

# Feeding time!

**Professor Michael H Böhlen** from the University of Zürich and Agroscope's **Monika Boltshauser** describe the motivation behind their latest collaboration and explain how the partnership will be mutually beneficial

**To provide some background, can you explain how the existing Swiss Feed Database and Tameus project are linked? Will Tameus build directly upon the Swiss Feed Database platform or will a new platform be created?**

Tameus is an SNF-supported research project and the Swiss Feed Database is a service offered by Agroscope to its customers. There are significant mutual benefits to linking these endeavours. On the one hand, Tameus works with the data from the Swiss Feed Database. It uses this data to abstract generic data management problems and to validate and evaluate newly-developed solutions. On the other hand, Tameus generates new ideas that are implemented and thus advance the functionality of the Swiss Feed Database.

**What was it that provided the motivation for the Tameus project? Can you tell us what needs the project is hoping to meet and who the outputs are intended to help?**

- Motivation for research – the Tameus project gives us the opportunity to work with data and problems from the real world. This is highly attractive as it increases the relevance and



impact of our research



- Motivation for teaching – we incorporate the problems and findings from Tameus into our teaching, which makes the teaching much more robust and attractive to students
- Motivation for Agroscope – the Tameus project gives Agroscope the opportunity to expand the existing Swiss Feed Database, which so far only provides the mean values of nutrients

**Why did you form a partnership between your two institutions?**

Agroscope contributes domain knowledge, data, practical relevance and applied research, whereas the University of Zürich contributes basic research, data management know-how and technical expertise. This is a win-win situation for both partners. The new Swiss Feed Database is deployed as an innovative and user-friendly geographic information system (GIS)-based web application with scope for future development. Students have the opportunity to work on practical problems.

**Have there been or do you foresee any challenges in working together?**

This type of interdisciplinary cooperation requires both sides to be open, have mutual understanding and be prepared for an intensive exchange of information. The data is the common denominator of our work and a big challenge. With 1,000 feed types, 600 distinct nutrients and 100 biological and technical properties, we are dealing with a high-dimensional data structure. The data is also multi-granular since it is collected irregularly and with various levels of detail.

**Further to this, what is the significance of the granularity of data? Why is this such an important variable in your research?**

It is an open and interesting research problem to combine values recorded at different granularities, eg. phosphor content for a year, three months, seven weeks and a specific hour. The ability to combine data recorded at different granularities broadens the scope to process and analyse data.

**Have you developed new techniques to aggregate multi-granular measurement sets and support approximate aggregation techniques to control the balance between cardinality and precision of the result?**

We have developed new database solutions to deal with cumulative values associated with time intervals. This is done at the highest level of precision without cardinality constraints. Other areas we have been focusing on are geo-referenced information and calculated feed values.

**Web dissemination is one of the most important parts of Tameus, and end-user feedback is expected to help develop the project. How do you intend to incorporate feedback into the project, and how close are you to the final Web application?**

We are constantly incorporating feedback that helps us to reach our goals. In one workshop at the start of the year, representatives from advisory services, farming practice, the animal feed industry, training and research had the opportunity to submit their suggestions. We are also in direct contact with other selected stakeholders in order to clarify their requirements. This has led us to explore the possibility of a follow-on project with a partner in the industry.

In 2012, we will be making a beta version available to a group of regular clients and will also be evaluating their feedback. The updating and expansion of existing feed data and the input of new feedstuffs will be a long-term undertaking for us.



# Time for Tameus

Seeking to build on the success of Agroscope's existing Swiss Feed Database, the collaborative **Tameus** project will manage time-varying measurement sets to establish an improved database for current and historical farm animal feed

**INCREASING DEMANDS ON** the livestock industry, combined with a growing concern about the condition and health of farm animals and their environmental footprint, has led many researchers to focus on methods of feeding and the nutritional content of animal feed. In order to feed farm animals in an ecological and economic way, it is essential to have in-depth knowledge of the nutrient content in raw materials and roughage and of the nutrient requirements of these animals.

The Swiss Feed Database currently provides such knowledge as a public service for companies, private farmers and research institutions. Feed data characterises the quality of grown, imported and feed additives, and originates from feed samples collected from all parts of Switzerland. Feed quality comprises feed properties, nutrient content and derived nutritional values of livestock feed. The essence of feed data is the nutrient measurements that are multi-valued, sparse and highly correlated. Currently, the database is only able to provide the mean value of nutrients so Agroscope – the research station behind the operation of the service – has linked with the University of Zürich under the Tameus project – an SNF-supported collaboration – in order to expand on the scope of the current Swiss Feed Database.

## A NEW APPROACH

The goal of the Tameus project is to design and implement new database techniques for modelling, aggregating and analysing feed data and to establish a reference for current and historical information. This will evolve the Swiss Feed Database towards a multi-dimensional

model that supports the aggregation and analysis of time-varying feed data for different time periods and for various biological, technical and spatial properties.

