Feedlot dairy farming in subtropical Australia - the M5 feedlot farmlet

Findings from the "Sustainable dairy farm systems for profit" project

M5 Project Information Series - Studies on Mutdapilly Research Station and subtropical dairy farms 2001 to 2005

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OVERVIEW

BASED on the information collected from the fully-irrigated 20-cow M5 feedlot farmlet at Mutdapilly, which was scaled and modelled into a 900-cow enterprise, the feedlot farming system produced a positive cash flow and an average operational return on assets of 13.9% over the four years. Average annual gross margin/cow was $1,497, and operating profit $823/cow.

These returns were for an established feedlot enterprise, and do not include financing the start-up years when infrastructure has to be constructed and herd numbers built up. Of all the farming systems, the M5 feedlot infrastructure was the most difficult to model because of these phasing and sizing issues, and the lack of feedlot-dairying case studies.

The M5 feedlot farmlet averaged 9,180 litres/cow/year at 4.01% milk fat and 3.18% protein. Total milk production from the farmlet was 39,490 litres/ha/year, with an estimated 43% of production coming from purchased supplements, 42% from homegrown forage and 15% from purchased forage. The estimated milk production from homegrown forage was 16,730 litres/ha.

INDUSTRY BACKGROUND

WITH pressure to increase production per cow and per farm to remain viable – and the impact of drought on forage supplies – many subtropical dairy farm businesses have increased their use of conserved forage and purchased feeds in recent years. They have become semi-feedlot farms 'by default'.

The industry has become interested in the business potential of a full feedlot as an alternative production system – either setting up a feedlot dairy 'from scratch' in sub-coastal cropping regions, or by converting from a grazed pasture/forage crop system on an existing dairy farm.

Feedlot dairying has the potential to allow an existing business to expand by making more intensive use of existing resources, including land, water and forage. However, the summer heat and potentially high rainfall of the subtropical environment can be a challenge when managing dairy cows in intensive feedlot conditions. Maintaining supplies of reasonably-priced feed; ensuring the enterprise is environmentally sustainable; and producing sufficient income to allow employment of suitably-skilled labour are other issues faced by this farming system.

Queensland Government
Department of Primary Industries and Fisheries

Strengths and weaknesses of this dairy farming system in northern Australia

Strengths

- POTENTIAL for sufficient scale and size to employ staff and to contract-purchase feeds and forages.
- Potential for high water-use efficiency from 'cut and carry' use of crops.
- With a high irrigation component, the system can be buffered against drought.
- More opportunity to manage, capture and use effluent.
- Easier management of cropping program without grazing animals.
- Potential to build and maintain cow body condition - for consistent peak yield, production and milk composition, and for improved fertility.
- Ability to fine tune rations and obtain milk production close to the herd's genetic potential.

Weaknesses

- REQUIRES more specialised skills in staff management, animal management, ration balancing and environmental management.
- Requires computerised record-keeping programs to manage the herd, formulate rations and manage finances.
- Higher capitalisation, so more sensitive to milk price fluctuations.
- Dependent on reliable water supplies – or reliable sources of forage.
- Requires sourcing large numbers of quality grade cows.
- Potential for substantial point-source pollution (nutrient leakage, odour) if inappropriately designed or located.
- Small scale compared with beef feedlots, if forced to compete for scarce supplies of grain, by-products and fodder.
- Requires at least 12-months forage supply on hand to avoid purchasing high-priced fodder in low-yield or drought years.
- Requires careful choice of location (including rainfall and heat considerations) and design for satisfactory year-round dairy cow health. A dry-lot dairy feedlot may work in a semi-arid, sub-coastal environment. A free-stall barn would be required in a subtropical coastal environment.
- Mid-summer heat has the potential to impact on cow intake and production.

LESSONS FROM THE M5 FARMING SYSTEMS PROJECT

The aim of the *Sustainable dairy farm systems for profit* project was to research the possibilities of the common dairy farming systems in the subtropical region. The project looked at intensification and its implications, with a goal of 10% return on assets and 600,000 litres/labour unit.

The project's M5 farmlets at the Mutdapilly Research Station provided four years of data, through both good and bad farming seasons.

NB. The 20-cow farmlets were managed under research station conditions and in the low-rainfall Mutdapilly environment, so results cannot be directly extrapolated to commercial farms across Queensland and northern NSW. However, the farmlets project does indicate potential ways forward for similar farming systems in the region.

MUTDAPILLY M5 FEEDLOT FARMLET HERD

THE 20-cow M5 feedlot farmlet herd was modelled on:

- Farm area of 209 ha of crops and 20 ha of buildings and yards with 900-cow total herd.
- Milking cows in a feedlot, heifers and dry cows off-farm.
- Total crop area irrigated - 100% of the farm
- A forage system based on irrigated summer and winter silage crops, plus lucerne for hay or haylage.
- High stocking rate, 4.3 cows/ha on the cropping area, under a cut and carry system.
- High level of purchased supplementary feed – 3 tonnes grain/cow.
- High milk production target – 9,340 litres/cow/year, with a 350-day lactation; 13.5 month inter-calving interval giving 10,500 litres/lactation
- Year-round calving, and milking 3 times/day
- Large enterprise with substantial (up to $5M) investment in plant, equipment and stock.

Weather Conditions

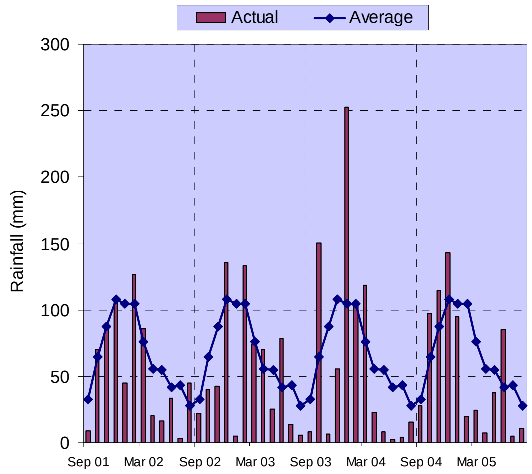
THE farmlet project years from 2001 to 2005 were based on the 12-months from September to August to fit with summer-winter seasons.

