THE BENEFITS OF AN AUTOMATED DATA CAPTURE AND MANAGEMENT SYSTEM TO AN APPLIED DAIRY RESEARCH PROGRAMME

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SUMMARY

In an applied dairy research programme, data capture and data management are the starting points for information development and knowledge transfer to industry., The efficiency of these processes often dictates the rate at which such transfer can take place. Increased demand from industry for new technology has meant that data collection and data management need to be efficient in terms of time and labour. This prompted researchers at Mutdapilly and Kairi Research Stations to access the technology available to automated data capture and data management processes, resulting in the acquisition of commercial automated data capture systems, including accompanying commercial and in-house developed software to capture and manage milk yield, milk composition and liveweight data. These major measurements are indicative of nutrition treatments applied in dairy research and can be measured twice per day. With the installation of a commercial automated data capture system, commercial software and in-house developed software, the demand for research effort was transferred from manual data capture and management to project performance monitoring, timely reporting of preliminary results, methods of statistical analyses, interpretation of results, and information and knowledge transfer to industry and scientific community.
Keywords: labour efficiency in data capture, data management, milk yield, milk composition, liveweight

INTRODUCTION

To make continued gains in efficiency the dairy industry needs a sound, applied research programme. This research programme in turn requires a data capture and mariagement methodology which supports efficient and timely data capture and data management, accuracy to a required precision, and a suitable presentation for efficient statistical analyses and interpretation of results. The majority of dairy research results focus on the data captured at the dairy, thus making this a key centre for measurements such as milk yield, milk composition and liveweight. The milking of cows at least twice per day gives the opportunity to collect vast amounts of data on each individual cow. However, the resources of research teams do not extend to constant manual collection and collation of these data beyond brief specific periods. This paper explains an automated data capture and management system developed for an applied dairy research unit and the benefits gained.

The data capture and data management system was implemented at Mutdapilly Research Station 80 km south west of Brisbane, and Kairi Research Station on the Atherton Tableland, north Queensland. At Mutdapilly, applied research into pasture management, the effects of heat stress, milk production systems and supplementary feeding is conducted while at Kairi Research Station a programme is conducted involving the study of tropical pasture species and responses to supplementary feeding. Both research stations have a herd of 150 Holstein-Friesian cows calving in either spring or autumn.

Milk yield can vary up to 20% over the period of a week, arising from the effects of research treatments, health status, feeding system and/or climatic conditions. Heat stress causes sudden and marked decline in appetite and milk yield. As well as a record of long term changes in liveweight, there is the need to monitor short term changes which reflect gut contents. Supplementary feeding projects aim at introducing high levels of supplementary feeds into the diet of grazing dairy cows with the aim of optimizing milk production over the lactation. High rates of supplementation and daily fluctuations in pasture yields produce the potential for metabolic diseases which have an adverse effect on daily milk yield, milk composition and liveweight. To help address these issues, an efficient system in terms of data capture, data management, statistical analyses and interpretation of results was needed. Commercial automatic animal identification, milk yield and liveweight data capture hardware and herd management and milking system control software were purchased and installed. In-house developed software utilizes milk yield and liveweight data captured at the dairy and milk composition data from the remote laboratory. This software uses experimental design for the basis of all reports and data files which are imported directly into statistical analysis software packages for timely analysis and interpretation of results.