Professor Michael H Böhlen, coordinator of the project alongside Monika Boltshauser, believes achieving these objectives will open up entirely new possibilities that were previously unavailable for feed data based on the current level of knowledge: "We will be in the position to implement queries that visualise and quantify temporal and spatial influence on feed data; we will be able to offer our stakeholders more precise feed data, which can be applied specifically for feeding plans, ecological assessments and advisory services". The use of long time series will also make it possible to identify changes or patterns of environmentally-relevant nutrients, especially phosphorous and nitrogen, so that it will become a useful resource for environmental monitoring. This will assist the modelling of national emission inventories which have to rely on such information. Charts and statistical reports will also be generated which will be useful for rapid outlier detection and data cleaning.

Much of the feed data comes from Agroscope's existing feeding and feed variety trials which are prepared, analysed and validated in its own laboratory. Additional sources of data come from feed samples sent to Agroscope by farmers, animal feed companies and food industry associates for quality assurance, and feed samples that are sent to private animal feed laboratories. The latter of these is a particular focus of the Tameus project: "We are

seeking more collaboration with animal feed laboratories in order to expand our data basis," explains Boltshauser. "Annual data surveys are planned, whereby we will incorporate information on roughage, for example, or mycotoxin."

## DATA WAREHOUSE TECHNIQUES

One of the Tameus work packages outlines the use of data warehouse techniques to design a Swiss Feed Data Warehouse. This technique organises the data according to different business needs, and it facilitates the analysis of the data. In the case of Tameus, the Feed Database models measurements of feed samples enriched with comprehensive dimensional information (location, date, feed, etc.) and makes it easy to analyse stored and derived measurements. The enhanced analysis capabilities of the feed data using this technique will benefit all players in the field including stakeholders and the researchers themselves.

Farmers, the extension services and the feed industry require tables that have up-to-date mean (aggregated) values on the nutrient contents. Agricultural research, in contrast, will be interested in detailed information enhanced by charts, maps, statistics and search refinement – Tameus will make this a possibility.

In addition, education and governmental organisations will benefit from its intuitive and simple navigation. Boltshauser offers an illustration of how Tameus provides this information work in an applied example: "If a farmer requires reliable feed data in order to

calculate a feeding plan and nutrient balance sheets, using the temporal data warehouse he will be able to query roughage data in his region for a particular year," she explains. "This increases the accuracy of feed data and helps the farmer to save on analysis costs while simultaneously protecting the environment."

Bracher, also from Agroscope, is responsible for data curation and Dr Andrej Taliun and Francesco Cafagna from the University of Zürich are responsible for the development of the Swiss Feed Database. An associated panel of experts who are representatives from advisory services, farming practice, the animal feed industry and

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A new element improving the existing database will be the time-varying data generated by the Tameus project. In order to conduct a successful analysis of this new information, the team is developing new solutions to query and manage time-varying data. Most prominently, they have proposed new solutions to efficiently answer sequenced queries that view a database that stores time-varying data as a sequence of regular databases. Their track record is proven in this area as they have been handling time-varying data for two decades with the resulting work regularly being published in the best outlets available to the database community.

#### COMBINED EXPERTISE

Tameus is a joint research effort between the University of Zürich and Agroscope. Such a collaboration brings together key players who increase the success of the project with their expertise. Although retired, Professor Hans Hinterberger from ETH Zürich – the person responsible for the design and operation of the first version of the Swiss Feed Database – continues to be involved in the Tameus project as a member of the Steering Committee along with Dr Giuseppe Bee from Agroscope. Annelies

teaching, also lends the project valuable input. In addition, animal feed laboratories are important partners since they provide the feed data.

#### BEYOND THE PROJECT

In 2012, after a two-year development period, the new Swiss Feed Database will replace the current one and will be accessible at [www.feedbase.ch](http://www.feedbase.ch). Beyond this, the researchers hope to further extend the information on animal feeds, which would make the database of even greater benefit to researchers and the project stakeholders. The eventual aim is to produce a widely recognised reference platform for accurate and extensive feed information. For example, new areas of research could cover details on variety, botanical composition of roughage, time of harvesting, biological or conventional production, etc. Calculations of feed values such as energy or protein should also be integrated into the database. In the long term, the project would like to establish links with other databases housing climate, geographic or food information. In so doing, Tameus can create links at a European level, preferably in the context of an EU project.



## INTELLIGENCE

### TAMEUS: MANAGING TIME VARYING MEASUREMENT SETS IN DATABASES

#### OBJECTIVES

- To design and implement new database techniques for modelling, aggregating and analysing feed data
- To establish a reference for current and historical feed data
- To evolve the Swiss Feed Database towards a multi-dimensional model that supports the aggregation and analysis of time-varying feed data for different time periods and for various biological, technical and spatial properties

#### KEY COLLABORATORS

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**PROFESSOR MICHAEL H BÖHLEN** obtained his PhD degree in 1994 from the Computer Science Department of ETH Zürich. Afterwards, he held positions at the University of Arizona, Aalborg University and the Free University of Bozen-Bolzano (2003-09). In the latter, Böhlen was Head of the Faculty of Computer Science from 2003-07. He is currently Head of the Database Technology group at the University of Zürich.

**MONIKA BOLTSHAUSER** is responsible for the Research Group Forage Conservation and Feed Advisory Service at the Agroscope Liebefeld-Posieux Research Station ALP in Posieux, Switzerland. She graduated from the Swiss Federal Institute of Technology (ETH Zürich) with an MSc in Agronomy in 1988.



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