Rainfall

Mutdapilly average annual rainfall is 801 mm, however average rainfall over the project was significantly less at 680 mm/year *(Figure 1).*

- 2001-02, 651 mm, 81% of average, reasonable spring, dry cold winter.
- 2002-03, 648 mm, 81% of average, dry summer but good winter.
- 2003-04, 751 mm, 94% of average, with a poor distribution, good start to spring and end to autumn, then dry summer and winter.
- 2004-05, 667 mm, 83% of average, good spring, poor autumn and early winter.

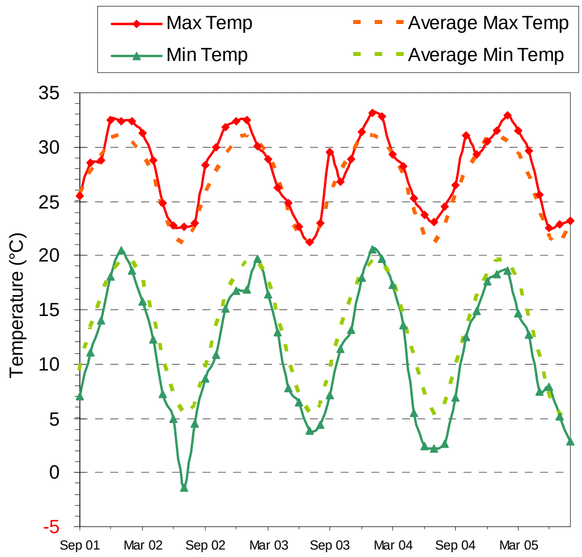
FIGURE 1. RAINFALL (mm) over the 4 years of the farming system project.



Temperature

MUTDAPILLY is a location with wide temperature extremes, *(Figure 2)*. The winter of 2002 was colder than average and the summer of 2003/04 particularly hot.

FIGURE 2. MEAN monthly minimum and maximum temperature (ºC) at Mutdapilly over the 4 years of the farming system project.



Milk production

MUTDAPILLY herd cows selected for the feedlot farmlet demonstrated that grade Australian Holstein Friesian cows are capable of producing 8,000 to 10,000 litres/cow/year, provided they have consistent intake of a quality ration.

Over the 4-year project, average annual milk production from the M5 feedlot farmlet was very close to its target of 9,340 litres/cow/year, *Table 1*.

As shown in *Table 1*, the farmlet produced more than 8,600 litres/cow/year in its worst year - the start-up year 2001-02, when cows gained liveweight, and adjusted to changed rations and the farming and milking system. The best year was 2002-03 when cows produced more than 9,800 litres/cow/year, due to better quality forage. In 2003-04, extreme heat wave conditions in early summer caused the milk production of all farmlet herds to crash, but the M5 herd was most severely affected.

In February 2005, sprinklers were installed, which turned on when air temperature reached 26ºC. Both feed intake and milk production of the feedlot herd improved, despite continuing stressful conditions.

TABLE 1. MILK production per cow from the M5 feedlot farmlet in each year of the project.

M5 feedlot farmlet	Litres/cow/year	Variation
Budget/target	9,340	
2001-02	8,650	-7.4%
2002-03	9,870	+5.6%
2003-04	8,740	-6.5%
2004-05	9,470	+1.4%
4-year average	**9,180**	**-1.7%**

The 4-year average milk production was 39,490 litres/ha, with an estimated 16,720 litres/ha from homegrown conserved forage (by reverse calculation).

Table 2 presents the milk yield and composition over the 4 years of the project. Average liveweight of the feedlot herd was the highest of all farmlets at 608 kg.

TABLE 2. AVERAGE milk yield, milk composition and liveweight of animals in the M5 feedlot farmlet over the 4 years of the project.

Litres/cow/year	9,081
Litres/cow/day	29.3
Milk fat (% and kg)	4.01 and 369
Protein (%and kg)	3.18 and 292
Lactose (%)	5.00
SCC (x 1,000)	237
Liveweight (kg)	608

Figure 3 and *Figure 4* present the milk production pattern for the M5 farmlet herd in total and per

cow. The budgeted pattern was based on 900 cows calving evenly through the year. With a herd of 20 cows, the calving pattern of individual animals had a marked effect on production patterns.

FIGURE 3. DAILY milk production pattern (L) for the herd in a 900-cow, M5-style herd.

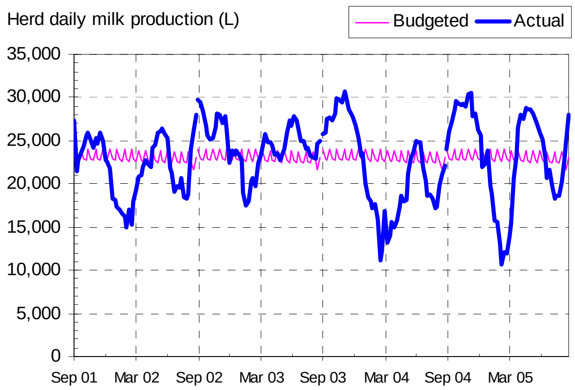
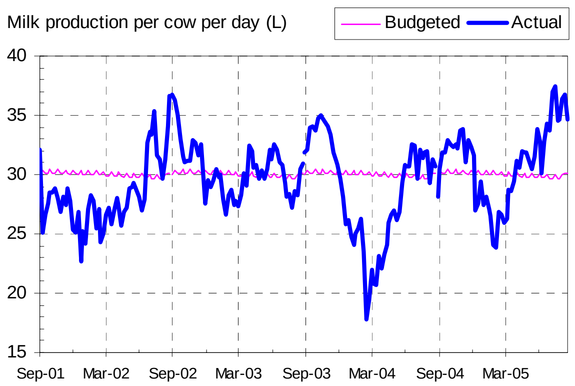


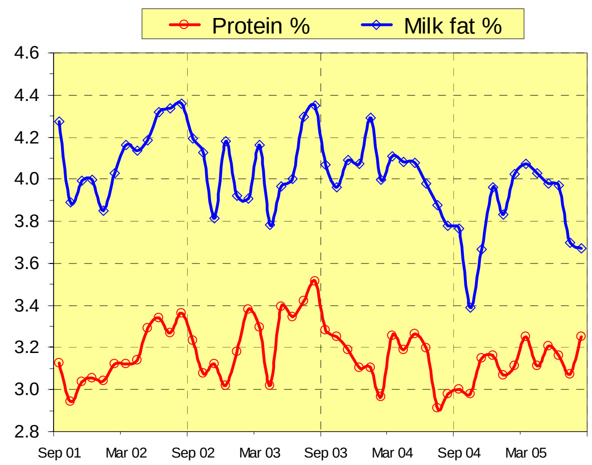
FIGURE 4. DAILY milk production pattern (L) per cow in a 900-cow, M5-style herd.



