Managing the transition from pasture to housing- the New Zealand experience

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The New Zealand dairy system is based on grazing grass throughout the year, with only limited use of supplements (principally palm kernel extract alongside hay and maize and grass silage). This can be achieved by seasonal calving in late winter/early spring alongside drying off in autumn when grass growth slows.

Dairying in New Zealand has therefore, traditionally, been a low input, low cost enterprise based on cheap feed – grazed grass. Maximising grazed grass is the key management role for farmers on New Zealand dairy farms – this is reflected in kgMS/Ha being the key economic benchmark for between farm comparisons. However, the situation is changing with an increasing number of farms becoming more reliant on supplementation, and more farms using off-paddock systems both covered and uncovered

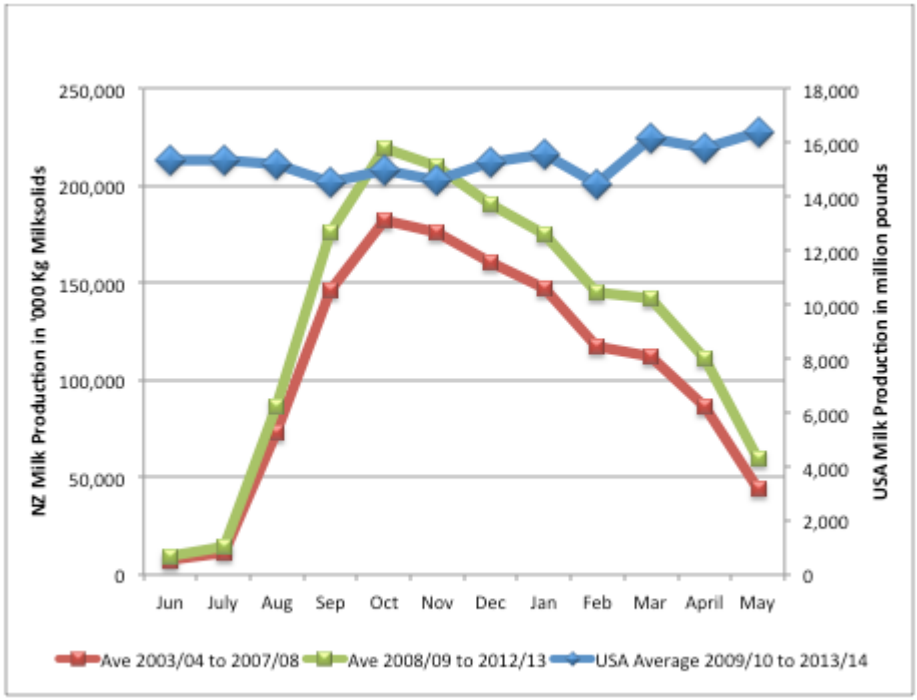

Fig 1: Seasonality of milk production (kg milk solids [MS]) in New Zealand (compared to US data). (From **http://tinyurl.com/NZ-milk-production)**

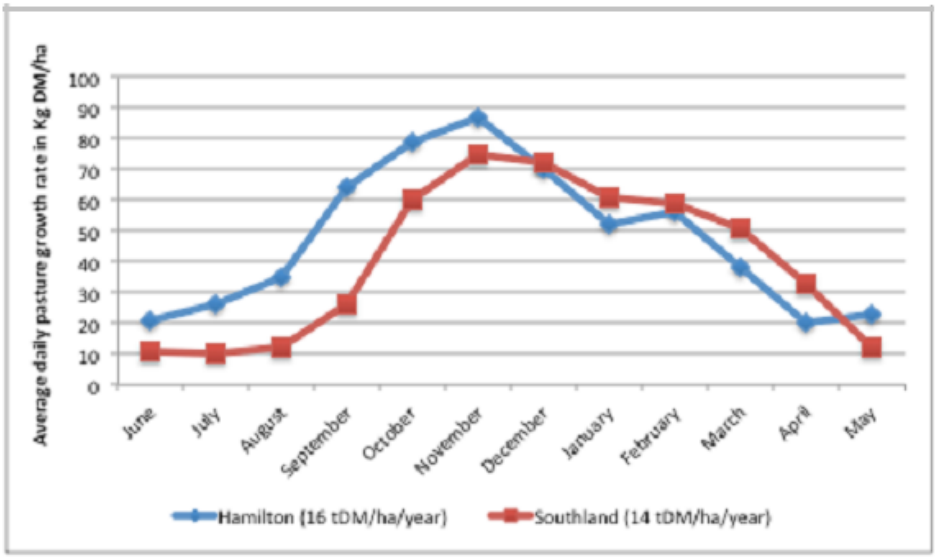

Fig 2: Grass growth rates on New Zealand dairy farms: Comparison of North Island (Hamilton) and South Island (Southland) farms. (From **http://tinyurl.com/NZ-milk-production**