MATERIALS AND METHODS

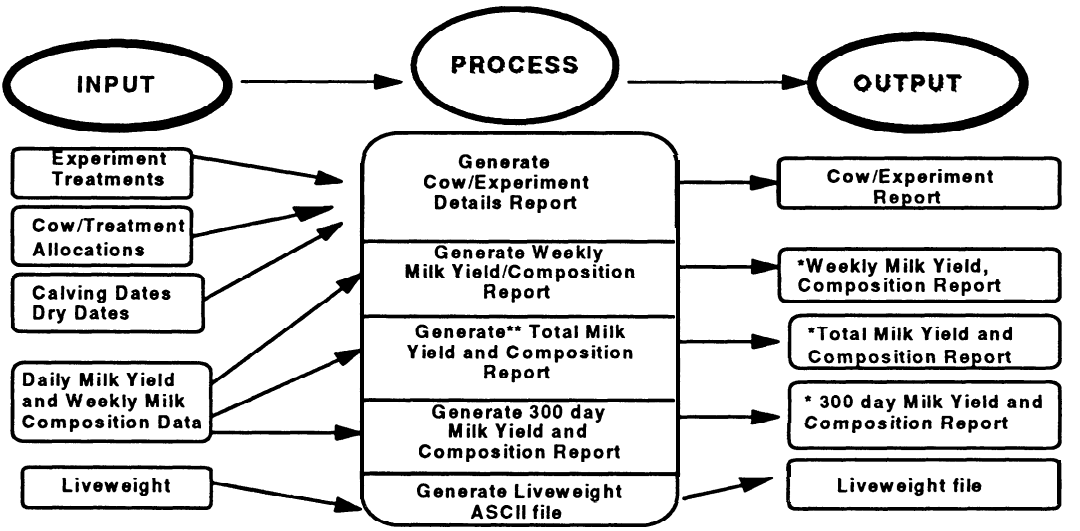
The milking systems at Mutdapilly and Kairi Research Stations were equipped with automatic animal identification and milk yield measurement hardware and software to maintain herd management records for all cows and produce reports and data files on computer at the dairy. These processes are controlled from a computer running commercial software at the dairy. At Mutdapilly, an automated animal weighing system was installed. Cows are weighed after milking as they leave the dairy. To facilitate the transfer of data from the dairy at Mutdapilly Research Station, a fibre optic link was established between the computer at the dairy and a computer at the research station office. At present Kairi data transfer is accomplished by the use of a diskette.

The data capture hardware consists of antennas which energize a transponder attached to a neck collar on each cow to record animal identification, electronic milk meter at each milking position and automated weigh scale (Mutdapilly dairy only) at the dairy exit. The antennas are situated at the entrances to the herringbone dairy and at the weigh scales.

The fibre optic link between the dairy computer and office computer at Mutdapilly provides access by researchers to the dairy system, herd management information and milk and liveweight data. These data are processed using the in-house developed Lactation Performance Information System (LPIS) and Liveweight Performance Information System (LWPIS). The system analysis and design methodology as outlined by Gore and Stubbe (1988) was used in the development of the in-house software and has ensured that the specific needs of the dairy research programme have been met; it is user friendly and easily integrated with other operations such as statistical analyses. This included working through the study, design, development and operation phases with a degree of project management to produce a robust system. LPIS and LWPIS produce specific reports and files of milk yield and composition and liveweight files for each treatment of a selected research project and period or lactation (Figure 1).

These modules were developed using Foxbase+™, a dBASE™ compatible relational database management system (Wray 1988) for personal computers. Structured and modular programming techniques were used to minimize development time and to enable easy maintenance of programme code. Importantly, the developed software integrates milk yield and liveweight data files generated by the dairy commercial software and the transfer of milk composition data from the Herd Improvement Laboratory (H.I.L.) at Wacol, Brisbane, in a seamless fashion into the research database. Daily milk yield and liveweight files are transferred from the dairy computer to the office computer via the fibre optic link, and automatically appended to the daily milk yield and liveweight files respectively. The average daily am and pm milk yield for each cow is calculated for the test week and appended to the weekly average milk file. The weekly average am and pm milk yield is used with the milk composition percentages for the corresponding test week to calculate kg of butterfat, protein and lactose. These calculations are performed automatically after milk composition data has been transferred from H.I.L. via a modem connection. Daily milk yield for each cow is maintained in the database.

LPIS and LWPIS use relational database design to link milk yield, milk composition and liveweight data files to the cow allocation file which has cows in treatment standard (blocking) order. The use of spreadsheets was considered inappropriate for the long term storage, manipulation and management of milk yield, milk composition and liveweight data given the amount of data to be constantly stored, processed and queried. Relational database design is used to manage data redundancy, accuracy, and inconsistency. Recorded in the database is the experiment identification and treatments, cows assigned to treatments, entry date to and exit date from a treatment, calving date and dry date for each cow and milk yield, milk composition and liveweight. No further details are required as the software modules LPIS and LWPIS specifically manage research lactation and liveweight data. These modules are not a replacement for the commercially supplied herd management software which reports on a herd, group or individual basis the lactation and reproductive performance, and health status of animals. LPIS allows the assignment of cows to treatments within experiments and maintains the continuity of the data when cows are replaced or when the experiment is completed and cows are assigned to a new group or experiment. LPIS does this by maintaining a record of experiment design which includes the entry date to and exit date from a treatment for each cow.