Milk composition

Initially the M5 feedlot herd produced the highest protein milk, but this advantage lessened over time *Figure 5*. Most of the variation can be explained by stage of lactation effects caused by a trend towards autumn calving - a consequence of intensive mating programs in the Mutdapilly herd.

FIGURE 5. MILK composition for the M5 feedlot farmlet herd over the four years of the project.

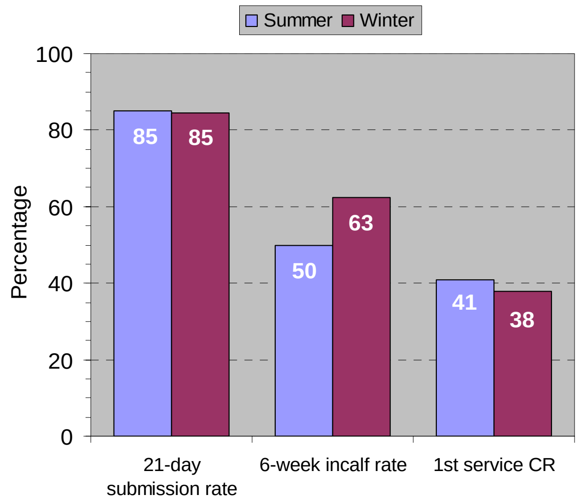


Calving pattern and reproduction

THE modelled M5 feedlot herd was to calve year round with a 13.5 month inter-calving interval. The herd was mated year-round, but tended to calve seasonally as replacement heifers calved seasonally, and an intensive seasonal mating program was implemented for the Mutdapilly herd, including the M5 farmlet herd.

Submission rates for both mating seasons were similar (around 85%) and above the industry average, indicating that cows were cycling and detected in heat. However the prime indicator of reproduction success – the 6-week in calf rate – was 50% for summer mating compared with 63% for winter mating. This pattern was similar across all farmlet herds, *Figure 6*.

FIGURE 6. M5 FEEDLOT FARMLET herd summer and winter 21-day submission, 6-week in calf and 1st service conception rates (%).



First-service conception rates were similar, around 40%, in both mating seasons. These results are considered to be below the percentage that should be achievable.

Overall, the feedlot herd replaced the lowest number of animals (22%) for an unacceptable period between calving. However the feedlot herd had the highest replacement rate for culling due to high cell count and other fertility reasons (14.1%) and one of the highest exits for sickness (8.2%). The planned replacement rate for the feedlot herd was 33% compared with 25% for other herds.

In the economic analysis of the enterprise, an allowance was made for the cost of replacing animals above the 33% replacement rate. In the M5 feedlot herd, less emphasis was placed on inter-calving interval as well-bred Holstein Friesian cows producing 10,000 litres/cow/year milked on in late lactation, and with increasing fat and protein %, continued to produce adequate milk solid yields.

Forage crops

HOMEGROWN forage for the M5 feedlot herd was maize and barley – double cropped for silage - plus lucerne for round bale hay or haylage. The initial M5 feedlot desktop study indicated that about 45% of the crop area should be maize + barley, and the remainder lucerne. If the crop area had been in this proportion, with good yields, the 20-cow farmlet herd's forage requirements should have been met, and there would have been a good ratio of cereal silage and lucerne forage in the diet.

Table 3 summarises the areas of different forages grown on the M5 feedlot farmlet, scaled up to the modelled 900-cow farm. On a commercial farm, there would be lucerne areas of different ages, with new lucerne planted each year and cereal crops following lucerne. This was not possible in the farmlet area, which relied on two separate areas - lucerne and the maize-barley area. This caused difficulties when the lucerne needed replanting.

TABLE 3. PERCENT and area of forages on the 209 ha cropped area of the modelled M5-style farm.

% area	ha	Forage type
43	90	Maize – barley
57	119	Lucerne

The farmlet stocking rate was 4.3 milking cows/ha of crops.

The project began with no crops, so the first crop planted was maize. The area was chosen for proximity to the dairy, but was on salt-affected soil, which proved unsuitable for maize. By the time the next maize crop was planted, the feedlot cropping area had been moved to a block of better agricultural soil. In effect, the M5 feedlot cropping area did not become operational until the second year of the project.

Maize crops were harvested in January and barley crops in September of 2003, 2004 and 2005. Crops were direct cut by contractors and ensiled in timber sided, gravel floor above-ground bunkers.

The M5 feedlot lucerne area became very grassy early in 2004, following a wet summer. So the 2003/04 maize area was replanted to lucerne in early winter; this establishment crop of lucerne yielded 12.2 tonnes/ha. The 2004 barley planted into the old lucerne area yielded 7.4 tonnes/ha, and the following 2004-05 maize crop yielded 19.4 tonnes – indicating the value of rotating forage crops with lucerne. *Table 4* presents the actual forage yields and the target yields for the M5 feedlot cropping area.

The poor maize yield in 2003-04 was due to low soil moisture at establishment, low and poorly distributed rainfall, restricted summer irrigation water, and difficulty with irrigation management.

The lucerne yield of 18.0 tonnes DM/ha in 2002-03 was from an established crop, 2003-04 was a re-establishment year, and complete records were not available in 2004-05.

Forage yields close to 30 tonnes DM/ha were achieved from double-cropped maize + barley.

TABLE 4. FORAGE yields (achieved and target) (t DM/ha) on the fully irrigated M5 feedlot farmlet cropping area.

