L I M S - Data Management and Information System for Animal Production

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Abstract

LIMS, a data management and information system for animal production data, is a flexible tool helping to collect, handle, and summarize livestock production data. It is applicable in a variety of situations as found in livestock research and production, and it is not restricted to certain animal species or production systems. It helps ensure the quality and accessibility of data by applying extensive error-checking and storing the data along with their documentation. The LIMS system can be especially useful with complex data recorded over an extended time period or several generations.

Introduction

Computerised data-management programs are widely distributed and considered as essential parts of high-tech animal production systems, such as dairy cattle and pig production systems. Those commercial packages are designed for collecting, handling and summarising livestock production data and targeted at a single species and production system. The alternative is to use general-purpose data-management software, such as various data-base packages. These, however, cannot handle the more complex aspects of animal data sets without extensive programming and are generally not "application-ready" and not "user-friendly".

In livestock-related research the data-management problems are less standardized as compared to commercial animal production. Although the goals of data-management systems in animal research and production are similar with respect to collecting and summarising data, but in research additional requirements such as flexibilty, ease of accessibility and user-friendliness have to be met. ILCA as an international research organization working in Africa has undertaken efforts to help livestock researchers manage their large and complex data sets using microcomputers.

ILCA,s first efforts in this direction led to IDEAS - the ILCA Data Entry and Analysis System. IDEAS was released in 1986 and has been in use in several African countries. The drawbacks of IDEAS were that it had fixed data structures and its built-in analysis module was relatively inflexible.

In 1990, ILCA started to develop a new package called LIMS (Livestock Information Management System) that would improve IDEAS. The program has been tested in some of ILCA's research programs and on a large dairy farm. The complete system is now available and will be provided by ILCA upon request.

Areas of data management addressed by LIMS

The LIMS system consists of several modules of compiled CLIPPER programs and a generic set of files for storing animal performance data. This consists of a series of pre-defined files for storing basic animal data, parturition and environmental data. Some variables (fields) within the files can be modified by the individual user. Raw data are stored in standard dBASE files.

The SETUP module allows users to define a customised animal-performance data-set based on the generic data-set distributed with LIMS. The customisation includes modifying existing variables and defining additional data files and variables to meet specific needs, such as files for traction data or sales prices of animals, which are not part of the generic data-set. This allows users to integrate a large variety of user-defined variables into a LIMS data-set. Data that are not directly related to individual animals, e.g. meteorological data and household- or market-survey data, can also be integrated to produce a multidisciplinary LIMS data-set.

A LIMS data-set can be defined and documented on a file, variable and code-value level. For example, at the file level, the user can enter an explanation of what the file contains. At the variable level, taking the example of body weight, the user can document how often the animals are weighed, the level of accuracy, the method etc - all the information that migth be needed by someone unfamiliar with the study who wishes to perform additional analyses or continue the study. At the code level, the user can document what each code used means. The user can also specify breed-combination rules, which LIMS used to automatically assign breed codes to offspring based on the breed codes of the dam and sire of the offspring. Once entered, this definition and documentation become part of a data-set and can be printed at any time. Each LIMS data-set has a special text file which can be used to store research protocols, information on husbandry practices or management procedures, detailed post-mortem reports or programs to access and analyse the raw data.

The UPDATE module allows records to be edited in a way similar to dBASE. Extensive user assistance and cross-referencing is available during data entry. The system looks up data and rules already stored in the data-set to provide this assistance and helps to reduce manual checkin and calculation. This assistance helps reduce errors and saves time, especially for non-observed data such as parity number, breed code or the selection of a successful mating among a series of matings. In case the identification of an animal changes, e.g. if the animal loses its ear tag and has to be assigned a new number, a special facility is available to apply this change throughout the entire data-set and keep the data consistent.

An initial data validation is carried out during data entry and a more thorough, though time-consuming, validation can be done using the VALIDATION module. This module

checks the entire data-set for errors or inconsistencies and produces a printed error report. There are several user-defined settings in the validation to allow for differences between species. Depending on the data files and variables defined, more than 80 types of error are automatically checked for during each validation.

The REPORTING module produces standard reports, such as population summaries (e.g. herd structure at a given date, entry/exit of animals into/from the herd over a given period) and action lists (e.g. a list of animals attaining weaning age during a given, future period). The idea is to use data that are mainly collected for research purposes also for the management of the animals under study.

The EXTRACTION module provides the interface between the mainly data-management-oriented LIMS system and commercial statistical analysis packages such as SPSS and SAS. This module extracts data and calculates standard performance traits on an animal basis and a parturition basis and exports for more sophisticated analysis.

Advantages of LIMS

From an individual scientist's point of view, the advantage of using LIMS lies in its flexibility in designing data-sets. The software helps ensure the quality of data by enforcing a high level of data definition prior to data entry, and facilitating subsequent checking of the data for plausibility and internal consistency. Data validation and preliminary data analysis can be carried out concurrent with data recording, without having to rely on specialist computer and data-management support. This in turn helps shorten the time between completing a project and final analysis of the data.

From an institutional point of view, the advantages of using LIMS lie mainly in its standardisation and documentation of data recording. Not only can data-sets from different species, production systems and research sites be highly standardised, but customised data-analysis programs can also be reduced with minimum modification. The documentation features of the LIMS system, together with the concept of integrating the documentation of the data-set with the raw data, means that a LIMS data-set can be archived with little or no external documentation and yet still make sense to secondary users.

Present use of LIMS

The LIMS system is already in use at ILCA and some cooperating organizations with several small and medium-sized data-sets, including data from a large dairy farm, on-farm performance surveys with sheep and several on-station experiments. LIMS is also being introduced in an animal traction project and a study aimed at selecting sheep for resistance to endoparasites. These few examples of the range of uses of LIMS serve to highlight the system's flexibility.

Conclusions

The LIMS system is a very flexible tool for managing animal performance data and is applicable in a variety of situations. It helps ensure the quality and accessibility of data by applying extensive error-checking and storing the data definition and documentation along with the raw data. The LIMS system can be especially useful with complex data that are recorded over an extended period.