

ADVANCING YOUR MANAGEMENT THROUGH TECHNOLOGY – OPTIONS FROM NEAR AND FAR

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Key points

- Technology use will become more common on New Zealand dairy farms for management of larger and more complex farms
- Technologies focused on automating tasks are currently most popular with farmers
- Areas of new technological development include: the use of Apps, grazing and nutrient management, mobile milking, and combining farm data into cloud-based databases
- Farmers should carefully consider which technologies will offer real value in their business and what possible alternative non-technology changes they could implement for greater gains on farm.

Introduction

Technology has become a feature of our society, with internet connectivity and data capture/storage available through tools such as smartphones, tablets, and apps. In the past decade there has been a marked increase in technologies that help capture and manage data for milking, animal performance, grazing management and people management. In this paper, we examine how technology might help farmers face future challenges, provide an outline of some technology options, briefly outline recent research findings, and provide a guide to help farmers evaluate technology investments.

Challenges facing dairy farmers

Dairy farm businesses are increasing in complexity, with larger farm sizes, more diverse systems and increasing compliance requirements (Jago et al. 2013). This complexity often requires greater thought around daily task allocation to staff, and staff with greater skills are needed for good decision-making. Recruiting skilled people is a challenge, with 40% of farmers reporting difficulty recruiting at any skill level. Currently, average employment tenure is less than 2 years; therefore the effort required to upskill staff is lost when they leave, with negative consequences for farm performance. The use of appropriate technology has potential to help farmers face these challenges.

Technology use is increasing on NZ dairy farms

Technology can lift or maintain farm performance through a) automation of repetitive tasks, and b) improved decision making via data collection and decision support software. More farmers are turning to technology to improve labour productivity and the work environment, and to make more timely and fact-based decisions. Future farmers will be even more reliant on technology, and they will need staff members that are proficient in its use and in the interpretation of the data to make better decisions at the right time. Support outside the farm gate, such as farmer learning networks and industry databases that accept and share farm data, will further increase the benefits that technology can provide.

There are already numerous devices, apps, and software packages available, so farmers need to ensure they select the technologies and systems that will fit with their farming operation and staff competencies, and which will add value to their business. A key barrier to rapid adoption in New Zealand is that new technologies are often developed overseas, so their application is less suited to our low cost pasture-grazed systems. NZ farmers that have adopted milking related technologies reported improvements in labour efficiency, herd management and profitability. The same farmers also reported challenges from a lack of integration with other technologies, limited learning networks, a lack of trust in the technology, poor uptake by staff members, and unexpected learning time/costs (Eastwood and Yule, 2015). Considered evaluation of any technology pre-purchase will ensure expectations are met, and integration of the new technology is as smooth as possible.

A flow chart for considering new technologies

When contemplating any investment to improve on-farm performance, such as mastitis or heat detection, it's important to consider all options and their likely outcome. Flowcharts can help users step through the decision-making process. Below is a four-step flowchart (Figure 1) which focuses on 1) assessing current performance first, to identify what works well and where improvements could be made; 2) goal consideration for this particular area of the farm system - what is the end result you are looking for?; 3) the options available for meeting those goals. A

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technology investment may be one option, but changing basic processes on farm or staff training may prove a more cost-effective solution; and 4) the final step, if new technology appears to fit your farm and goals, to spend time investigating the different technology options in terms of their performance, the data they capture and what decisions you will use that data for, along with other important factors such as usability for you and your staff. DairyNZ is developing some guides to help with this process, and these will be made available on the DairyNZ website.