Crop	02-03	03-04	04-05	Target
Maize	19.8	6.0	19.4	20.0
Barley	9.3	7.4	10.9	10.0
Lucerne	18.0	14.4	Na	18.0

Conserved and purchased forage inventory

WHILE yields were recorded for maize and barley grown on the M5 cropping area, forage from the M5 crop area was blended with other silage crops grown for the remaining 100+ cows in the Mutdapilly herd. Mutdapilly grows more winter than summer silage crops, so the ratio of silage fed to the M5 herd was not the same as that harvested from the M5 cropping area. The M5 feedlot herd used about 30% of the silage harvested at Mutdapilly each year.

However, the M5 feedlot lucerne was kept separate, as it was in round bales.

With no forage on hand at the start of the project, and with cropping not commencing effectively until the second year of the project, a forage inventory was developed from-

- Actual quantity of ensiled forage fed to the M5 herd. Accurate feed wagon figures were available.
- Actual yields of forage from 2002 to 2005 and average yield in 2001-02.
- Estimated losses during ensiling and feeding - from yield in the paddock to actual silage fed.
- Balancing the amount of forage grown and silage fed by budgeting for forage purchases and allowing for loss factors.

It was calculated that the M5 feedlot grew 64% of its maize/barley silage and 93% of its lucerne hay/haylage requirements over the 4 years of the project.

With the benefit of hindsight, the area of land allocated to the M5 feedlot in the desktop modelling was insufficient. In the initial model, animal requirements were conservative, no allowance was made for crop rotations and failures, and no allowance was made for respiration losses during ensiling, or wastage between harvest and intake. The figure used for losses in inventory calculations was 15%, in keeping with Top Fodder recommendations. Forage yields were less than those used in the budgets, due to dryer than average seasons and restricted irrigation.

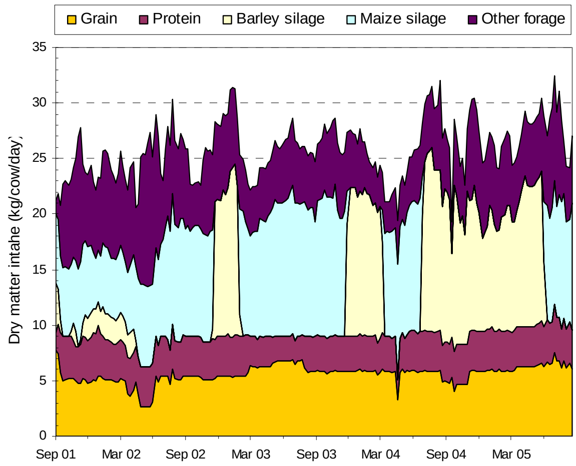
TABLE 5. QUANTITY and type of silage fed (tonnes/cow/year) to the M5 Feedlot farmlet herd and the percentage that was homegrown.

Silage type	01-02	02-03	03-04	04-05	% HG
Barley	0.4	0.8	1.6	3.0	64%
Maize	2.1	2.9	2.1	0.6	
Lucerne	2.5	1.8	1.5	1.9	93%

To meet the dry matter (DM) requirements of the M5 feedlot farmlet, crop areas needed to be expanded by 7% for lucerne and 46% for maize + barley.

Figure 7 presents DM intake of the M5 feedlot herd over the 4 years of the project. There was an increase in intake over the first 12-months. In the first 12-months, other forage – mainly lucerne – was fed at a slightly higher rate than later in the project.

FIGURE 7. FORAGE and supplement intake (kg DM/cow/day) over the four years of the project.



Milk from concentrates and forage

ESTIMATES of milk production from forage are usually made by subtracting an estimate of milk produced from concentrates from total milk production. The M5 feedlot was in the unique position of knowing total milk production and the quantities of concentrate and forage DM fed. The overall milk production response in the M5 feedlot was 1.15 litres milk/kg DM of the total ration.

Using milk production response figures of 1.5 litres/kg DM for grain, 1.2litres/kg DM for protein meals, and 1.0 litres/kg DM for conserved forages, it was calculated that 43% of milk production came from concentrate, 42% from homegrown forage and 15% from purchased forage. These figures indicate the M5 feedlot herd achieved 16,730 litres/ha from homegrown conserved forage (maize + barley + lucerne).

Fertiliser use

TABLE 6 presents the quantities of nitrogen fertiliser applied to forage areas on the M5 farmlet. Low rainfall was the main reason for lower N applications in some years.

Table 7 presents the amounts of N applied to the M5 farmlet/cow/year. By industry standards, the average N fertiliser use of 26 kg/cow/year on the M5 farmlet is regarded as low use of N fertiliser. However the quantity of N coming onto the farm through 3 tonnes of supplements/cow/year was high - 420 kg/ha or 98 kg/cow. For full benefit, all of these nutrients would need to be redistributed to cropped paddocks as feedlot manure.

TABLE 6. NITROGEN fertiliser applications (kg N/ha) for each forage type on the M5 farmlet.

Forage type	Kg N/ha applied in year			3-year average
	02/03	03/04	04/05	
Lucerne	-	-	-	-
Maize	226	203	168	199
Barley	52	61	61	58

TABLE 7. NITROGEN fertiliser applied to the M5 farmlet per cow per year.

	Year			3-year average
	02/03	03/04	04/05	
Kg N per cow	28	26	23	26

Irrigation and water use

RAINFALL over the four years averaged 680 mm/year, compared with the Mutdapilly average of 801 mm *(Figure 1)*. One megalitre (ML) is equivalent to 100 mm rainfall over 1 hectare.

The M5 fully-irrigated feedlot farmlet was designed to have 100% of the farm irrigated with an allocation of 6.0 ML/ha or 1.40 ML/cow.

Irrigation records were available for three winter-summer seasons (April to March) from 2002 to 2005 *(Table 8)*.

TABLE 8. IRRIGATION water allocation and use in the M5 feedlot.

Allocation		% allocation available		
Per ha	Per cow	02-03	03-04	04-05
6.0	1.4	97	34	73

- In 2002-03 irrigation was relatively unrestricted, and the farmlet received 97% of its total allocation.
- In 2003-04, restricted irrigation water supply and pumping difficulties limited the total volume of irrigation water to 34% of allocation; the maize crop was seriously affected that year.
- In 2004-05 irrigation use was almost back to normal, and the M5-feedlot received 73% of its allocation.

Over 3 years of data collection, the M5 feedlot farmlet received 68% of its water allocation, equivalent to 4.7 ML/ha or 0.9 ML/cow.

