SNAPSHOTS OF OUR DAIRY AUSTRALIA LEVY AT WORK: FUTURE DAIRY – INNOVATIONS TO MEET TOMORROW'S CHALLENGES

Sean Kenny

Extension Leader, FutureDairy, University of Sydney, Camden, NSW,

Take home messages

- **FutureDairy is a new project designed to address the major challenges dairy farmers are likely to face in the future - the availability and cost of land, water and labour.**
- **We have developed partnerships between technical researchers, social researchers, dairy advisers and farmers to achieve a more robust picture of how new technologies are best applied on farm**
- **Our complementary forage rotation has achieved over 40t DM/ha/yr in its first two years**
- **We have established four farmlets exploring the profitability of achieving a 50% increase in milk production/ha through increased stocking rate, production per cow or both.**
- **We have established a state of the art Automatic milking facility designed to explore how best to facilitate voluntary cow movement to and from the units whilst maximising pasture utilisation.**

Background

FutureDairy is a new initiative developed to help Australia's dairy farmers manage the challenges they are expected to face over the next 20 years. It is investigating the issues associated with large increases in forage and milk production/ha along with new technologies to improve labour efficiency and lifestyle. The project is designed around partnerships between researchers, both technical and social, extension agents and commercial dairy farmers. Such partnerships aim to develop the knowledge and practices required to make new technologies work effectively on farm.

FutureDairy centres on three modules of research based at NSW DPI's Elizabeth Macarthur Agricultural Institute (EMAI) at Camden, 60km south west of Sydney. The forages module aims to produce more home-grown feed from any given parcel of land. The target is to utilise over 40t DM/ha/yr sustainably using a Complementary Forage Rotation (CFR) (Garcia and Fulkerson, 2005). The feeding module is researching alternative pathways to increasing production per hectare by 30-50%. The key question relates to the pressure on dairy business to intensify their operations – if dairy farms need to increase output to overcome declining terms of trade, and given the increasing competition for land and water resources, what is the most efficient way to use bought in feed to grow the business? Finally, the innovations module is investigating a number of innovations that have the potential to improve farm efficiency, labour management and lifestyle. The key innovation being explored is automatic milking systems (AMS).

The early results are reported in this paper.

Forages

Over the last two years we have found that the target yield of 40t DM/ha/year is achievable with a complementary forage rotation (CFR). This CFR consists of maize sown in mid October as a bulk crop, forage rape sown in late February, early March as a break crop, and Persian clover over sown after the first grazing of the rape to fix atmospheric N. In the first year maple peas were sown in August due to the failure, for a number of reasons, of the Persian clover. The forage yield from the CFR was 2.5 times greater than pasture managed to best practice as a control treatment, despite the fact that total pasture utilised (17t DM/ha) was more than 2 times higher than historical averages for the area (Garcia and Fulkerson 2005) (see Table 1).

Table 1 Forage yields of CFR in first 2 years

Year	Brassicas	Maple peas	Maize	Complete CFR	Pasture
1: Mar 04-Mar 05	12.0	3.5	26.6	42.1	17.2
2: Mar 05-Mar 06	9.5	5.1	26.2	40.8	17.4

We have also found the CFR system to more efficiently utilise nitrogen and water than a well managed pasture, which confirms results reported from a related project at Camden (Neal *et al*. 2005).