The drivers of change:

1) Environmental degradation

Dairying in New Zealand has a detrimental effect on the environment, particularly when compared to other pasture livestock such as sheep. Water quality is a key issue with dairying producing significant amounts of excess nutrients, especially nitrogen (N) and phosphorus (P), that leach or run off into waterways. Environment New Zealand reported in 2007 (**http://tinyurl.com/environment-new-zealand-2007**) that 39% of monitored groundwater sites in New Zealand had nitrate concentrations greater than natural background levels, indeed in some water sources nitrate concentrations exceeded the drinking water standard of 11.3mg/L.

The increasing environmental impact of dairy farming in New Zealand has been driven by conversion of non-dairy farmland (particularly sheep) to dairy farms and by increased stocking density on dairy farms (from 2.10 cows/ha in 1982 to 2.87 cows/ha in 2013. So we have more cows on more land and less land per cow.

Keeping animals off pasture, particularly at critical periods in spring and autumn, can significantly reduce N and P leaching and run off (Christensen et al 2012); thus increasing environmental restrictions by regional councils have led to many farmers exploring the possibility of reducing grazing time, either by standing off cattle on uncovered areas or by building proper cow housing.

2) Welfare perception

Dairying in New Zealand has a 'clean, green' image. This is because of the perception that cows outside grazing is 'natural', that cows want to be outside

and that pasture is the most suitable place for a cow to be.

However, the expansion of dairying across New Zealand, especially the south of the South Island has meant that cattle are now kept in areas with cold winters where pasture growth is often insufficient to provide maintenance for dry cows (see Fig. 2). Alternative crops, particularly fodder beet, turnips, swedes and other brassicas, are now commonly used. Cattle graze on these leaving bare muddy paddocks. Particularly in wet conditions when farmers are trying to protect pasture from pugging, cattle are kept on these crop paddocks for prolonged periods of time. This further churns up the paddock increasing the muddiness of the paddock and dirtiness of the cows. Cow comfort is compromised as cows are reluctant to lie down, but there is very limited evidence of what the long term effect of this management strategy is.

Nevertheless, cows in mud up to their hocks is not a good 'look' and public perception is generally negative. Housing cows or using well-managed covered stand-off facilities avoids this problem, so some farmers particularly in Southland (the southernmost region of the South Island) have been building stand-off facilities in order to 'improve' animal welfare

3) Productivity

The New Zealand system, because it is based on grazed grass, is very dependent on land price. On most farms if you want to increase herd size (and thus farm income) you need to increase farm size. However, the move to dairy has meant that land prices have risen significantly more than the milk price; using inflation adjusted figure the current average price per hectare of dairy land (NZ$35 000) is 2.5 times what it was 20 years ago, whereas even in the boom year of 2013 the inflation adjusted milk price was only 50% higher than the average price in the late 1990s (and for the last two years it has been lower than that seen in that period) [Data from http://tinyurl.com/DairyStatistics-2013-14]

Although the New Zealand dairy cow produces only around 400 kgMS/year (equivalent to ~4500 L), it has the capacity to produce over 700 kgMS. Thus increasing the yield per cow is a potential alternative way of increasing income without purchasing expensive additional land. More effective use of pasture alongside better quality (higher ME) pastures can increase income cow, but supplementary feeding with non-pasture feed results in a much greater impact on yield.

In pasture-based systems, significant amounts of supplement cannot be fed at pasture, because the losses are too high. Thus increased supplements are usually fed on a feed pad or, increasingly, in a housing system.

These three factors, combined with a relatively high milk price in the first three years of this decade have resulted in a marked increase in the proportion of farms designated as 'high' input (i.e >20% of feed input purchased (see Fig 3); ; this has resulted in many farms developing additional facilities for feeding/standing off or housing cattle.

