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## Structure and role of SIL in sheep genetic improvement in New Zealand

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### ABSTRACT

Sheep Improvement Ltd (SIL) has been developed to manage the national genetic database for the New Zealand sheep industry. Since its launch in 1999, SIL has gained acceptance as the provider of the industry standard sheep genetic analysis. As part of the greater industry, SIL has a key role to play in fostering the uptake of performance recording to maximise the rate of genetic improvement in the commercial flock, through improved ram breeding and selection decisions. Long-term benefits of genetic improvement are dependent on delivering scientifically advanced analysis to all members of an informed industry. This requires consistency of information, supplied at varying levels of complexity, but always in a simple, accurate and relevant form. SIL provides information in a flexible and easy to understand format, backed up by a strong focus on industry education. Continuous development focuses on delivering new outputs related to improved profitability, more accurate analysis, including major-gene effects as they become available, and greater flexibility at a computational level. Equally importantly, SIL will develop outputs to provide greater flexibility, relevance, ease of use and understanding by all users of genetic information.

**Keywords:** sheep; genetic improvement; SIL.

### INTRODUCTION

Continuing productive improvement in the New Zealand sheep industry is dependent on genetic improvement. Since the development of the National Flock Recording Scheme in 1967, geneticists and ram breeders have worked together to improve the accuracy and relevance of national performance recording schemes.

Genetic improvement theory has changed little in the last 46 years, but developments in computers and telecommunications have allowed huge advances to be made in data transfer, storage and analysis. The sheep performance recording services offered by SIL are among the most advanced in the world, yet the ability to deliver real benefit to the sheep industry is still limited by lack of effective uptake and implementation of the available information by ram breeders and ram buyers. The ability of SIL to operate as an integral part of the wider sheep industry is essential if the industry is to reap maximum rewards from genetic improvement.

#### Development of SIL

Sheep performance recording has been delivered to the national industry through a succession of schemes, starting with the National Flock Recording Scheme (NFRS; 1967 – 1976), Sheeplan (1976-1988) and Animalplan (1988-2002). Competing independent services have been provided by Flocklinc (1989-1999) and the PC-based software programme Studfax. In August 1997, it was agreed to merge data from flocks using Animalplan, Flocklinc and Studfax into a single national database, operated on behalf of the industry by SIL. SIL is jointly owned by MeatNZ and the NZ Wool Board, and commenced full commercial operation in 1999. Several key objectives in the development of SIL have been achieved. For example,

- a single national database with standardised analyses and outputs.
- a reliable and accurate, Internet-based, data transfer and analysis system.

- a marked increase in the utilisation of performance recording by all sectors of the sheep industry.
- an industry education programme.
- a cost-effective continuous development programme.

SIL has a staff of two, with a further 3.5 full time equivalents (FTE) on contract. These cover the three areas of SIL operation; delivery of genetic information (1.3 FTE), continuous development (2 FTE) and industry education (2.2 FTE). Additional research and development contracts are negotiated on an individual basis as required.

#### Genetic improvement in the national flock

SIL defines genetic improvement as the improvement in production traits due solely to genetics. Ram breeders have traditionally applied additional traits to their selection criteria, often those associated with breed type. These have responded to visual selection and still play an important role in selection, but in many cases they do not contribute to improved productivity. Most productive traits, such as number of lambs born, lamb survival and lamb growth, require high-level analysis to ensure effective genetic improvement. This is primarily due to their low heritability and is compounded, in some cases, by a relatively high repeatability. In such cases, the phenotype, or visual appearance, of a sheep is not a good indicator of its genetic merit.

It is well accepted that genetic improvement is dependent on performance recording and that efficient genetic improvement is impossible without making full use of performance recording. This has been well recognised by sectors of the New Zealand sheep industry since the inception of the NFRS.

To maximise the rate of increase in genetic merit of the national flock, all rams supplied to commercial buyers should be the product of an effective genetic improvement programme. Given the nature and structure of the national ram breeding industry this requires a significant proportion of ram breeders to be involved with

performance recording. The history of breeder involvement has been well documented in terms of the number of ram breeding flocks involved with performance recording schemes. Rae (1985) reported that the NFRS peaked in 1974 with 630 flocks and 170 000 ewes. Daniell & Callow (1982) reported 450 flocks transferred to Sheeplan in 1976 and that 1100 flocks (out of an estimated 4500 total) were recording with Sheeplan in 1982.

There are currently approximately 2400 ram-breeding flocks in New Zealand, comprising 1900 registered and 500 unregistered flocks. SIL currently records performance information for only 700 flocks, an increase from approximately 400 when SIL was established in 1999. This is expected to further increase in the short term, but is likely to plateau as average flock size of successful breeders increases. These 700 flocks are estimated to produce 60% of the rams supplied to the national flock.

### DECISION MAKERS IN GENETIC IMPROVEMENT

Genetic improvement in the national flock relies on the cumulative decision making of a number of **key decision makers**.

The main determinant of genetic improvement is the decision of **commercial ram buyers** to seek the best available genetics. Additionally, they need to satisfy other requirements for breed, type, structure and adaptability. Equally importantly, they need to develop trust and a robust business relationship with the ram breeder. They rely on the ram breeder for genetic improvement, but can also choose to buy high-genetic-merit rams from the ram-breeding flock. Genetic information can be kept to a minimum, but ram description should be focused on genetic merit, summarised by economic selection indexes. The SIL Overall Indexes should be the main focus for this group.