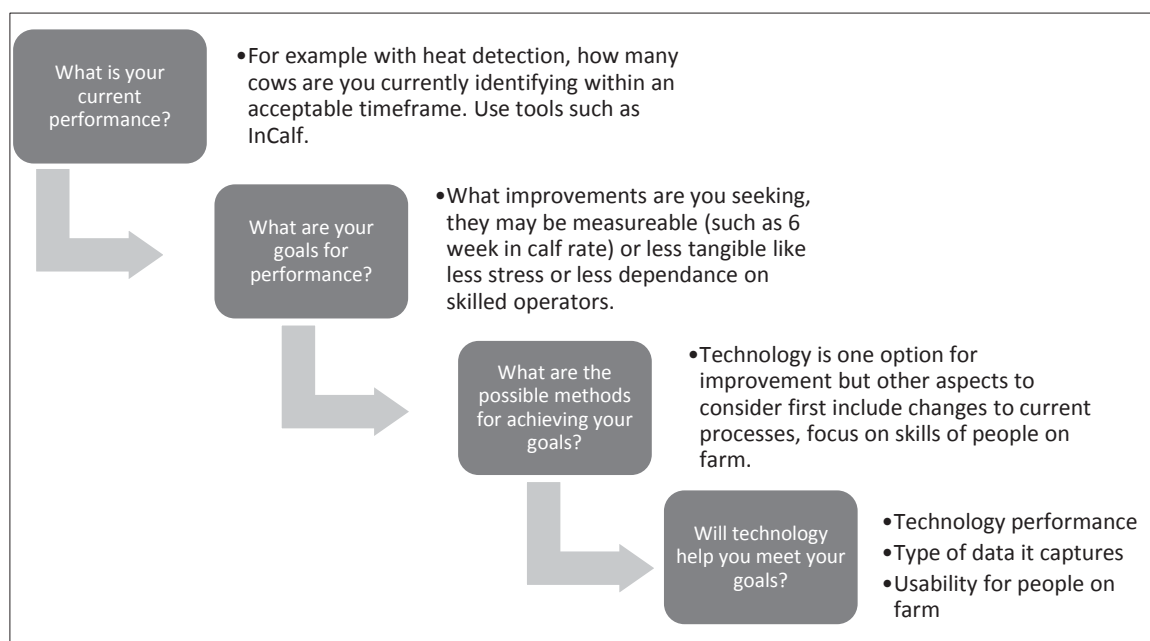


Figure 1. Flow chart of decision points when considering investing in new dairy technologies

Technology options – now and in the near future

Automating the milking process

Milking accounts for around 50% of farm labour hours on farm. Farmers investing in technologies at the dairy are commonly seeking improved labour productivity and moving towards a ‘one person milking’ operation to allow reallocation of labour into other tasks. DairyNZ surveys of technology use in the dairy in 2008 and 2013 highlighted farmers’ preference for technologies that automate tasks, such as cup removers, auto drafting, electronic ID, and auto teat sprayers (Figure 2). The surveys also identified that adoption was low for technologies that don’t directly influence labour productivity, such as milk meters, walk over weighing, mastitis detection and heat detection. Improved efficiency appeared to be a key driver for capital investment in technology.

Automatic milking systems (AMS)

Future gains in milking efficiency will be reliant on fully or partially automating the milking process. The DairyNZ Greenfield Project introduced automated milking systems (AMS) to NZ pasture grazed systems and the original ‘single box’ AMS has provided farmers with an option to minimise labour involved in milking and has changed the landscape of working routines. Around 20 New Zealand farms now milk cows using AMS, but farms are limited by current per box capacity to milk only 60 to 90 cows/day. Cow throughput, capital cost, and implications for farm system management means most current pasture-based AMS farms are smaller than the industry average.

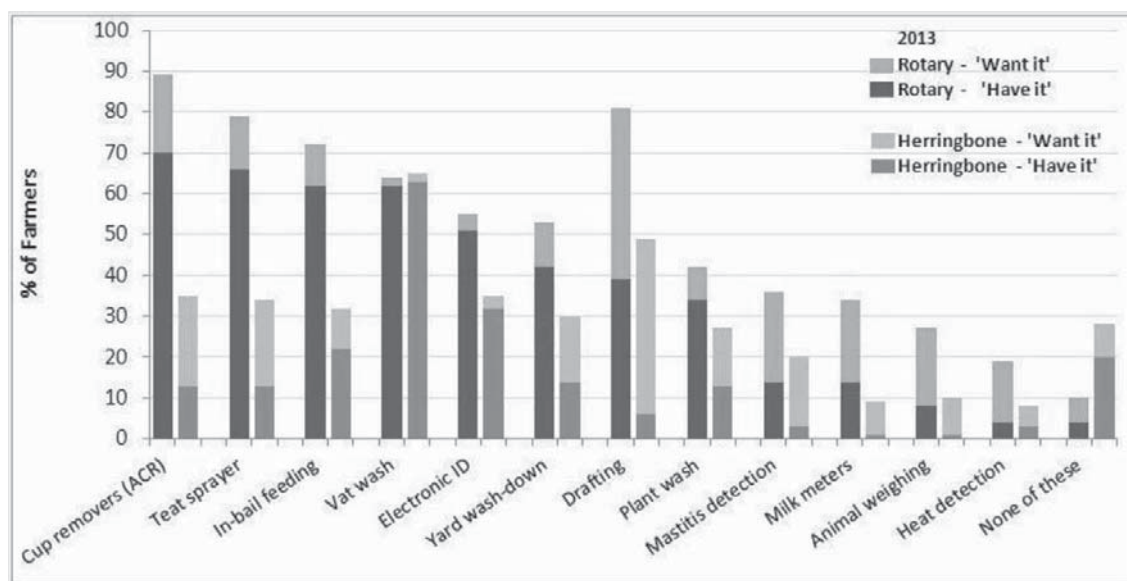


Figure 2. The percentage of dairies with a technology installed (‘Have it’) or where farmers would like to install it (‘Want it’) for rotary and herringbone dairies in 2013.