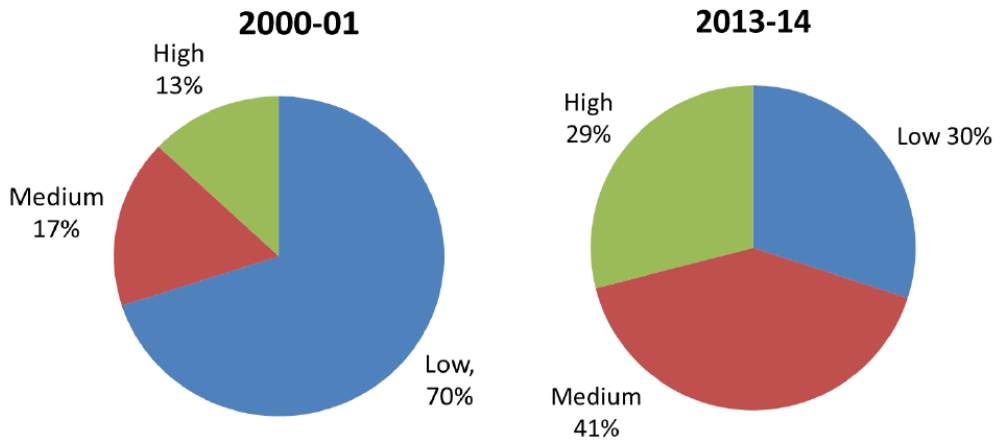

Figure 3: Change in system in New Zealand dairy farms. High: >20% of feed purchased; medium: 10-20% of feed imported, fed to milking and dry cows; low: feed may be imported (<15%) but fed only to dry cows.

How many are there?

A recent DairyNZ survey found that 24% of farms had an off-paddock facility (~2900 farms). Over 80% of these are uncovered facilities. The proportion of farms with an off-paddock system in each region is summarised in Fig. 4.

The most common such facility is the feed pad (accounting for 52% of all off-paddock facilities) – a feed pad is a defined hard surface area (usually concrete) where water and supplementary feed can be provided. It is not intended as a place for cows to lie. Stand-off pads (constructed of free-draining material, such as sand or woodchip, on a sealed surface) are the next most common facility (22%). In contrast to feed pads, these are designed to provide a lying space for cattle. The final uncovered facility is wintering (self-feed) pads; these are simply areas of material, such as woodchip which are laid directly on to pasture; these are used by about 7% of farms which have off-paddock facilities

In contrast, covered facilities are much less common. They can be divided into three categories: i) loose housing with bedding (such as woodchip) (6%); ii) loose housing with concrete floor (10%) and iii) cubicle (free stall) housing (2% - ~60 farms).

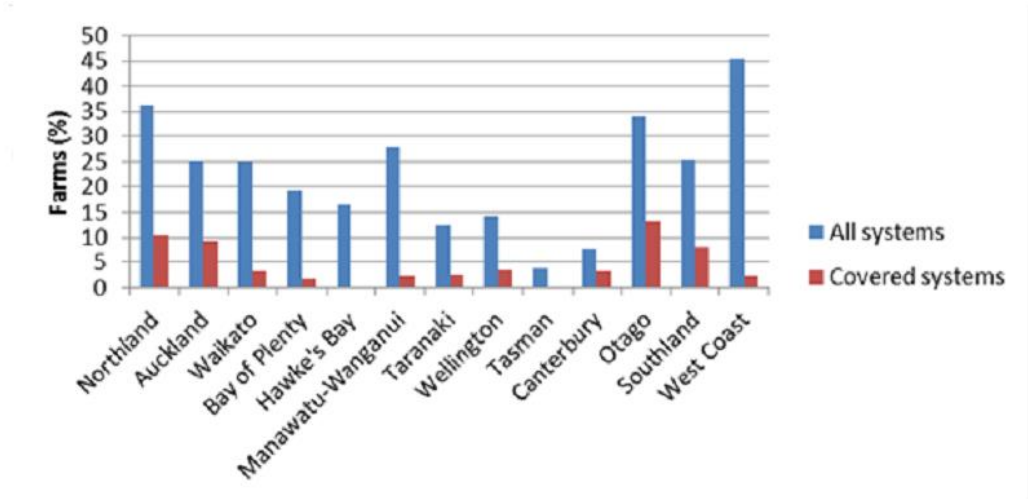

Figure 4: Comparison between regions in proportion of farms with off-paddock facilities. Note from left to right you go from north of North Island (sub-tropical) to south of South Island (cold temperate)

How are they being used?

The principal use of off-paddock systems is in protecting pasture during winter and spring. Thus, as for covered facilities, the majority of use of facilities occurs between May and September (Fig 5). Interestingly, despite being the most expensive covered system, the utilisation of cubicle yards (stalls) is significantly less than that of loose yards, particularly outside of the winter period.