The **commercial ram breeder**, or ram multiplier, must be driven by a desire and ability to breed and select the best rams for sale to commercial ram buyers. Performance recording, with emphasis on economic selection indexes and Breeding Values, is essential to maximise the genetic merit of rams offered for sale. It also allows for accurate ewe selection, objective assessment of bought-in rams and for top home-bred rams to be identified and retained.

The **stud, or elite, ram breeder** is driven by genetic improvement. This group is likely to utilise high level genetic solutions to maximise gain in their desired direction. Frequently, large scale breeders fulfil the requirements of both elite and multiplier flocks.

Professional **animal breeding specialists** provide essential advice about the design of breeding programmes, genetic analysis and the interpretation of genetic evaluations.

**Rural advisers**, including stock agents, vets, farm consultants and others also influence ram buying decisions. Although not usually the key decision makers, these groups can influence farmer opinion and need to consider genetic improvement in their advice, from the basis of a sound understanding of the application and

economic benefits of using SIL information.

**SIL** does not make breeding decisions, but the information provided by SIL is an invaluable tool for use by all decision makers. In consultation with other groups, SIL implements and manages the development of performance recording for the national flock.

No single group can facilitate effective genetic improvement in isolation, but combined and working together, industry benefits far exceed individual contributions. SIL plays an important role in providing all decision makers with relevant and accurate information. Equally, SIL responds to industry requirements and targets development opportunities of maximum relevance and benefit to all groups.

### INTERPRETING GENETIC INFORMATION

Newman *et al.* (2000) described the SIL genetic analysis, including available breeding values. The computation of breeding values, although an essential aspect of any genetic analysis, is of less importance to genetic improvement than their application. Interpretation and balancing the 20 available breeding values into an effective selection programme is not a simple task. If left to ram breeders, this could create inefficiencies in selection practices and, at worst, a tendency towards single-trait selection. Summarising genetic merit across disparate traits necessitates the use of selection indexes. SIL economic indexes (Amer, 2000) not only provide ram breeders with balanced selection criteria, but also provide a simple means of ram selection for commercial ram buyers. Consequently, effective genetic improvement can be achieved without reference to breeding values.

However, the standard SIL indexes are not mandatory and ram breeders can, using the services of a genetic consultant, design indexes to suit their personal breeding objectives. Several breeders and breeder groups have adopted this approach. This is a critical philosophy of SIL; at no point is any breeder compelled to use a standard SIL solution, whether it is an index, report format or even a recorded trait. Everything is designed to be flexible and easily customised to achieve individual breeder objectives.

### CONTINUOUS DEVELOPMENT

Computer and software developments will continue to enhance the way SIL operates. However, these are largely behind the scenes and do not necessarily deliver noticeable impacts for the sheep industry. A major project presently under development in this area is the automated use of genetic groups in the SIL analysis routine. This will allow SIL to better represent the genetic merit of animals brought into the flock with no performance history, e.g., bought-in rams and screened-in ewes, account for hybrid vigour in crossbred flocks and, potentially, allow across-breed comparisons.

Developments of more direct relevance to users that focus on the interpretation of SIL data include;

**Ram Focus:** This software package (Jopson, 2003) will provide ram breeders with a tool to describe sale rams in the most economically relevant manner for commercial

ram buyers' individual flocks.

**Mate allocation:** Computer-generated mating lists, allowing for random mating, but avoiding inbreeding, or best-to-best mating maximising genetic progress towards a defined objective, utilise the pedigree and genetic information held on the SIL database. Automated analysis of mating lists will simplify the arduous task of maximising genetic gain while minimising inbreeding. In the future, it will be possible to download such lists to "smart" equipment for automatic drafting, using electronic ear tags.

**Desired Gains:** Progressive ram breeders can design their own breeding programme, based around desired levels of performance in specific traits. Currently, this involves employing an animal breeding consultant to derive an index to achieve the desired result. A simplified software programme to calculate the potential rates of genetic progress in a specific flock for a number of traits, could potentially allow elite ram breeders to make informed decisions about the direction of their breeding programme.

**Central Progeny tests (CPTs):** SIL is involved in three CPTs, in Hawkes Bay (Poukawa), Canterbury (Lincoln) and Southland (Woodlands; Campbell & Jopson, 2003). CPTs play an important role in the understanding of new traits, development of improved analyses and demonstration of the on-farm relevance of genetics to productivity and profitability.

**Marker assisted selection (MAS):** As biotechnology discovers gene tests for sheep SIL will play an important role in storing and reporting data to ram breeders. Software will have to be developed to account for the presence of major genes affecting productivity in the SIL genetic analysis.

### Key points

- SIL is built on over 40 years of national sheep performance recording in New Zealand.
- SIL manages the delivery of analysed genetic information (sire and dam summaries, selection lists) for the national flock, based on production traits measured in recorded flocks.
- SIL extension services foster understanding of SIL and performance recording by all industry participants.
- Genetic improvement of the national flock will be more effective when all decision makers actively pursue rams with high genetic merit for productive traits.
- Continuous development of SIL systems is essential to realise potential genetic improvement.
- SIL provides users with flexibility to design customised breeding programmes, which is critical to maintain genetic diversity and maximise genetic improvement.
- SIL is accepted as an essential component of the ram-breeding industry.

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