SIEOL: implementing a global information system for genetic and techno-economic support in dairy sheep in France

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Summary

With 945 000 ewes in milk recording in 2 660 flocks, the impact of milk recording in dairy sheep is high in France and has permitted the development of efficient breeding schemes in the 5 French local dairy sheep breeds. A new information system called SIEOL has been implemented since 2005 for dairy sheep in France to manage both genetic and techno-economic data. As the previous one, this system is based on a three-levels organization. The local level corresponds to the PC of the field technician, in charge of milk recording, on-farm valorisation and techno-economic advise to the breeders. A regional site, the second level, gathers the data from all milk recording technicians, as well as data from other organizations, such as breed organizations, AI centres, milk analysis labs, dairy plants. These data are replicated to the national central database, the third level, whose main objective is to provide data for genetic evaluations, as well as to receive data from molecular analysis labs. The data model is the same whatever the site. This organization enables a mutualisation of the different valorisations and advice to the breeders, and facilitates therefore the interactions between technicians and breeders.

On the whole, the SIEOL system manages data of 55% of French dairy sheep farms and 65% of the dairy ewes.

After presenting the background and management of the new SIEOL information system, we focus in this paper on the main organisational characteristics of the system and emphasize its multiple-purpose objectives, through genetic evaluations, technical and economic support, and new sanitary purposes.

Key words: Dairy sheep, Information system, Genetics, Techno-economic support.

Introduction

With 945 000 ewes in milk recording in 2 660 flocks, the impact of milk recording in dairy sheep is high in France and has permitted the development of efficient breeding schemes in the 5 French dairy sheep breeds.

The information system for animal recording and genetic data management, which includes the central and local databases, software to input, check and calculate data, as well as the exchanges between the different databases (central and local), is a key point of the efficiency of a breeding program since it is a requirement to obtain accurate, unbiased and on-time EBVs. In France, each species and production of ruminants has its own specific genetic information system. These systems are, until now, supported in a large part by state subsidies, in the framework of the French Breeding Law. Given the evolution of computing technologies, needs of breeders (new traits, new criteria, new organisation) and genetic evaluation, these information systems must evolve regularly, indeed be totally rebuilt. Over the last 10 years, all genetic information systems for ruminants in France (cattle, dairy sheep, meat sheep, goats) have been reconstructed. This paper focuses on the new dairy sheep information system, whose acronym is SIEOL, meaning Dairy Sheep Information System for Breeders (DSISB). This system gathers 55% of the dairy sheep flocks and 65% of the dairy sheep animals (Table 1).

Table 1. Impact of SIEOL in 2007 in France.

Dairy sheep population in France		SIEOL population	
Dairy sheep flocks	Dairy sheep ewes	Dairy sheep flocks	Dairy sheep ewes
4 820	1 452 000	2 662 (55%)	945 000 (65%)

This paper will successively highlight the background in which this new system has been built (decisions and management, main objectives), the conception of the system and its articulation within the different organisations involved in selection and support in dairy sheep in France. Finally, we will make a focus on the main purposes and specificities of the system, which is opened, beyond the data for genetic evaluation, on an increasing range of data, from techno-economic data to sanitary data.

Background and management of the new SIEOL dairy sheep information system

Historically, 3 successive national genetic information systems for dairy sheep have been implemented in France, since the sixties, with the main purpose of genetic evaluations. The last system operated from 1984 to 2005, including, along its lifetime, major adaptations such as integration of specific simplified design for milk quality recording, management of data from breed and AI organizations, on-farm PC computerization of milk recording. The costs of investment and maintenance of these systems have mainly been supported by Ministry of Agriculture.

Beside the genetic information system, a system had been conceived in the early nineties to produce technical and economic support data (margin on feeding costs, gross margin, analysis of chemical and hygienic quality of milk) for extension service to the breeder. The data, input by field technicians on a PC, through a specific software, or got from economic organizations (milk payment data), were sent to a central database run by the Breeding Institute (Institut de l'Élevage).

In 2000, the field organizations involved in breeding activities for dairy sheep, co-ordinated in the National Committee for Dairy Sheep (CNBL) decided to conceive and develop the so-called SIEOL information system whose main innovations would be:

- Share management of genetic data, techno-economic data, and other data, such as sanitary data, in a same database.
- Same structure of data (same data model) whatever the sites.
- Use of the new technologies of information and communication.

SIEOL is the national information system for genetic and techno-economic uses for dairy sheep in France. The Ministry of Agriculture and the CNBL, full member of the new French Inter-professional organization for genetic improvement of ruminants (FGE), are co-owners of SIEOL. According to the Law, the central database is managed by INRA, which is also in charge of official EBVs. The system was mainly financed both by the Ministry of Agriculture and the organizations involved in the CNBL, through European subsidies or with their own funds. SIEOL was conceived and is administrated by the Breeding Institute. Its development was co-performed by the regional (ARSOE Soual) and national (INRA-CTIG) sites of SIEOL.

Organisation of SIEOL

The SIEOL information system is based upon a pyramidal organization with 3 levels:

- At the local site, each milk recording operator inputs on-farm data on a laptop (identification and registration, matings and lambings, milk recording), using a SIEOL software (developed in Visual Basic language) to check data and propose on-farm correction (if needed) and valorisation to the breeder.
- The field technicians send all data, through an intranet solution, to a regional site located in the town of Soual (Midi-Pyrénées).
- A national site located at INRA Jouy-en-Josas includes all the data available and needed for genetic evaluations (data from all flocks submitted to milk recording since 1950). The exchanges between the regional and national levels lay on replication from one database server to the other.