Effective rainfall

In calculating water-use efficiency (WUE) of forages and milk production, irrigation plus effective rainfall (rather than total rainfall) was used. Effective rainfall is the fraction of total rainfall that is available for pasture and crop growth. Daily rainfall of less than 5 mm was excluded, and only the first 50 mm of heavy rainfall included in daily totals. For crops, only 20% of total rainfall in the preceding fallow was considered effective.

Water use efficiency of forage production

WATER use efficiencies of the M5-feedlot forage crops are given in *Table 9*.

TABLE 9. AVERAGE DM yields (t DM/ha) effective rainfall (ML/ha), irrigation (ML/ha) and WUE (t DM/ML water) of the M5-feedlot farmlet forages.

Forage	Yield	Total water	Irrigation	WUE
Lucerne	13.0	10.9	5.1	1.2
Barley	8.4	2.2	1.2	3.8
Maize	19.7	5.4	2.5	3.7

The M5 feedlot maize and barley crops recorded similar water use efficiencies - 3.7 to 3.8 t DM/ML. Both crops were harvested once and conserved as silage. Barley yielded half the tonnes of DM/ha of maize. This double-crop combination of maize + barley yielded almost 30 t DM/ha. The year when the maize crop failed (6 t DM/ha) was not included in these averages

Water use efficiency of milk production on M5

THE M5 fully-irrigated feedlot farmlet produced the most milk per megalitre of water used on homegrown forage (1,830 litres/ML) under the very dry seasonal conditions experienced during the project – indicating the value of irrigation, even with reduced water allocation, *Table 10*.

The M5 feedbase consisted of water-use efficient crops such as maize and barley. Conservation – as opposed to grazing – maximised forage utilisation and minimised herbage wastage, which improved water-use efficiency.

TABLE 10. EFFECTIVE rainfall (ML/ha), irrigation inputs (ML/ha) and WUE (L milk/ML water) on the farmlets.

Farmlet	Rainfall	Irrigation	Total water	WUE
M1	5.8	0.0	6.8	1,020
M2	5.8	1.0	7.8	1,310
M3	5.8	0.4	7.2	790
M4	5.8	3.6	10.4	1,260
M5 feedlot	5.8	4.0	10.8	1,820

Concentrate feeding

THE M5 farmlet feed budget incorporated 3 tonnes of grain-based concentrate/cow/lactation (10 kg/cow/day).

The M5 feedlot farmlet aimed to use concentrates plus conserved forages as a total mixed ration to optimise milk production from forage and increase returns/ha. Increased use of energy-dense concentrates is one of the best ways to do this, within the limits of a forage/grain ratio of 60/40 to 50/50 – which is optimal for cows of high genetic merit. The average (homegrown + purchased) forage/concentrate ratio fed to the M5 feedlot farmlet herd over the 4 years was 64/36.

The concentrate ration *(Table 11)* consisted of mixed grains, sorghum, barley and wheat; cottonseed and soybean meals, and whole cottonseed, with formulation adjusted seasonally on the basis of forage nutrient content and availability and the herd's level of production and stage of lactation. The herd also received trace minerals and phosphorus.

TABLE 11. AVERAGE concentrate and forage ration fed to the M5 farmlet herd (kg DM/cow/day)

TMR ration component	M5 farmlet
Grain	5.6
Protein meal	1.8
WCS	1.6
Maize or barley silage	10.7
Lucerne hay or silage	6.1
Minerals	0.3
Total ration	**26.1**

As well as higher rates of concentrate, the M5 feedlot farmlet had a higher stocking rate than the industry average for grazed farmlets. Stocking rate for the M5 farmlet feedlot herd was 4.3 cows/ha on the whole farm.

The M5 feedlot herd was fed a total mixed ration twice a day, with no feeding in the dairy during milking. All cows in the farmlet were fed the same ration. However, in a 900-cow commercial feedlot, cows could be grouped according to production or days in milk (DIM) and fed accordingly. The net effect was that the M5 farmlet herd was underfed in early lactation and overfed in late lactation.

Managing the cost of purchased feeds – both concentrates and forages – is critical to the performance of this system. With concentrate prices increased by drought conditions during the project, high grain feeding impacted on total variable costs. Purchased concentrate costs were highest in year two (2002/03) at 12.2 c/L. However production was maintained and concentrate costs were spread over a large volume of milk. Average concentrate costs are presented in *Table 12*.

TABLE 12. THE AVERAGE concentrate mixture cost over the 4-year project for the M5 feedlot farmlet ($/tonne).

M5 Feedlot concentrate	01-02	02-03	03-04	04-05
$ per tonne as fed	272	354	267	243

Calendar of operations and farm activities

A YEARLY operational plan and farming activities is presented in *Figure 8* for the M5 feedlot herd.

FIGURE 8. A YEARLY operational plan for the M5 feedlot herd with irrigated crops conserved and fed back to the herd as a total mixed ration.

	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Calving pattern		Year-round calving pattern										
Some cows are dry												
Reproduction - AI												
Planting irrigated crops					Barley		Lucerne			Maize		
Irrigation	Strategic irrigation require throughout the year											
Harvesting	Maize								Barley			
Highest milk price		ʌʌʌ ʌʌʌ	ʌʌʌ ʌʌʌ					ʌʌʌ ʌʌʌ	ʌʌʌ ʌʌʌ			

ʌʌʌ = varies with processor supplied

Nutrient Balance on the farmlet

THE imported nutrients in grain and conserved forage need to be factored into the farm's nutrient balance – with adjustments made to the fertiliser program to account for imported nutrients, and spreading of nutrients over the farm.

A simple whole-farm nutrient-balance model was developed during the course of the project to consider the ratio between farm inputs (supplementary feeds, fertilizer) and outputs (milk, meat and forage sales) in terms of their nitrogen (N), phosphorus (P) and potassium (K) content.

Running figures for all farmlets through *The Farm Grid Nutrient Balance Model* produced the results summarised in *Table 13*.

The combination of a high proportion of lucerne in the feedbase, efficient use of N fertiliser in the maize/barley system, and a high overall utilisation of homegrown forage gave this farming system the lowest overall N input output ratio.