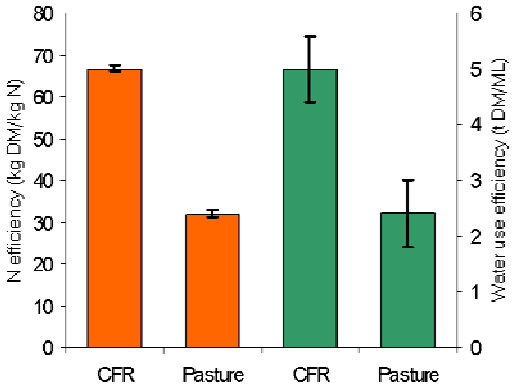


Figure 1. N (left) and water (right) use efficiency of CFR and pasture

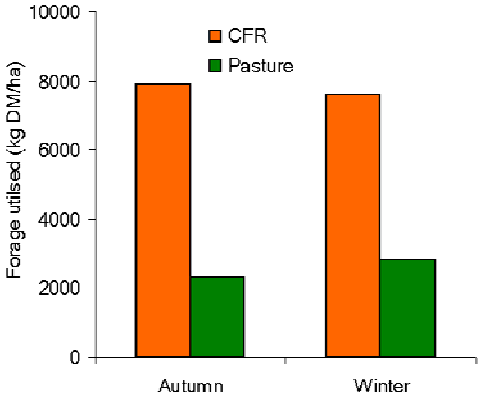


Figure 2. Comparison of forage utilised in autumn and winter

Seasonal forage production of the CFR was three times greater than that of the well managed pasture control during autumn and winter (15 t DM v 5 t DM/ha, Figure 2). This has important practical implications on dairy farms -particularly on those producing milk in winter, as high quality, grazed forage rape could be used as an alternative to more expensive brought in supplements. The forage quality results are indicative of the complementarity of the CFR when it comes to feeding cows. Forage rape and Persian clover, (high protein, high energy, low fibre) complement well the lower protein and high fibre maize silage. This, combined with the higher forage production of Brassicas in autumn and winter, shows the potential of the CFR to provide better forage balance and supply, and complement the pasture base of dairy farms.

Initial reflections from Partner Farms

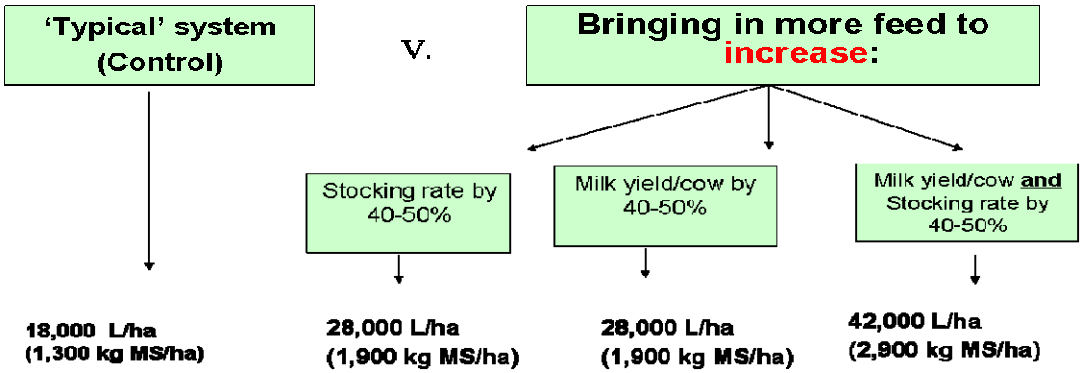
Two commercial farms have been trialing the CFR, starting with maize in October last year. Understandably what we have discovered is that timing and logistics are the two major challenges to getting the CFR 'right' under commercial conditions. It is one thing to get 40t DM/ha on a 1 acre plot, another thing to do it on 10ha while everything else needs to be done on the farm. Both of our farms managed to achieve close to or over 20t DM/ha with their maize crops this year despite significant seasonal and operational challenges. Key insights to date are:

- Timing of sowing, fertiliser and irrigations will drive the yield of the maize, which has a major impact on the cost effectiveness of the CFR.
- Timing of Brassica grazing and maize harvesting will also drive the overall energy production of CFR. Potential 'disasters' at harvesting – machinery breakdowns, bad weather, poor management - will ensure that you effectively have very expensive dry cow feed.
- Scale will have a large impact on the logistics of growing Brassica's. As only 3-4kgs DM/cow/day is recommended, small areas of Brassica must be allocated each day. This means that several sowings will be required which runs the risk of compromising overall yields. Thus there will be an upper limit of the area that can be sown to Brassica in the autumn of around 3ha per 100 cows.
- The level of planning for the CFR on a larger scale is far greater than that of pasture based systems. The challenge for farmers is to balance up this extra 'cost' with the potential benefit of the system.

