Integrated Information Systems for Animal Production

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1. Background

In 1985, when the Universidad Nacional (UNA), Costa Rica, and Utrecht University (UU), The Netherlands, started a co-operation project to improve clinical training of veterinary students, it could not be foreseen that one of the most important results would be in the field of information systems for animal production. The principal catalysing event in this process was the arrival in Costa Rica (1986) of the VAMPP system (Noordhuizen, 1984), developed at UU to support veterinary herd health and production management. In Costa Rica, the system was translated to Spanish and introduced on a few farms. After a successful field validation, positive information was obtained about the feasibility of adapting the system to tropical conditions and broadening it as to serve other actors than veterinarians.

From 1988 on, an ambitious effort was undertaken to develop an integrated and decentralised information system for Costa Rica and other developing countries. Our general objective was to increase knowledge and information on livestock production systems, as to contribute to increased efficiency and sustainable development. The specific objectives were and are:

- to support of health and productivity management at farm level;
- to generate regional and national databases for livestock statistics, research and analysis in the fields of genetics, epidemiology, economics, nutrition, etc.;
- to generate information for planning and priority setting in research, extension, training and policy making.

Research co-operation was sought and found with universities in other Latin American countries, the USA and Europe. In system development, a new standard was set with the VAMPP Dairy 5.0 system (1995), that adapts to a very wide range of dairy production systems, from small holders to large commercial operations. The VAMPP Swine 3.0 version, presently in the last testing phase, obeys to the same standards. The dairy information technology was transferred to the Costa Rican dairy sector and 12 other countries in Latin America and Africa, where it is now used on about two thousand farms.

2. Organisational structure

Keywords in the structure of the information systems we support are: decentralisation, privatisation, standardisation and institutional participation.

2.1 Decentralisation

The system is organised and operated by users in the field that are not directly dependent on nor permanently linked to a national/regional centre. On-farm data collection (including data quality assurance), data processing (herd management, field trials and local studies) and data concentration (in regional databases) are all carried out in a decentralised way. Portable computers (with the complete farm databases) are often used for farm visits.

2.2 Privatisation

The majority of the users, and so the funding of the system, are private: farmer organisations (with technicians for monitoring and farm advice), veterinarians and other farm consultants, individual farmers, etc. In some cases, institutions carry out the monitoring and advice activities (CIAT in Bolivia and KARI/DRSK/ILRI in Kenya).

2.3 Institutional participation

To obtain maximum benefits, the decentralised users should not operate in isolation. An important added value to their efforts is obtained by data centralisation on behalf of (research) institutes (in Costa Rica the UNA School of Veterinary Medicine), for analysis on a national level. Research projects can be undertaken to find diagnosis or solutions for problems that cannot be solved at the local level. Part of the results can be incorporated in the decentralised software, e.g. correction factors for milk production, equations for growth, simulation and optimisation models. User training at different levels and product support and development are other important tasks of the co-ordinating institution. The UNA also manages a 25-farm dairy pilot project for software testing, research and training. Local users can generate reports and administrative documents for their breed organisations. In some countries, the breed organisations intend to use the VAMPP system as their main database.

3. Description of activities

3.1 Product development, distribution and support

Products and development lines are indicated below. The distribution and support are carried out by CRIPAS, a non profit organisation of the UNA. The VAMPP Dairy 5.0 version can be bought or leased. For farmers, a licence (3 farms) costs $1 000 and leasing $365/year. For farm advisors, a licence (50 farms) costs $ 2 000, leasing $730/year. For organisations with multiple licences, discounts apply up to 40%. VAMPP can be supplied as regional or (inter)national database.

3.2 User training

The UNA provides training at several levels: basic and advanced software operation, herd health and production management, epidemiology and field trials, both as short courses, in the veterinary curriculum and at Master course level.

3.3 Research

Research lines are aimed at increasing efficiency and sustainability of animal production. The scope is gradually changing from animal to farm, and from farm to sector level. Important research co-operation programs were or are:

- Epidemiological research with UU, University of California, University of Missouri, USDA-APHIS (El Salvador).
- Reproductive research with International Agency for Atomic Energy, Swedish Research Co-operation (SAREC), Autonomous University of Mexico (UNAM).
- Genetic research was carried out with Yucatan University (Mexico), NRS (correction factors for daily and lactation yield) and Wageningen University (PhD bioeconomic animal evaluations, breeding objectives under sustainability constraints).
- Pasture and nutrition research with Wageningen University (resulting in VAMPP pasture and nutrition module) and Edinburgh University (PhD on integration of models for grassland, cow requirements and herd dynamics). Presently ODA finances a joint research project with Edinburgh and CIAT, Bolivia.
- The "Regional Centre for Training and Research in Sustainable Animal Production" (RESAP) is a 4 year research program (sustainable animal production), currently starting with Wageningen University and International Institute for Aerospace Survey and Earth Sciences (ITC).