TABLE 13. THE units of nutrient input for N (nitrogen), P (phosphorus) and K (potassium) required to produce a unit output (2001-2005)

Farmlet	N	P	K	Description
M1	5.8	1.9	3.9	Raingrown tropical pasture some oats
M2	5.1	1.7	3.6	Limited irrigation pastures
M3	3.6	1.9	1.6	Limited irrigation forage crops and ryegrass
M4	3.1	1.4	1.3	High irrigation pastures and forage crops
M5 feedlot	2.5	1.3	1.2	Feedlot home-grown irrigated silage and hay

With respect to P, a ratio of 1.0 to 1.5, considered ideal and anything above 2.0 seen as undesirable. All systems were within acceptable limits at the whole farm scale.

K is not seen as a problem as a potential pollutant.

Other environmental considerations

Strengths

- The cut-and-carry forage system of a feedlot eliminated problems of soil compaction from grazing animals.
- A strong emphasis on fodder conservation - rather than having to meet daily animal requirements - meant forage production could 'best fit' climatic conditions.
- The forage systems used (double-crop maize-barley and lucerne) provided good ground cover and posed minimal risk in terms of nutrient and water leakage – particularly without the uncontrolled element of grazing.
- Good nutrient management was possible with a well planned, constructed and maintained feedlot.

Weaknesses

- The forage system needs to be well managed to achieve forage yield targets and efficient use of water and nutrients – to prevent soil nutrient rundown and structural decline.
- The farming system proved suited to a low-rainfall environment, with sufficient irrigable arable land to grow the bulk of forage requirements. Failure to site this system appropriately could require substantial and uneconomic engineering intervention to overcome geophysical limitations.
- Community expectations of issues such as odour, visual, noise, dust need to be met.
- Good nutrient management will not be possible unless the feedlot and feed storage facilities are well designed, constructed and maintained.

Business results

AN average milk price - based on the pricing formulae used by Dairy Farmers, Parmalat and Norco - was used in the financial and business trait analysis for all farmlets, *(Table 14)*. The difference in milk receipts between farmlets reflects varying season of supply, milk composition and volume incentives.

Dairy income includes milk receipts, livestock sales, fuel rebates and genetic incentives.

Individual dairy farms will know their average dairy income, so can make a comparison between the farmlet data and their own enterprise.

TABLE 14. AVERAGE milk receipts and dairy income for each of the modelled farmlet herds.

	M1	M2	M3	M4	M5 feedlot
Milk receipts c/L	33.3	34.1	34.6	34.9	37.2
Dairy income c/L	36.6	37.4	37.9	38.4	40.9

The 4-year average key financial indicators for each of the Mutdapilly modelled farmlets are presented in *Table 15*. All farming systems, including M5 had a positive operational 4-year average return on assets.

Business performance of the M5 feedlot farming system in the spreadsheet analysis was very good, *Table 15*, and *Table 16*. The modelled data compares favourably with the initial desktop model. The initial model used a lower milk price (27 c/L) and lower costs compared with the modelled farmlet data. The capital value of establishing the feedlot dairy was reviewed in 2003 and the revised figures in *Table 17* were used in the business trait analysis.

TABLE 17. ESTIMATED capital required ($) to establish a 900-cow feedlot dairy taken from the desktop study in 2001 and a revised estimate made in 2003.

Capital item	Desktop ($)	Revised ($)
Land	920,000	1,920,000
Buildings	1,137,000	1,637,000
Plant/equipment	437,000	937,000
Stock	810,000	1,210,000
Total	**3,304,000**	**5,704,000**

Scaling up the production results and costs of the 20-cow Mutdapilly M5 farmlet herd over 4 years, the feedlot M5 farming system returned a gross margin of $1,497/cow/year, for an average operating profit of $823/cow/year.

The financial analysis of the feedlot was on the basis of an enterprise that was 'up and running'; no payment of principal – only interest – was included.

TABLE 15. BUSINESS traits and KPI's of the five modelled farming systems averaged over the 4 years of the project.

BUSINESS TRAIT SUMMARY	M1	M2	M3	M4	M5
Liquidity					
Dairy cash surplus ($)	20,757	63,146	149,852	192,817	518,213
Interest costs per cow ($)	155	155	159	162	150
Solvency					
Equity %	57%	60%	60%	65%	64%
Liabilities per cow ($)	2,216	2,217	2,267	2,312	2,141
Profitability					
Change in Net Worth per year ($)	56,995	30,281	46,372	40,510	89,483
Return on Assets % (operational)	0.7%	2.8%	6.3%	6.6%	13.9%
Return on Assets % (Capital+operational)	7.7%	7.0%	9.6%	11.1%	18.0%
Return on Equity %	-4.1%	-0.1%	5.8%	6.4%	17.7%
Operating profit ($/cow)	40	158	358	436	823
Efficiency					
a) Capital efficiency					
Asset turnover ratio %	44%	45%	46%	43%	64%
b) Financial efficiency					
Feed related costs (c/L)	17.8	17.9	15.8	15.9	16.8
Forage costs (c/L milk from forage)	7.5	7.6	7.0	9.6	10.4
Margin over feed related cost (c/L)	18.9	19.5	22.1	22.5	24.1
Gross Margin per cow ($)	640	747	950	1,128	1,497
c) Physical efficiency					
L / cow / year	6,148	6,534	6,871	7,395	9,182
L / hectare	11,491	17,779	9,304	20,541	39,492
Litres / labour unit	551,719	672,050	618,367	665,526	883,815
Cows / labour unit	90	103	90	90	96

TABLE 16. BUSINESS traits and KPI's of the initial desktop model and the 4 years of the farmlet study of the M5 feedlot modelled farming system.