Further development in robotic milking, targeted at larger herds, has led to commercialisation of the DeLaval Robotic Rotary, a customised 24 bail platform with 2-5 robotic arms. Milking throughput is between 50 to 90 cows per hour so cows can be either milked in batches (herds brought to the dairy) or walk voluntarily to the dairy for milking at any

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time. Another option is the recently launched GEA Dairy ProQ rotary, where every bail has a robotic arm. This system can be installed as a new dairy or fitted to a rebuilt existing rotary (with fewer bails) and has the milking throughput of a conventional dairy of a similar size, although current costs may be prohibitive. The Scott Milktech system, developed in New Zealand and currently near-market, uses an industrial robot with customised capability to automatically cup cows. Future options may include re-locatable or mobile AMS units that enable dairying on marginal land that is either small in size or under alternative ownership structures (e.g. lease land).

Technologies to assist grazing management

There is still significant room for grazing management improvement on most New Zealand dairy farms, with recent estimates of unutilised pasture valued at \$600/ ha (Chapman et al. 2014). Grazing management tools to date have ranged from the simple, but effective, plate meters to on-the-go devices like the FeedReader and Rapid Pasture Meter, as well as various computerised decision support tools. In the last decade there have been attempts to provide new technology options for farmers through projects such as Pastures from Space (Dalley et al. 2009). Pastures from Space research identified that farmers are looking for pasture information which is: timely (relates to current pasture covers); frequent (e.g. weekly in peak growing season); accurate and reliable (usually at least comparable to plate meter accuracy); in a format that farmers can use (e.g. .csv files, feed wedges, or annotated farm maps).

The advent of better and smaller remote sensing devices, along with the rapid development of improved remotely piloted aircraft systems ('drones' or UAVs), will eventually lead to improved near-ground measurement of pasture quantity and quality. At a paddock scale, grazing behaviour devices may enable real-time (or near real-time) paddock related information that would support timely decisions around grazing residuals. Commercial application of such technologies is still some years away.

Technologies to assist people management

People are and will remain the most important component to profitability on farm. Managing and supporting staff effectively to ensure high labour productivity, good communication, high staff satisfaction and meeting compliance requirements around employment and health and safety will be an increasing challenge for many farms. Computer and smart phone apps (applications) will be a commonly used tool to manage and complete daily tasks. An example is AgRecord, an online farm management system that managers and staff can contribute to which becomes a permanent record of all staff related activities/ documents, farm maps, auto-updating calendars for tasks and meetings, and access to manuals

and instructions. DairyNZ is developing apps to support people on farm including practical tasks like staff rostering, body condition scoring and pasture management.

Information management - making better decisions

Decision support systems can be as simple as spreadsheets or as complicated as commercial software tailored for farm specific needs. Multi-farm businesses are likely to have a higher need for reliable and accurate farm management information. A OneFarm study identified 127 farm management decision support tools used by farmers and rural professionals (Allen and Wolfert, 2011). Most were in more established areas of farm management such as stock, feed and financial, with fewer in the areas of nutrient management and labour. Farm management software often focus on a single process or area, such as herd management, and do not integrate with other management tools. Development of online ‘dashboards’, where key farm management data is presented via a webpage, are becoming more common. However, the value of these systems still relies on the ability of users to interpret the data and use it to make better decisions. Some other points to note about farm information systems include:

- there is current debate over privacy, security of information, data standards and data ownership
- greater integration of farm management tools is slowly occurring (e.g. AgHub, Farm IQ, iAgri) and cloud-based networks are leading to more comprehensive databases with greater capacity for feedback.
- Data standards are currently being developed through a cross-sector project called the NZ Farm Data Standards.