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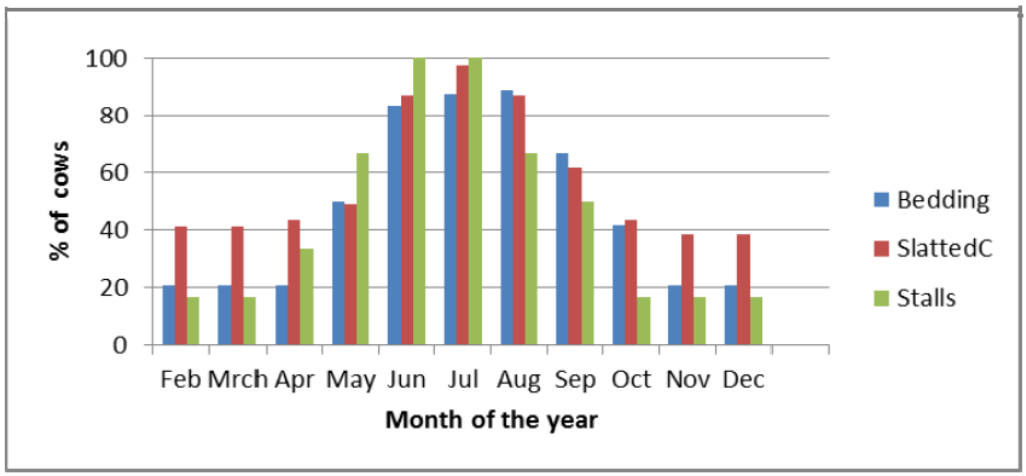

Fig. 5: Timing of the use of covered facilities (winter is Jun-Aug; spring is Sept to Nov).

The use of uncovered facilities is a lot more ad-hoc and weather dependent and therefore more variable, so a similar graph cannot be produced.

Nevertheless the proportion of time spent on such facilities mirrors the use of covered yards.

What are the key cow comfort issues?

In uncovered facilities the key issues are lying times and comfort while lying. These two factors are strongly linked. Before the development of off-paddock systems, pastures were managed by keeping cows on tracks (which link paddocks with the milking parlour) or by developing sacrifice paddocks, which work by restricting severe pasture damage to a small proportion of the grazing platform.

Neither of these is a suitable solution to the problem of pasture damage. Compared to lying times on a clean woodchip pad with good drainage, lying times on a track way and a small sacrifice paddock were significantly lower (11.9 h/day vs. 5.7 and 6.9 h/day respectively) (Fisher et al 2003) Keeping cows on concrete (i.e. keeping cows on a feedpad with concrete base) also reduces lying times (7.0 h/day; Fisher et al 2003). The difference was even greater on commercial farms. Stewart et al (2002) reported mean lying times of 11.3 h/day on woodchip compared to 2.9 and 4.1 h/day on concrete and trackways, respectively. These findings have resulted in the New Zealand code of welfare recommending: "After standing on concrete surfaces for 12 hours or more per day, for more than three consecutive days, cows should be given at least one full day on a suitable alternative surface, where they are free to lie down and rest." However, the same document states that "the welfare of cows for which lying is restricted to four hours each day, for up to four continuous days, is compromised"; a target which was not exceeded even in animals kept on concrete in the study reported by Fisher et al (2003).

So the situation in New Zealand is currently vague, with most of the emphasis placed on avoiding keeping cows for more than 3 days on concrete even though lying times in sacrifice paddocks can be just as short.

The use of these alternatives reflects the focus of the New Zealand dairy farm on pasture management rather than cow comfort, even though the evidence that pasture productivity is better when these alternatives are used is very limited. This is particularly so for 'sacrifice paddocks' which as well as sacrificing the paddock, 'sacrifice the cows and future productivity' (Ian Lean, personal communication).

So alternatives are needed to keeping cows on wet winter paddocks. However as Fisher et al (2003) shows, these alternatives need proper planning and simply using existing tracks or feed pads does not result in a satisfactory solution. The lying times reported by Fisher et al (2003) for woodchip stand-off pads are acceptable; however these are only achieved in situations where cows kept on the stand-off pads for short periods of time. Prolonged use, particularly in wet conditions (which is when they are going to be used) leads to markedly reduced lying times (to as low as 2h/day; Longhurst et al 2013) as the woodchip surface becomes converted to mud. Lying times can be maintained by regular application of woodchips onto the pad, but this is expensive and most farmers are reluctant to do this.