4. Information systems

The VAMPP software is the backbone of the decentralised information system.

4.1 General characteristics

- The program is elaborated in the M language (formerly called MUMPS), which is one of the four computer languages certified by ANSI (American National Standard Institute). The Micronetics Standard M version 3.0 of 1994 is used. M is characterised by high speed and efficient storage and provides facilities for a fully integrated database with rapid checks for quality control. Database size has little effect over access speed: a 30 times increase will bring speed down by about 15%, not by 3 000% as in most other systems.
- Although VAMPP can be run on mini or mainframe computers, a personal computer will do well for a VAMPP dairy database. A 1 Gigabyte hard disk can store up to 1 million cow years (including health, production, reproduction, growth aspects, etc.).

- VAMPP has no limitations for the number of farms, the number of animals per farm or the number of events per animal (naturally within data quality restrictions).
- All original data (including culled or dead animals) remain always stored, allowing for valid historical analysis (150 animal and farm records are provided, one record contains e.g. calving details).
- Apart from original data, VAMPP generates and stores also about 500 calculated parameters. The calculation system is autonomous (e.g. automatic regeneration after changes in original data), only periodic activation by the user is required.
- VAMPP is multi-user under MS-DOS. Several terminals can simply be connected to a standard computer by using serial cables.

4.2 Standardisation

- VAMPP is a standardised program (independent of language), but at the same time adaptable to the needs of individual users (50 system management parameters). No specific software adaptations are supplied to individual users, with the exception of a country level customising (reference databases for political division, ecological zones, bull catalogue, correction factors for milk production, equations for growth, etc.).

- With the exception of comments on events, all data are completely codified (e.g. cows, bulls, breeds, inseminators, disease and (re)productive events). This permits valid comparisons within and between farms, and within and between regions and countries.

4.3 Integrated data quality assurance system

Internal data validity in the technical/biological sense is the prime concern, comprising consistency, accuracy and completeness. The assurance mechanisms (which form the main component of the software) can be described as:

- Easing on-farm data collection, including user training and feedback (motivation!) and system generated recording forms for routine measurements coupled to data entry.
- Facilities during data entry, like error trapping (almost 2 000 checks on referential data and possibility/probability ranges) combined with instructions for the user. In the case of animal data modification, both past and following history are checked. References files are also provided, e.g. 10 000 internationally used sires, partly with current genetic index.
- Data validation (after entry) by the final user, the database manager and researchers.

- High operational safety, even with inexperienced users (fool proof) and under adverse conditions (electricity supply), with protections against unauthorised access (three levels: farm, farm administrator and system administrator).
- Related aspects are: storage of all original data (culled animals, test day yield, etc.), completely integrated database (e.g. genealogy is automatically derived from reproductive data) and high access speed for immediate checks.

4.4 Ease of operation

- All pathways are easily found. A course book for basic operation is supplied to all users. The duration of an introductory course is from 3 hours for users with computer experience, up to two days for computer illiterate farm personnel.
- A complete reference manual is provided.

4.5 Hardware requirements

- A personal computer (IBM compatible), XT, AT 286, 386, 486 or pentium with a 10 Mb hard disc and 512 Kb RAM memory.
- A Sentinel protection device provided by CRIPAS is required for operation.
- Printer (optional, but strongly recommended).

4.6 VAMPP as a farm management tool

The first step in the control of management is monitoring, for which numerous facilities are supplied. Once the data have been entered, daily management is supported with attention list for the planning of activities and spotting of problem animals. For tactical herd management, a Herd Abstract is provided to evaluate strong and weak points (and the effect of previous measures) in milk production, reproduction, health, body condition and young stock growth. When problems are detected, detailed analysis can be carried out to define the problem precisely and to support the diagnostic process (testing of causal hypothesis by quantitative analysis). E.g. if conception at first service is found as a weak point, the service intervals can be studied. When most repetitions are in the 18-24 days interval, the next logical step is an analysis of conception rates of individual bulls and inseminators. To confirm the causal hypothesis, often the farm, the management procedures and the animals have to be examined and sometimes laboratory analysis has to be done. Once a diagnosis is achieved, adequate measures can be taken. Pasture/nutrition evaluations can also be made (using NRC equations), including margin over feed cost.

4.7 VAMPP as a population database

With the consent of the final users, the farm databases can be centralised with simple procedures in regional or national databases. With the so-called splitting module, all farm reports can be made available for a certain population, e.g., all pure-bred Holsteins in the country or region. This

way routine population statistics and reference values can be generated by non specialised personnel, with the same ease (and hardware) as for one farm. The module supports also field trials and the diagnostic process (e.g. reproductive performance can be analysed for cows with/without lameness). Populations and herds can also be compared in "farm comparisons". Files can be extracted (after definition of quality standards) for research, genetic analysis, etc. Additional data validations can be carried out at population level. Due to low hardware requirements, high speed is maintained even in very large databases.

