The use of farm computers in animal management

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ABSTRACT

Computers will become an increasingly important tool in animal management, as well as in most other areas of agricultural endeavour. Computers are commonly used for recording and analysing both research and centrally located production data, but seldom for on-farm use. This discussion concentrates on the traits that can be recorded at the farm level, and how these records can be used. System specifications for successful on-farm use are also outlined.

INTRODUCTION

Given the speed of computing developments over the last decade, it is very likely that within ten years it will be impossible to operate a farm business without an on-farm computer. Most buying, selling and banking will rely on a computer as both a communication and operational centre. Similarly, most pedigree and genetic calculation work will depend on central computers linked to on-farm machines. This will occur due to commercial pressure stemming from a reluctance to deal with paper records, in contrast to electronic systems.

In view of this situation all workers must be aware of what is possible using computers. The future farm will leave its computer/s running 24 hours per day and will be connected by telephone line to many other computers operated by businesses, banks, livestock organisations, other farmers, accountants, the golf club, information data bases and even the local general practitioner. The computer/s will also be connected to various devices around the farm such as a weather station, scales, moisture meters and so on. These devices will be forwarding information for assessment and action as required. For example, irrigation systems may be turned off/shifted, animal rations altered, measured out and fed.

The first section of this paper contains comments on the current use of on-farm computing, the second has a review of the recording and analysis possible in animal management and consequently computer use for animal management (third section). What is necessary for successful animal computing is covered in the fourth section, national schemes are briefly commented on, and a discussion on the economics of management information is provided in the last section.

THE PRESENT

Current estimates suggest twelve per cent of farmers have an on-farm computer and this is expected to increase. A decade ago there were virtually no farm computers. A national random survey in 1986 (Pryde and McCartin (1987)) showed 6 % of farmers had a computer and 4 % had regular access to one. U.S. studies (Batte *et al.,* (1990)) suggest figures as high as 31 %.

By far the most significant use of on-farm computers is for financial management and budgeting. This is to be expected as these functions are common to all farms. A 1990 survey of recipients of the Kellogg Farm Management Unit's newsletter provided data on the time spent on various functions (Table 1).

TABLE 1

Hours spent per month on a computer carrying out business activities (No of respondents = 926)

Whole farm budgeting	4.61	Livestock recording	1.92
Payroll	0.65	Enterprise budgeting	0.88
Paddock recording	0.49	Letter and report writing	6.45
Financial management	7.28	Spreadsheet use	3.08
Feed budgeting	0.36	Non-farm	0.91
Other	3.67		
Total/Month (hours)	30.30	Hours/Week	6.84

While only 1.92 hours, on average, were spent on livestock work per month, the 50% of respondents who indicated they used a computer for livestock analysis spent 3.84 hours/month. It is likely the interpretation of 'livestock analysis' was quite liberal and serious animal breeders probably put in more time than this.

Currently there are a number of both micro and mainframe computer based animal breeding and management schemes available. Some of these have been reviewed, e.g. Harvey *et al.,* (1990), Johnson *et al.,* (1989) and McKay (1988). Most achieve similar ends, though some are also specialised to handle a particular species or function. None has, by any means, a universal following, though all must be regarded as achieving at least one or more functions very successfully.

Some of the packages available include sophisticated genetic calculations, others provide simple analyses, and others have a greater emphasis on animal management rather than breeding. The animal science literature abounds with articles on breeding schemes and their associated genetic calculations (examples include Meuwissen (1989), Gibson (1989) and Ponzoni and Newman (1989)), but it can be questioned whether in practice the very detailed and extensive calculations inherent in the theory provide production gains that cover the cost of implementing the sophisticated systems. In some cases, greater effort in developing easily used and supported systems might provide greater national benefit.

In the search for more readily acceptable packages, the reactions of existing computer users are relevant. The 1990 Kellogg survey elicited the advantages, disadvantages and financial benefit perceived by the respondents. The latter data are summarised in Table 2.

TABLE 2

Profitability of a computer
Percentage of Respondents (1068) Believing in Each Category

	Percentage	Adjusted Percentage *
Computer is profitable	56.3	72.1
Breaks even	11.5	14.7
Computer does not cover costs	10.3	13.2
Don't know	21.9	

* The 'don't knows' are spread across the other categories in the same proportions.

The majority of users believe a computer is an economically justifiable investment. The other data showed a computer has the attributes of saving time, easier record keeping and providing advantages in the financial area. Users also believe computing is somewhat time consuming with a need for constant re-learning of the skills required. This might be expected for casual users.

A third of the respondents estimated their average increase in PROFIT was $4559. The remainder did not feel they could provide an estimate.

RECORDING FOR ANIMAL MANAGEMENT

Anything that can be observed or recorded in some way can be held on a computer and processed. In animal management most traits and factors that are likely to be required can be recorded and analysed. Whether all of these can be economically justified is debatable. For example, photographs can be stored in a computer, but the cost is probably not worth the benefit.