Feeding

It's early days in our feeding research with work in this area starting in February after a 12 months adaptation period. The primary question under exploration relates to the best use of bought in feed. The amount of supplementary feed used on dairy farms has increased dramatically over the last 20 years and it is our belief that significant gains in productivity can be achieved from a more appropriate and efficient use of these feeds. We have chosen to focus on the specific question of whether this additional feed should be used to carry more cows per ha or to increase milk yield per cow, or both. To address this we have established four farmlets to examine the productivity potential of different combinations of stocking rate and per cow production (Figure 3).

Figure 3. Feeding module farmlet design



Control farmlet

This is a 'control' system providing a ration typical for most regions of Australia. Cows will be on pasture most of the day and fed concentrates at milking and hay and silage to fill feed gaps. The aim is to have 60-70% of the diet as pasture, cows producing around 6000L per lactation and stocked at 2.3 cows/ha.

Stocking rate farmlet

This system will aim to achieve a higher milk yield per hectare through a higher stocking rate (3.4 cows/ha) with a similar level of production/cow (6000L). The focus for this farm will be on addressing the question: "can we lift productivity by increasing stocking rate without changing the basic feeding approach?"

Production per cow farmlet

This system will achieve a higher milk yield per hectare through higher milk yield per cow whilst keeping the same stocking rate as the control system. Cows will graze on available pasture and be supplemented with concentrates and fodders using a partial mix ration as required. The key question to be addressed is: "Can we lift productivity by focusing on increasing milk yield per cow?"

Quantum leap farmlet

This system will look at a quantum leap in milk production per hectare by combining higher stocking rates with high production per cow. The key question driving this system is: "Can we increase profitability by combining a very high milk production per cow with high stocking rates but still retaining a high level of pasture utilisation? What are the impacts of this on management and labour requirements?

Initial reflections from Partner Farms

We have two commercial farms involved in the project that have set themselves the target of increasing milk production per hectare by around 30%. The purpose of their involvement is to provide a site for exploring the aspects of improving milk production per hectare that we cannot quantify on a research farm. The involvement of social research on these farms is enabling us to capture the decision making process that farmers go through to achieve change as well as the lifestyle and labour impacts of these changes. Early insights from partner farms include:

- Achieving profitable change on farm requires a detailed understanding of the farm, physically, financially and socially. Developing this understanding requires good relationships and a lot of time
- No one solution will bring about change – increasing milk production per hectare requires improvements in a number of areas
- The 'ideal' of feeding cows and grazing grass 'properly' is easy to talk about but difficult to attain. The challenge for any farm is to understand their operation and set realistic targets that align with their resources – physical, financial and social.
- Third party support, whether it be advisers or farmers, is critical to developing momentum for change. The challenge facing the industry is having enough people who understand what drives profit in pasture based systems to support this change.

Innovations

The purpose of the innovations module within FutureDairy is to examine key innovations that have the potential to either improve labour efficiency and lifestyle or enable more precise decision making around pasture allocation and supplementary feeding (Fulkerson, 2006). The major innovations being explored are automatic milking, remote sensing of pasture mass and remote sensing of rumen status.