The same data model is applied at each site. Whereas the national and regional levels have the whole data, the database of each technician computer includes the data corresponding to the flocks managed by this given technician.

SIEOL is supplied by all the organizations involved in both genetic and techno-economic assessment: milk recording organizations, technical advise organizations, breed organizations, AI organizations, milk analysis laboratories, molecular analysis laboratories, milk plants and inter-professional organizations, INRA for EBVs and research purposes. Each organization may, according to specific access rights, update the database and visualize data through a client x server solution.

Updating of data are authorized, whatever the organization, only through a national software (collection of "functions" written in C language, portable and usable on the different databases and systems: SQL Anywhere and Windows, DB2 and AS400, DB2 and MVS or UNIX) which checks data before updating them and increases therefore security and quality of data.

Main purposes of SIEOL

Genetic information system and genetic evaluations

EBVs are the main purpose of the system. According to the Breeding Law, genetic evaluations are conceived and operated by INRA and cast to the field organizations by the Breeding Institute. At each run (3 times a year), SIEOL provides the relevant data for the evaluations, whose issues (EBVs, fixed effects) are fully stored. The computed EBVs to be published are sent back to SIEOL. To face this first goal, a specific evaluation and research information system, including scripts, programs and database, has been established to organize the interface between SIEOL and genetic evaluations (table 2). Scripts and software extract the relevant data from SIEOL, organize and calculate data in operational tables (pedigrees, performances) to be used for evaluations (extension of lactations, editing, other calculations, etc), codify the effects and the animals, launch the evaluation, get back the raw data from the evaluations and organize them in a properly way.

This set of tables and software may be easily used to implement experimental evaluations (in order to test new modellings for example), analyse data, estimate genetic parameters and is thus a useful tool for genetics purposes.

Table 2. Dairy sheep population in SIEOL, genetic evaluation and PrP information system.

	SIEOL	Data included in the evaluations (2008)	Published EBVs in 2008 (active animals and reliability threshold)	PrP molecular data
Sheep (ewes and rams)	4 149 041	4 016 316	8 715 rams and 317 454 ewes	126 748
Lactations	7 511 547	6 414 737		

Techno-economic

SIEOL is the only information system of ruminants in France that combines both genetic data and techno-economic data. Indeed, in dairy sheep in France, the field technician provides a global service to the breeder and is therefore responsible for the collection of all on-farm data, genetic-purpose data (milk recording, inventory, AI and matings, lambings), as well as techno-economic data (data permitting calculation of gross margin or margin on feeding cost). He is also responsible for the valorisation of these data towards the breeders. Since the implementation of SIEOL in 2005, the same system (same database, same software) has included genetic and techno-economic data (table 3), with numerous objectives, such as:

- Facilitating the job of the technician who can import individual data collected for each ewe to generate technical assessment at a flock scale in aggregating individual data, avoiding double input.
- Allowing consistency between all the statements produced to the breeder.
- Economic and genetic data in the same database is a useful tool to rationalize the breeding objectives with an economic background.

Sanitary data

During the last decade, the different sanitary crisis (scrapie, blue-tongue) have been a growing concern in sheep. The SIEOL system has been useful to manage sanitary data in order either to provide advise to the breeder, or to overlook sanitary situation of the flocks.

Table 3. Techno-economic assessments produced by SIEOL in 2007 in France.

Type of assessment	Technical assessment	Techno-economic assessment		Chemical and hygienic assessment
		Margin on feeding cost	Gross margin	
Assessments produced in 2007	1 860	1 683	329	1 687

The strong impact of milk recording in sheep has been used to build a large-scale observatory of culling causes for ewes and rams. This collection of data lays on the knowledge of the breeders, who may give the cause of culling with three degrees of precision: generic group (ex.: mastitis), sub-group (ex.: subclinical mastitis; clear symptoms), precise cause (ex.: somatic cell count; *S.aureus* mastitis). The causes of culling have been defined jointly with veterinarians. In 2007, among the farmers of the Lacaune breeding scheme, almost 25% of the culled ewes had a culling cause. These data may be used as an observatory of sanitary problems and diseases in sheep.

In the framework of the national breeding plan to eradicate scrapie on the basis of the PrP gene selection, PrP genotyping has been set up at a large scale, requiring the record in a specific molecular database available for both meat and dairy sheep (Table 2). This database is connected to SIEOL and enables passing on of checked genotype for selection purposes and computation of genotype predictions on relatives.

The SIEOL system has been set up in 2005 and is now running routinely. The objectives defined for the conception of SIEOL are fully achieved: gathering all relevant data for genetic evaluations, spreading EBVs and molecular information to the breeders and the managers of the breeding schemes, allowing the field technicians to propose adequate valorisation (genetic, technical, economic) to the breeders, permitting collective valorisations (statistic, research, answer to breeders concerns). The main challenge for the future will be to associate and link the SIEOL information system, which concerns 55% of the dairy sheep breeders, to the future tracing system for small ruminants, which will be implemented within the next 2 years. In order to avoid multiple recording of the same data (for example movements of the animals), the relationship between the SIEOL information system and the tracing system must be built. A system such as SIEOL has a lifetime of around 15 years, the condition being that it evolves during its lifetime to take into account new technologies, as well as new data to be managed (new raw data, new selection criteria, new needs from the breeders). This kind of system is expensive to build and maintain, compared to the quite limited population of dairy sheep. Therefore, one of the biggest issues for the future will be to find enough funding to keep the system efficient and at the service of the breeders.

Conclusion