The general categories of data that can be recorded and analysed are listed below.

(i) Identifiers	Tags, (e.g. yy/xxxx where yy is year of birth and xxxx is a unique number for that year, or something similar).
(ii) Measurements	Numeric values representing values for a wide range of measurable factors.
(iii) Dates	The day, month and year on which various activities occurred (or lesser time units, depending on the requirement).
(iv) Codes	Usually numeric values representing some defined state, but can be alpha-numeric. Examples include condition scores, fate codes and so on.
(v) Names and/or Comments	Free form alpha-numeric characters to record pedigree names and non-classifiable comments. Not very useful.
(vi) Formulae	While not a factor type, using a defined formula on recorded numeric values can produce a whole new range of information. Formulae can be defined to include any previously recorded data (including average and totals of this data), constants and various manipulations of the information using multiplication, division, addition, subtraction and exponentiation.

Given the above information it is then possible to perform the functions and output listed below.

(i) Pedigree Trees	Details of parents for as many generations as required given the data is on file.
(ii) Progeny/Ancestor Reports	From historic and complete records it is possible to calculate items such as the average wool production of offspring, the fertility of ancestors and so on.
(iii) Indices and Breeding Values	Simple and complex calculation of the relative genetic merit of individual animals.
(iv) Inbreeding Co-efficients	
(v) Date Manipulations	Calculating important management orientated dates and intervals, such as the days or weeks until an event, the time between events, and so on.
(vi) Searches, Sorts Rankings	Using<, #, =, >, and between, primarily on dates, codes and measurements.

A key component of any information system is the ease with which data is captured and recorded in the system. Data entry can be through keyboard, disk files, telephone lines and various electronic devices such as scales, backfat measurers and automatic animal identifiers (implants, electronic ear tags etc). The latter can also be used in devices designed to make management easier (e.g. automatic feeders, drafting mechanisms).

USE OF COMPUTER INFORMATION IN ANIMAL MANAGEMENT

One of the keys to successful management is to observe and record useful data, and then convert them into information on which to base decisions. The forms of information defined above can be used as follows in animal management.

(i) Feed planning and management - budgeting and problem solving.

(ii) Animal breeding - culling, selection and mating groups.

(iii) Animal management - event reminders, review of activities (drench calendar) ...

(iv) Health management - check reminder, history of activities, diagnostic assistance possibly through expert systems.

(v) Marketing - buyer reports giving production and pedigree reports, local area through to international auctioning systems (e.g. Computer Aided Livestock Marketing (CALM) in Australia), and simple electronic notice boards.

(vi) Research records - use of computer systems to maintain these should not be overlooked.

The above discussion has tended to assume records and analyses are based on individual animals. However, while high priced animal situations (studs, pigs, cows, deer ....) warrant individual animal records, the majority of sheep farms cannot justify detailed individual animal records (except in cases where

ingenuity can reduce the cost - a simple example is the use of coloured raddles at tupping time). However, in these situations there is a case for using computers to keep mob records. This is certainly possible with existing software and enables keeping grazing, event and health records for each mob and subsequently producing decision information.

REQUIREMENTS FOR SUCCESS

There are a number of factors which will determine whether any system will most likely be successful and useful. When comparing and choosing between alternatives these factors must be taken into account. The following is a list that should be considered.

(i) Flexibility - any package must be very flexible. There is nothing more certain than everyone's requirements will be slightly different, even though it is desirable a central core be the same across most users. There should be flexibility in the following factors.

  (a) The types and quantity of records able to be selected.

  (b) Report content and format be selected although a similar core format is useful.

  (c) Sub-sets selected from the total data set for data input sessions - blank spaces must be removed (e.g. shearing details while entering lambing information).

  (d) System configuration for a wide range of hardware types.

(ii) Adequate capabilities - The system must be able to:

  (a) Record all the information required for each animal - 'Are, for example, 50 items sufficient, or should it be 100'?

  (b) Have the ability to record the type of information necessary - tags, dates, codes etc.

  (c) Perform the calculations required through a formula system.

  (d) Achieve the functions required - 'report formats', ranking, sorts, searches, progeny and ancestor searches and calculations, pedigrees, ...

(iii) Adequate report presentation - The system should allow flexible formats, graphs, various printer types, . . .

(iv) Ease - The software should have good screen design with immediate access to background information through 'pop-up' boxes, access to 'help screens', use of codes to simplify data entry, use of bulk data entry for common figures, (e.g. date of weighing) . . . .

(v) Data entry accuracy support - This involves the system supporting the following:

  (a) Checking devices such as tag number existence and bounds on expected values and subsequent warnings if exceeded.

  (b) Ability to accept, and check, data from electronic devices such as scales, identification system (tags, bracelets) and backfat recorders. Electronic devices must be very sophisticated and reliable with the ability to search out transmission speeds and perform automatic error diagnostics.