The data thus suggest that uncovered off-paddock systems are either unacceptable except for very short periods of time (<12 hours) (feed pads or trackways) or acceptable for periods of up to but no more than 3-4 days (woodchip yards). This is reflected in the results of a survey of New Zealand dairy farmers using such facilities; all the farmers with a concrete surface that reported health problems had cases of lameness, compared with 71% of farmers using concrete in combination with another system and 25% using woodchip pads (Stewart et al 2002). However, mastitis was much more commonly reported by farmers using woodchip pads – probably because cows actually lay down in these yards!

If topping-up of pads is not going to be used then the only feasible alternatives to pasture are covered yards as the covering protects the bedding from the elements. However, loose housing currently accounts for <1/2 of the housing on farms. By far the most common covered system is the loose house where the floor is slatted concrete. One of the company's manufacturing and selling the housing have claimed that a 'greenhouse effect' dries the faeces and provides a more comfortable bedding than would otherwise be the case. However, the author's personal experience is that, unsurprisingly, the thin layer of dry faeces does not provide a comfortable lying surface. Some farmers, particularly when housing late dry cows do use additional bedding (usually straw) but the amounts used are often very small by international standards, principally because of the cost of the straw.

There are limited published data on lying times in loose house with concrete flooring; but on commercial farms mean lying times are ~8 h/day, but there is significant individual variation and a high proportion of cows (63%) had lying times below the 8 hour figure (Dalley et al 2012). Further research is ongoing but it is likely that such houses are best used as a high quality feedpad rather than a 'cow house', with the same restrictions applying to them as for non-covered concrete feed pads.

Covered bedded loose housing would seem to be an attractive alternative to non-covered pads and covered slatted concrete floors. However, they do require significant management, especially when stocking density is <9m^2/cow , which is very common on New Zealand farms as the recommendations are that 5m^2/cow is sufficient if cattle are only housed for short (undefined) periods of time (Stewart et al 2002). However even when stocking rates are 8.6 m^2/cow prolonged use of covered woodchip yards without effective replenishment of the bedding leads to significantly reduced lying times (Davison et al 2015). So the same issue apply to covered woodchip yards as to uncovered ones, in that there is resistance to taking the time required to effectively manage the yards and to ensuring that the quality of the bed is maintained by continuously replenishing the woodchip. Further research is required to evaluate the optimal method of management of covered woodchip on New Zealand dairy farms, bearing in mind that they are going to be used for shorter periods of time than covered housing on Northern Hemisphere farms.

This leaves cubicle (free stall) housing. Currently there are very few farms with this type of housing. The main drawback is the cost which is ~$5000/ cow space. These high costs, combined with limited understanding of cow house construction by the local building industry means that there is constant pressure to reduce costs by altering the design of a house. This often results in poor quality housing, particularly in terms of cow comfort. Changes include 3-row rather than 2-row cubicles, reducing water troughs and feeding space, and eliminating passageways between cubicles, so that cows in the middle of the house have to walk to the end to get access to the feed passage. There is also a focus on reducing costs and time when managing the building. This means that sand bedding, even though it provides significant cow comfort is unpopular, and perhaps more importantly bedding on top of mast/mattresses is not commonly used. These changes mean that many of the cubicle houses would be substandard if in Europe or North America. However, the limited use of these buildings may mean that their impact is less than it would have been if cows were permanently housed during winter. For example, hock injuries (a simple measure of cubicle comfort) have been much higher this year in the housed cows at Massey university (35% affected, mean longest diameter <1.5 cm; author, unpublished observations). The cubicles are no more uncomfortable this year than in previous years; the crucial difference is that in the winter/spring of 2015 cows spent >80 days indoors whereas in previous years this was <40. The hybrid pasture-housed system allows cows to recover from housing problems, therefore reducing the impact of poor housing on cow health and welfare. However, this may not always be the case if poor housing is combined with poor management at pasture (such as long distance walked, pressure on cows on poor tracks, poorly designed collecting yards), then it is quite possible that the two systems could interact to make cow health, especially lameness, much worse.

Conclusions

Changes in dairying in New Zealand have meant that managing cows exclusively at pasture all-year-round is no longer the standard system on many farms. In particular, managing cows at pasture in winter and early spring has become a problem, especially on farms with high sticking rates or on farms in the south of New Zealand. This has meant that more farms are using off-paddock facilities; however there are no simple options. Uncovered facilities are not suitable for anything other than short term use, while covered facilities are more expensive and, if not managed effectively, may have similar impacts on welfare to uncovered ones. The key to good management is changing the focus of the New Zealand dairy farmer to manging the cow rather than the pasture. However this is likely to be difficult because even in intensive systems efficiently grazing grass is likely to stay a major driver of profitability. Thus increased use of housing requires staff to be able to manage pasture and cows; this will require significant focus and training.

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