* Option to create ASCII data files at report creation

** Total refers to complete lactation or a selected period within a lactation

Figure 1. Main input, processes and output of LPIS and LWPIS software modules developed in-house

RESULTS

The installation of automatic data capture hardware and associated software has reduced the time devoted to the data capture and management of animal identification, daily milk yield, milk composition and liveweight to 4 hours per week per 100 cows, a reduction of 17 hours per week. Time spent manually recording, doing calculations such as progressive totals and butterfat, protein and lactose yield and reporting results has been eliminated. To date, the milk sampling process has not been automated beyond obtaining a proportional milk sample for subsequent manual sub-sampling. This facility was available prior to the installation of the new system. However, all other manual procedures previously performed in the management of milk yield, milk composition and liveweight (Mutdapilly only) data have been automated thus eliminating transcription, keying and calculation errors. The accuracy of analysis of data is enhanced through access to milk yield and liveweight data for individual cows on a daily basis. Researchers conducting experiments such as the study of the effects of heat stress on milk production now have the daily measurements of milk yield and liveweight in order to capture climatic and treatment effects.

The provision to generate statistical files in American Standard Code for Information Interchange (ASCII) format from LPIS and LWPIS allows for the direct importation of these files into personal computer based statistical software programmes. This enables milk and liveweight data for specific experiments to be managed and processed from capture through to the statistical analysis stage thus eliminating the keying of data to generate statistical files. This has resulted in a saving of several hours to many days depending on the amount of data generated by a particular experiment and the elimation of any key stroke errors. One method previously used was to key in the data twice, compare the values and if a difference occurred, signal

an error. This was labour intensive and time consuming. Specific reports for project management and assessment of treatment trends can be generated on demand. An example of report format generated by LPIS for weekly project management is the weekly milk yield and composition report (Table 1). This report shows, for each treatment, milk production and composition for each cow as well as the treatment average.

Table 1. Example, showing 1 treatment only, of report format generated by LPIS

WEEKLY MILK YIELD AND COMPOSITION

TRIAL ID: xxxxxxxxxx TEST DATE: dd/mm/yy

		Milk yield (litres)		Milk composition (%)			Milk composition (kg/week)			Cell Count
Treat-ment	Cow No.	Day	Week	BF	P	L	BF	P	L	000's
xxxxxxx	432	24.10	168.70	4.48	3.33	4.82	7.56	5.62	8.13	2034
	113	22.70	158.90	4.94	3.41	5.12	7.85	5.42	8.14	58
	251	22.40	156.80	4.67	3.35	5.02	7.32	5.25	7.87	67
	283	26.00	182.00	3.99	3.25	5.36	7.26	5.92	9.76	48
	379	24.50	171.50	4.69	3.22	4.97	8.04	5.52	8.52	122
	388	19.80	138.60	4.41	3.55	5.29	6.11	4.92	7.33	39
	mean	23.25	162.75	4.52	3.34	5.09	7.36	5.44	8.29	

DISCUSSION

The automation of data capture and data management is well suited to the applied dairy research programme by allowing a flow of data from the measurement site through to reports, computer-based spreadsheets for graphing and statistical analyses software. This can be achieved from the 1 relational database allowing for the selection of a particular research experiment, the year (lactation) and periods within a lactation. The implementation and use of information technology in the form of data capture hardware, computers, software, fibre optics, networking, databases and distributed data processing has meant efficient handling of large volumes of data which enables research staff to devote time to interpretation and presentation of research results. This development has been a critical component of the overall management of the applied research programme at Mutdapilly and Kairi Research Stations. The system accommodates any number of short and long term experiments and daily, weekly or monthly data. It has proven to be useful in managing an applied dairy research programme through savings in time, labour, improved accuracy, access to more timely data and integration with other research data operations such as graphing and statistical analyses. The challenge to produce and present research findings in a time and labour efficient manner has been met by the successful implementation of automation and information technology.

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