BUSINESS TRAIT SUMMARY	Desktop	2001-02	2002-03	2003-04	2004-05	Average
Liquidity						
Dairy cash surplus ($)	106,218	586,400	579,624	204,141	702,685	518,213
Interest costs per cow ($)	150	150	150	150	150	150
Solvency						
Equity %	42%	63%	64%	64%	65%	64%
Liabilities per cow ($)	2141	2141	2141	2141	2141	2141
Profitability						
Change in Net Worth per year ($)		41,450	72,863	105,116	138,503	89,483
Return on Assets % (operational)	11.6%	15.1%	15.1%	8.0%	17.1%	13.9%
Return on Assets % (Capital+operational)		18.8%	19.1%	12.4%	21.8%	18.0%
Return on Equity %	27.8%	19.9%	19.7%	8.6%	22.6%	17.7%
Operating profit ($/cow)	425	879	885	480	1046	823
Efficiency						
a) Capital efficiency						
Asset turnover ratio %	80%	61%	71%	59%	64%	64%
b) Financial efficiency						
Feed related costs (c/L)	12.4	14.5	18.6	18.9	15.1	16.8
Forage costs (c/L milk from forage)		8.1	9.9	13.7	9.8	10.4
Margin over feed related cost (c/L)	18.8	26.4	23.2	21.3	25.6	24.1
Gross Margin per cow ($)	895	1573	1565	1148	1702	1497
c) Physical efficiency						
L / cow / year	9,405	8,654	9,866	8,736	9,472	9,182
L / hectare	36,803	37,221	42,434	37,574	40,738	39,492
Litres / labour unit	905,309	832,999	949,668	840,896	911,699	883,815
Cows / labour unit	96	96	96	96	96	96

COMPANION FARMER EXPERIENCES

THE M5 project assessed the real expansion opportunities and implications for subtropical dairy farms by involving 22 commercial farms as Companion Farms to the project. The 6 farms in northern NSW, 9 in coastal southeast Queensland, 5 on the Darling Downs/South Burnett, 1 in central Queensland and 1 in north Queensland represented a broad cross-section of Australia's subtropical dairy farms – in terms of location, herd size and farming style.

With continued dry weather across the industry, more farms are using partial or total mixed rations.

Several companion farms have been producing milk from smaller scale semi-feedlot and full-feedlot farming systems during the project period.

Similar to the 900-cow feedlot simulated by the Mutdapilly M5 feedlot herd, companion farmers' experiences have included:

- An increasing culling rate for reproduction and mastitis.
- A need for a higher level of cow management.
- High sensitivity to input prices, such as grain.
- Increasing costs of building infrastructure.
- Inability to produce sufficient profit to adequately fund skilled labour.
- Difficulty in maintaining environmental sustainability with increased cow numbers on a small area of ground.

Companion farm comments were:

Location is important. For cow comfort and environmental management; for sufficient reasonably-priced arable land to grow forage; for proximity to purchased fodder and grains; and for access to reliable and adequate irrigation water supplies.

Efficient use of water. The cropping system used in the M5 feedlot system is an efficient user of water. Demand for a large quantity of forage indicates that a reliable water supply is essential. Few water supplies are proving reliable in dry conditions.

Feedlot size and economy of scale. Because of their capitalisation, newly-established feedlot dairies tend to have tight margins, and therefore require a large scale for economic viability. Queensland milk processors have slightly different payment systems, but average prices are within 1 to 2 c/L.

In the years since deregulation, many existing dairy farms have developed into smaller-scale feedlots 'by default' to handle dry conditions and increased use of conserved forages. These smaller-scale feedlot dairies, managed well, have proved successful in sub-coastal environments.

Environmental pressures. Under feedlot conditions - especially close to urban and non-farming areas - infrastructure and management needs to be sufficient to prevent odours and sights that are likely to attract negative attention. Nutrient movement needs to be restricted within the farm boundary.

Permits and approvals are needed. For large feedlot dairy farms, the approval process for permits from a range of authorities can add at least 12 months to the set up phase. Building up an existing dairy business into a feedlot is likely to be less difficult than starting from scratch, in many shires.

Family lifestyle pressures. Pressures can be magnified as the size and risk of the enterprise increase.

More complex labour requirements. As the size of the enterprise increases, several labour units – with specialised skills and different areas of expertise and responsibility – tend to be required in a large feedlot dairy. Regular time off for the owner-operator and family is important for a sustainable family enterprise.

Good staff management skills. Different management skills are required as labour units are increased – including delegating responsibility; providing access to training; incentives based on productivity and performance. Regular and open communication is essential. Workplace health and safety needs to be addressed.

CONCLUSIONS AND RECOMMENDATIONS

Key risk factors for feedlots. These include milk price; location; accurately budgeting the cost of setting up; obtaining permits and approvals; building infrastructure and project management; herd issues – purchase, management, health and reproduction; labour management, skills and training; feed costs and contingency plans; phasing and sizing in establishing a large feedlot.

Milk price. During the project establishment period, the project team assumed a premium for milk volume; however this has not proved to be a consistent market signal in the region. With higher-than-estimated feed costs, the lesson learned was that a feedlot established from scratch was unlikely to be profitable at less than 35 c/L. At the project outset, the predicted average milk price was 30 - 32c/L. The 2004-05 QDAS report showed an average milk receipt of 34.9c/L, with indications for further increases.

Location. There is general industry consensus that the preferred site for a large-scale dairy feedlot is on the Darling Downs. Land price, availability of sufficient arable flat land, access to grain and water, lack of urban pressure, lower humidity, and being tick free are positive aspects.

While construction of a large feedlot dairy is not recommended east of the dividing range, dairying utilising free-stall barns could be worth investigating.

On existing dairy farms, the lesson is to incrementally move towards the most sustainable and profitable system for your resource base – such as feed, water, humidity – and to not move away from a system that suits the location.

Permits. Obtaining the necessary approvals and permits across a range of government departments can be very slow and involved, and needs to be thoroughly checked before purchasing a potential property or starting building. Delays can cause difficulties in making suitable purchasing arrangements and meeting cash flow and repayment requirements.

Budgeting. An accurate budget and realistic prediction of cash flow is critical in setting up a feedlot. The capital cost of setting up a feedlot is estimated to be $5,000 to 8,000/cow for land, infrastructure and livestock, with the cost decreasing per cow as numbers increase. The reason that the majority of dairy farms are not feedlots is the high capitalisation required for setup.

Purchasing stock. It is recommended to buy heifers rather than cows if possible. The rationale is based on culling rates; it is generally accepted that 40% of cows are culled, but only 20% of heifers will be culled before they have a second calf in the herd.

Realistic feed-year plans. Forage production and inventory management need to be of a high standard and allow for contingencies and partial crop failures. For example, due to lack of irrigation water, the 2003-04 Mutdapilly maize crop was very low yielding (6.0 tonnes DM/ha). As a consequence maize forage needed to be purchased (from elsewhere on Mutdapilly). Some barley and lucerne forage also needed to be purchased to maintain the forage inventory. The lucerne area was affected by the wet February and March of 2004, and needed to be replanted, leaving a period when no lucerne was produced.