Recent DairyNZ research into technology application

Individualised feeding of supplements

Individual cow feeding of concentrate supplements (also called differential or targeted feeding) using computerised in-shed feeding systems could be considered to be the fine-tuning of a feeding system. It relies on the belief that being able to individually feed cows will improve

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response to supplement offered because the most responsive cows can be fed more than less responsive cows. While this approach is common overseas, the value of individual cow feeding in a pasture-grazed system was not clear due to a lack of robust research relevant to NZ farming systems.

A study funded by DairyNZ and the Sustainable Farming Fund examined farmer use of individual feeding, including their experiences and views. A review of scientific studies (Hills et al., 2015) and comprehensive modelling of common feeding criteria using the DairyNZ Whole Farm Model (WFM) were then undertaken (Inside Dairy, Dec 2014). Modelling indicated no benefit from individualised feeding compared with flat rate feeding (all cows offered same amount) of supplement using various decision criteria based on milk production, age, genetic merit, liveweight and body condition score. This was followed by a four week field trial to determine the difference in milk response to supplements between individualised feeding for milk production and flat-rate feeding. There was no observed effect on milk production (milk yield or milksolids), liveweight or BCS.

Individualised feeding systems add the ability to automate feeding of mobs within a herd without additional effort. However, this project found no evidence that individualised feeding provides an improved response to supplements in seasonal pasture-based systems compared to flat rate feeding that would support the additional technology investment for that purpose.

Grazing time sensors

New technologies are available to monitor individual cow grazing time and activity. DairyNZ designed a trial to validate the accuracy of a collar based grazing time sensor. Grazing behaviour of selected cows wearing the sensors was monitored visually and compared to the sensor data. There was good alignment in the patterns of grazing sensor data and visual observations when comparing data in 15 minute summaries (the standard output of the sensor). For use on farm, the data appears most useful over a 24hr period, at either an individual cow or herd level. Changes in grazing behaviour could be useful to indicate health issues, or as a sign of oestrus. Research is ongoing to examine potential usefulness of these sensors for farmers.

Economic value of automated mastitis detection

Automated mastitis technologies (AMD) are now used on approximately 6% of NZ dairy farms (Edwards et al. 2015) and many farmers have expressed interest in investing in this technology. Past work by DairyNZ has focussed on the performance of AMD technologies and the development of protocols (Kamphuis et al. 2013). Farmers using the technologies have expressed varying levels of satisfaction of their on-farm value but little information exists regarding the economic value of AMD systems. DairyNZ, in collaboration with Wageningen

University in The Netherlands, developed an economic model to assess factors influencing the economic value of AMD technologies in NZ dairy systems.

A partial budget modelling approach was used to compare AMD with visual detection methods (Dolecheck et al. 2013; Rutten et al. 2014). Profitability of using AMD was investigated through the use of net present value (NPV, discount rate 5%) and the internal rate of return (IRR). Due to the difficulty associated with attributing costs to mastitis infections, the model did not cover the costs associated with management of bulk milk SCC, or identifying end of lactation cows for dry cow therapy. The economic modelling focussed on comparing AMD devices using electrical conductivity at quarter level with visual detection of clinical mastitis.

The modelling exercise provided some useful information for dairy farmers looking to invest in automated mastitis detection devices. Based on the assumptions in the model, AMD systems would not provide an economic return over a 15 year timeframe. Additional factors, such as identifying non-clinical but high SCC cows, identifying cows for dry cow therapy, using AMD to compensate for low-skilled labour, or having greater peace of mind, may provide significant non-monetary benefits to farmers and need to be factored into an AMD investment. Analysis of the AMD devices in this study indicated that EC measurements at a quarter level was more effective than using EC at whole udder level, however quarter-level measurement can be more expensive. A major determinant of the economic return from AMD is the labour cost from checking alerted cows. The higher the false alerts from an AMD system, the more time has to be spent marking, teat-stripping and drafting cows.

Summary

Technologies for automation and decision support will be increasingly used by NZ dairy farmers to help manage larger and more complex farm operations, as well as to manage increased environmental and compliance demands. Experience with current technologies shows that their benefits can be very context specific, and dependant on factors such as existing farm management practice, ability to engage with the technology and data, and time spent on learning. Technological developments are taking place in grazing and nutrient management, mobile milking, the use of apps, and combining farm data into cloud-based databases. As such

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technology matures we expect them to become more integrated with a greater focus on using data for key decisions on-farm. However, in the meantime, farmers should think carefully to determine which technologies offer real value (in terms of overall profit, easier management, or peace of mind) and what non-technology changes they could implement for greater gains on farm.

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