5. Achievements

5.1 Software development

The original Dutch VAMPP package has been upgraded from a veterinary support system for Dutch conditions to an integrated management information system (MIS), applicable under a wide range of conditions, including in developed countries (NRS-Holland tested the package with positive results, but the report is internal). To the MIS function, the population database function was added. The database is used frequently for all kinds of research and the quality is considered very high.

5.2 Software distribution

In Costa Rica, about 30% of the milk production comes from 400 herds registered in VAMPP. In ten Latin American countries VAMPP users can be found, while in some countries large scale projects are being developed (hundreds of farms in Bolivia and Ecuador). Many Universities are also involved. Recently activities were started in Kenya (Naivasha Research Centre and Bahati smallholder monitoring) and Zimbabwe (dairy herd health program by University of Zimbabwe).

5.3 Training

Many hundreds of users of many countries have been trained in the past years, from basic operation to herd management. Fifteen students from the region obtained a Master degree in herd health and production management.

5.4 Research

The decentralised use of MIS has proven to be an excellent, practical and low/cost method for the quantification of livestock production systems. The VAMPP database is an inexhaustible resource for research. Two PhD theses were carried out (epidemiology-Utrecht, grassland/nutrition modelling-Edinburgh), two are ongoing (decision support-Edinburgh, genetics-Wageningen), two in preparation (GIS-ITC, epidemiologic modelling-Wageningen). The results are not only published in scientific and farmer magazines, but also used to upgrade the VAMPP system (e.g. corrected daily and lactation yield, growth equations), where the users have daily access to these scientific results.

6. Funding

The implementation of the decentralised component is almost completely funded by the private sector, in some cases by local institutions. CRIPAS sells its software products and courses, and the farmers that contract the monitoring service pay a fee to their advisors or organisations.

The centralised component (product development, research) is only partly funded by the sales of products and services. Funding of part of the running cost is provided through the international co-operation projects while the Dutch International co-operation has been funding several experts (presently one). The UNA has been in a financial crisis for many years and imposes a complete stop on new personnel. At the same time we have not been successful in interesting international co-operation agencies in system development. As a consequence, we have not been able to increase our development capacity and several VAMPP development projects are awaiting financing:

- Integrated data base and information system for all bovine production systems and buffaloes (with system specific interfaces).
- Farm economics integrated with nutrient balances, including decision support and expert systems (with LEI/DLO, The Netherlands).
- Electronic data interchange between farms/industry and with electronic farm devices.
- Decision support and expert systems.
- Graphical user interface (GUI).
- Additional (international or national) reference databases for treatments, medicines, feeds.
- Standardised national reports (ICAR format if available).

7. Constraints

The main problem has been the funding of (expensive) software development projects, which has been mentioned above.

7.1 Legal aspects

Minor problems have arisen about the ownership of electronic databases in a decentralised structure. We are developing a code for our users, where the principle is that farmer owns the data, but he has to pay for the electronic format if this is supplied by an agency. The agency can deny the transfer of the electronic format when the owner has not paid for it. All users have so far agreed on data-sharing under privacy protection, no formalization was yet required.

7.2 Data certification

In a decentralised system, the local databases are under local command and can be modified by the end user, although some constraints apply in VAMPP (e.g. genealogy). However, certification of the local database by a national organisation is technically feasible. Certified data could be "sealed" and/or copies maintained at the central level, with facilities for data comparison.

8. Future programs

Standardisation of IT is a main problem all over the world. Different applications use different definitions, calculations rules and data quality control mechanisms, so farm or sector statistics cannot be compared. A general problem in developing IT applications for livestock production in developing countries is the enormous variation in production systems, technology and management procedures, which requires a high system flexibility. Yet data quality control has to be very strict, which is more difficult to achieve in flexible systems, and the same applies for ease of operation. Thus, the cost to build a quality management information system with a universal applicability is very high (minimal US$ 1 million). However, countless development efforts are carried out in many parts of the world with much lower budgets, often resulting in a waste of time and money, deceptions at user level and increase of the existing babylonic confusion. Many large research efforts were undertaken to collect and analyse production and health data, with the final conclusion that the deficient data quality didn't permit any valid conclusions.

So there is an obvious need to join efforts, and international organisations like FAO, ILRI and ICAR should support this. Our group has sought contacts with potential partners to found an international consortium dedicated to the development, distribution, training and research for a standard information system for animal production in developing countries. With our experience and products we hope to make a significant contribution to the proposed standard.

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