A large feedlot requires sufficient stored forage to maintain a feed bank ahead of predicted usage.

Make sure allowance is made in feed budgets for losses from harvesting to intake. Minimising losses can quickly pay for the cost of installing good feed troughs.

The cost of forage is the main limiting factor to feedlot profitability. Do a sensitivity analysis on buying in feed vs. homegrown feed. There is likely to be an increased cost to bringing in feed, but decreased workload.

The project showed that it is possible to grow 30 tonnes DM/ha via a double crop of irrigated barley/maize.

High standard of nutrition management. Milk production per cow in the M5 farmlet herd was close to budget. A commercial feedlot is likely to run several herds based on level of production or days in milk. Each herd could be fed a different mixed ration.

Dry cow management was difficult in the M5 farming systems project. Dry cows lost liveweight when moved from the feedlot herd to the general dry-cow herd.

Extended periods of hot weather in January and February will reduce dry matter intake and milk production, and animals take months to recover. In the summer of 2005 when feedlot sprinklers were installed, both feed intake and milk production increased at Mutdapilly.

Herd health and cow management. Large herds require an increased level of management and skills in animal health and reproduction. Animal health prevention and treatment costs can be higher. Udder, feet and leg issues are likely to increase under intensive feedlot conditions. A computerised herd management system is crucial.

Herd dynamics. Obtaining the number of budgeted lactations per year is an important economic consideration. The feedlot farmlet herd had the highest budgeted replacement rate of 33%. The herd also faced similar problems to other farming systems in retaining a spring calving batch for even year-round production, with difficulty getting cows in calf during the summer mating period.

Required skills. The owner-operator of a large feedlot needs to be multi skilled – in business, herd and forage management – or needs to employ staff with these skills.

Irrigation water. How important is water for feedlots? Could you run a feedlot without irrigation? If you have a large area of cropping land, long-term silage pits, and reliable stock water, a raingrown forage feedlot could be viable.

Irrigation can mean more flexibility, but can add more risk and higher forage costs. Setting up a feedlot dairy in a cropping area allows for homegrown grain, silage and hay and access to contract harvesters, plus access to locally-grown forage and grain.

The benchmark water-use efficiency for homegrown forage from grazed dairy farms is 1,100 litres of milk per megalitre of water for raingrown farms and 1,400 litres/ML for fully irrigated farms. The feedlot farmlet was a full cut and carry system and the maize and barley were single cut crops. As a result the feedlot farmlet achieved 1,800 L of milk/ML of water, which was higher than the grazed farmlet benchmarks.

The most water-use efficient single-cut cool season forage was barley (1.9 tonnes DM/ML). The best double-crop combination in terms of yield/ML of water was maize/barley (2.7 tonnes DM/ML).

Total Variable Costs. Scaled up, the Mutdapilly feedlot farmlet had an average total variable cost of 24.6 c/L, compared with an initial budget estimate of 21.8 c/L. The costs were increased by higher requirements for purchased forage and higher feed costs due to extended drought. The project found that it was not possible to get feed costs consistently below 20.0 c/L for a feedlot.

The experience of the Mutdapilly farmlet indicates the likely tight margins of feedlot dairying at export-equivalent milk prices.

Key economic parameters. Cow numbers, milk production and number of lactations need to be 'spot on' to make a high-risk large feedlot farming system work.

Transition phase – between set up and being in 'full swing'. In the Mutdapilly herd, production per cow increased from 6,500 to 9,000 litres/cow/year in the first 12-months. Lower cash flow in the early stages necessitates access to an overdraft or substantial cash reserves. As herd numbers and production increase in years 2 and 3, there is corresponding greater requirement for feed supplies and effluent management.

With improved diets, feedlot cows gain weight in the first lactation and production subsequently increases in later lactations.

Work your assets. In large feedlot herds, there is potential to work the milking shed like a factory, milking nearly 24 hours a day with split herds. In the initial phases of a build up, it may be important for financial reasons to use the existing milking facilities to maximum capacity before committing funds to an expensive milking parlour.

Labour and staff. Employing casual labour for milking has proven successful. Skilled people are still required to oversee herd health and calf rearing, with 90-100 cows/labour unit an achievable target

Using contractors for paddock work and for harvesting and conservation should be considered.

Environmental considerations. Continued sustainable use of a feedout area requires some investment to manage manure, reduce feed wastage and provide shade. Feedlot manure is a valuable nutrient resource for cropping land.

Flexibility. Industry experience suggests using a partial mixed ration is a profitable and manageable alternative for many farms in the region – with grazing during periods of good forage/pasture availability, and silage-based mixed rations on a feedpad during periods of forage shortage. Depending on calving season, the combination might be grazing temperate species during winter/spring and full or partial feedlot during summer/autumn.

M5 INFO SERIES

THE M5 Info series will provide dairy farmers and the industry with a wide range of information from the *Sustainable dairy farm systems for profit* project.

M5 Info Series - 054 - Small-scale feedlots, up to 150 cows will be available shortly. Other topics in the M5 Info series are available at www.dairyinfo.biz on the home page look under,

- Information Databases
  - Dairy Farming - information handbook
    - Industry projects
      - M5 Farming Systems
        - M5 Info Series (New)

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The *Sustainable Dairy Farm Systems for Profit* project at Mutdapilly Research Station and on associated commercial farms investigated the potential impact of intensification of five subtropical dairy farming systems on business productivity, on the social well being of farming families and on the farm environment.

A project of this scale and time period involves the input of a large number of people. The authors acknowledge the valuable contribution made by Roslyn Arthy, Glenn Bake, Dave Barber, Ian Buchanan, John Cooper, Tom Cowan, Niilo Gobius, Geoff Hetherington, Sarah Kenman, Teresa Kunde, Kevin Lowe, Scott Lowe, Mal Martin, Richard Moss, Katrin Mueller, Che Murray, Warren Orr, Gordon Simpson, Tricia Skele, Helen Todd, Lex Turner, Warwick Waters, Rory Watson and Mutdapilly administrative and operational staff.

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