  (c) Operator training - the package suppliers should provide training. A well trained and careful operator facilitates accuracy.

(vi) Communication abilities - The system must provide and accept intermediate files to enable 'talking' to other systems. Consistency checking is essential otherwise the files will be corrupted.

(vii) Support - As most users are non-professionals, any package must have especially good support to assist with, initially, the correct set-up and configuration and, subsequently, ongoing training and assistance to ensure the package is used as efficiently as possible. Training must include animal breeding and management in general as this is part and parcel of efficient animal management.

(viii) Operator care and integrity - The system must be accurately operated if pedigree reports (parentage and production) are to be used for marketing, research and genetic work.

NATIONAL SCHEMES

Any discussion of computers and animal management must have reference to the concept of national recording schemes. New Zealand has had a number of schemes. Unfortunately none of the non-dairy schemes can really be regarded as prospering on a long term basis. Currently various proposals are before the sheep industry. The dairy situation is, of course, quite different. New Zealand has been a world leader in developing and maintaining a national data base.

The advantages of a national recording scheme are many in a country the size of New Zealand. Clearly there are cost economies, as well as breeding advantages through better information and sire referencing. The disadvantages include the need for perhaps too much standardisation and very careful system management.

There is a risk with a national scheme, for example in the original Sheeplan, of forcing on users fixed weightings when calculating breeding values where selection for more than one trait is required. This involves value judgements to which not all participants will agree. Groen (1991) clearly shows that if the wrong weightings are selected there is a significant economic cost.

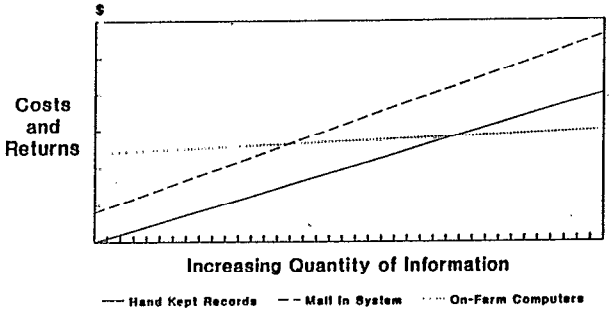
On-farm systems also have many advantages including convenience, immediate access and flexibility, but do require operator competence. The advantage of on-farm systems and the fact that increasingly farmers will have computers, means it has to be accepted farmers will keep animal records 'on-the-farm'. To also capture the benefits of national schemes, the logical approach is to have both, and to perform the detailed genetic work at the national level with data transmission between the farm and the national office using disk files and, eventually, electronic transfers. This is, of course, beginning to happen in some areas.

THE ECONOMICS OF INFORMATION

The search for useful information, whether or not provided through a computer, can be unending. Some information is readily available, other items more difficult to acquire. There is clearly a limit to how much time and expense should be put into acquiring decision support information. The pay-off from the investment is increased income and attainment of other, non-monetary, objectives (better looking stock, ease of management ...).

When setting up computer systems, the economics of the situation needs to be considered. Unfortunately it appears as though there is a complete lack of objective studies to provide real guidance. Currently common sense must prevail based on a knowledge of what the theoretical model looks like.

FIGURE 1 The costs of Information Processing



In theory the decision maker is faced with an increasing per unit cost of providing more and more information, and initially an increasing return to this information, but eventually the rate of increasing return declines until more information has no additional value. This gives a cost and return curve. Where the two curves are furthest apart gives the information level at which the difference between return and cost (for the economists, this is where marginal return equals marginal cost) is maximised. In reality, of course, the curves might not be continuous and well behaved. A small increase in information search costs may give a large increase in return.

The decision of whether to use an on-farm computer compared with mail, or even a hand-operated system, can be viewed similarly, at least in theory. Figure 1 contains this representation.

The on-farm computer has a high initial cost, but the cost increase is not great as more information is obtained. Hand maintained information has a constant increase in cost as does a mail-in operation, other than the initial joining cost. While the hand operation is probably cheaper for small quantities of information, there are some calculations that are just not possible without the use of a computer.

The real question is whether most farmers can economically justify an on-farm computer. This must vary with each animal and farm type, but certainly most survey respondents believe a computer is economic. As noted in the introduction, eventually these questions will become academic as the industry will force farmers to use computers. Stud farmers are already moving into this situation.

CONCLUSION

Using computers and electronics there is really no limit to what is possible for supporting animal management. The discussion has reviewed the scene in a general sense, and provides a framework for thinking about computer schemes.

The best way to conclude is to provide the following quote -

> The (computer) chip would be extraordinary enough if it were only low cost compact electronics, but its ability to embody logic and memory also gives it the essence of human intellect, so, like the mind, the chip has virtually infinite application and much the same potential to alter life fundamentally. (Boraiko)

Over the next few years animal management will be fundamentally affected. Computers will be used as a key component to all systems. Everyone should prepare for this new era.

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