produces reports on animals from genetically connected flocks. When SIL-ACE started in 2004, there were 151 flocks and 1.2 million animals in the evaluation. Now 335 flocks participate with over 3.2 million animals. The number of flocks connected for each major goal trait group are; Growth 269; Meat 197; Wool 151; Reproduction 232; WormFEC 58. More than 75 million breeding values are produced, making this the largest genetic evaluation of sheep in the world (Young & Newman 2009).

## DNA TECHNOLOGIES

SIL has been involved in the delivery of DNA technologies to the sheep industry in recent years, including facilitating accurate recording of data and results to routine calculation of breeding values accounting for DNA parentage results.

Parentage determination in extensively farmed sheep is currently the most widely used test (Crawford *et al.* 2007). Increasingly these tests are being supplemented by the use of performance trait markers, either by themselves or in conjunction with parentage testing. Commercial single marker tests currently available include meat yield, prolificacy, parasite resistance and production, lamb survival, footrot and scrapie susceptibilities. The number is increasing by 1 to 2 additional tests per year (McEwan 2009).

Future developments in this area are likely to be some form of genome wide selection where the test explains a major part of the genetic variation in an animal for a range of traits (Dodds *et al.* 2007, Sise *et al.* 2008). This technology depends on the creation and use of high density SNP chips, something that has already been implemented in dairy cattle in several countries. A similar chip has been created for sheep and New Zealand animals are currently being genotyped (McEwan 2009). If successful the expectation is that industry release will occur in late 2009. Delivery to the New Zealand sheep industry will be in the form of breeding values using a blend of DNA and existing SIL information.

## EXTENSION

The existence of genetic evaluation systems does not in itself ensure genetic progress. Information must be used when making selection decisions for genetic progress to be achieved. During the initial years of SIL much effort was devoted to extension with SIL breeder clients. This work aimed to show how SIL features could provide robust information on which to base valid selection decisions. Industry extension continues to be a major focus of SIL although increasingly effort is devoted to commercial ram buyers (Young & Wakelin 2009).

## GENETIC GAINS

SIL's success in the decade since its commencement is clearly illustrated by increases in rates of genetic gain achieved (Young and Amer 2009). After the introduction of SIL in 1999, genetic gains almost doubled for both Dual Purpose and Terminal Sire flocks. A further lift occurred after 2004, when SIL-ACE was introduced, with rates of genetic gain close to three times that achieved prior to SIL.

**Table 1. Annual rates of genetic progress achieved in the New Zealand ram breeding industry.**

| Period | Genetic Gain (Index $/year) | |
|---|---|---|
| | Terminal Sire | Dual Purpose |
| 1990-1994 | 0.37 | 0.25 |
| 1995-1998 | 0.34 | 0.29 |
| 1999-2003 | 0.61 | 0.59 |
| 2004-2006 | 0.83 | 0.92 |

## CONCLUSIONS

Increases in genetic gain since the introduction of SIL can be attributed to a number of factors with SIL responsible for or acting as the focus for these. SIL has enabled breeders to confidently identify superior genetics within farm, within breeding groups, within the national flock and even between countries for some breeds. However a large number of flocks perform well below the rates of genetic progress achieved by other flocks, demonstrating there are substantial opportunities for further improvement.

SIL has an important role as a vehicle for delivering science to the sheep industry and works closely with researchers to enable scientific advances to be rapidly available. As ram breeders and commercial farmers face increasing pressure from changes in the market such as increased emphasis on product quality and on production efficiency, SIL's role will be critical in delivering appropriate solutions.

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