Automatic milking systems

In most cases, except the Warren's robotic dairy at Maffra and the Dexcel automatic milking units in New Zealand, automatic milking units cater for relatively small herds, confined indoors, where enticement to be milked is easier. Where cows do graze in Europe the emphasis is not on pasture utilisation – pivotal in Australia to profitable dairying. Thus to be viable in Australasia throughput/unit has to be increased from the present 60 cows/day and we have to develop a system around the AMS that entices cows to come to and from the dairy without compromising pasture utilisation. Both these aspects are the objectives of the research to be undertaken at Camden in the FutureDairy project. To do this two farmlets will be set up (table 1) – one with cows of 'average' production whilst the other has high production per cow, to test whether the enticement to come through the AMS will be different for cows of different production. We are working in partnership with Max and Evelyn Warren to ensure that our research work is in line with the practical challenges faced when using AMS on a commercial scale.

Table 3 Description of Automatic Milking System farmlets

Farmlet	**1**	**2**
Area (ha)	17	25
Stocking rate (cows/ha)	3.5	2.3
Target production (L/cow)	6000	9000

Remote sensing of pasture mass

Most farmers would be aware of the value of being able to accurately allocate pasture but are not convinced that the time spent measuring pasture is worth it. The time spent relates to measuring pasture each week and then using the data to formulate a ration. Two innovations are being developed that will take the footwork out of pasture measurements.

The first is satellite imaging, where a satellite picks up the amount of light of a particular wavelength absorbed by the pasture, which relates to pasture mass. FutureDairy is in the process of developing calibration equations for different species and recent studies have indicated that the accuracy of measurement by satellite image is similar to the rising plate meter.

The second innovation is a pasture sensor that is placed on the back of a quad bike. This technology is being developed by C-DAX Ltd (NZ) in collaboration with FutureDairy. We are calibrating the device for various pasture species (ryegrass, lucerne, prairie grass, kikuyu). The device measures pasture height very frequently (up to 400 times/sec) by detecting the interruption to beams of light. These meters are expected to be commercially available by June this year.

Remote sensing of rumen status

The remote measurement of such parameters as pH, NH_3, temperature and pressure in the rumen will allow real ration formulation. We can measure quality and quantity of feed in as accurately as we like, but in the end it is the rumen which can tell us how well we have done. Therefore such an innovation will not only give us warnings if we have erred in balancing the ration but it will also train us to formulate more appropriate rations.

The idea would be to have 8-10 cows with probes in their rumen to reflect the adequacy of the herds' feeding regime. FutureDairy is working in collaboration with Kahne (NZ) Ltd and Dr Keith Ellis to develop these sensors.

Conclusion

FutureDairy is a significant investment in the future of Australia's dairy industry. The expected impacts of this work are:

- Robust guidelines for the effective integration of CFR on commercial farms
- New insights into the productivity of high stocking rate and high production per cow farms
- New, ground truthed innovations that address many of the issues dairy farms face around labour availability and cost
- New innovations to give dairy farmers more of a life
- New insights into the role dairy farmers play in large research and development projects such as this
- More advisers with greater capacity to support on farm change in the industry

Acknowledgments
FutureDairy's major investors are: Dairy Australia, NSW DPI, DeLaval and The University of Sydney. Other investors include the Dairy Research Foundation, The University of Melbourne and the Dairy Industry Development Corporation NSW.

References
Fulkerson W.J. (2006) Innovations for the future dairy farm. Proc. Dairy Innovators Forum, Mount Gambier, South Australia.

Garcia S.C. & Fulkerson W.J. (2005) Opportunities for future Australian dairy systems: a review. AJEA, 45, 1041-1055

Sean Kenny – Bio

- Spent most of my early life in Warrnambool, South West Victoria
- Trained to become a marine ecologist, but somehow ended up as a dairy advisor with DPI
- Spent three years working with the Target 10 program based in Warrnambool
- Also worked closely with the Innovation and change management group at Melbourne Uni looking into how dairy farmers go about change and how extension people could best support this.
- Took a three year 'sabbatical' to study theology at Whitely College in Melbourne.
- Spent a year working with David Chapman at the University of Melbourne looking at alternate forage options for dryland farming systems
- Started working as extension leader for FutureDairy in December 2004.
- Married to Rachel with two children, Grace and Lachlan, with another one on the way