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Individualised supplementation of grazing cows – how does it stack up?

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Key Findings

- ***A review of recent scientific literature in this area found no evidence that individualised feeding improves the milk production response to supplements or profitability compared with flat-rate feeding.***
- ***A modelling study using the DairyNZ Whole Farm Model compared a range of commonly used individualised feeding criteria with flat-rate feeding. The results indicate no benefit over flat-rate feeding.***
- ***An on-farm experiment found no difference in the milksolids response to supplement feeding when comparing flat-rate feeding and individualised feeding according to milk yield.***
- ***Farmers may identify operational benefits of individualised feeding, such as offering additional feed to low BCS cows within a herd, rather than managing separate mobs, but need to consider whether these benefits outweigh the additional investment cost.***

The use of in-shed feeding systems within New Zealand has increased, with the aim of improving feed utilisation and labour efficiency and providing equal availability of feed to all cows. The inclusion of individualised feeding capability takes supplement feeding a step further, allowing cows to be fed individually or in groups according to pre-defined criteria, such as individual cow milk yield.

The concept of individualised feeding is based on the theory that it is more efficient to feed more supplement to cows that have a greater potential response and less to other cows. While this theory sounds feasible, in practice there has been little, if any, evidence of value in individualised feeding in a grazing situation compared with flat-rate feeding.

A project funded by the MPI's Sustainable Farming Fund and DairyNZ Inc. recently investigated the potential benefits of individualised feeding compared with flat-rate feeding of concentrate supplement. The project examined the current individualised feeding practices of New Zealand farmers, reviewed international literature, modelled the potential value of a range of individualised feeding options, and assessed the value of a commonly used individualised feeding strategy in an on-farm experiment.

Current use of individualised feeding

In-shed feeding systems are currently installed in around one third of New Zealand dairies[1]. The majority of these systems deliver equal amounts of concentrate supplement to each cow. This is often referred to as flat-rate feeding. However, around a quarter of in-shed feeding systems (7% of all New Zealand farms) are capable of feeding cows individually (individualised or differential feeding). Individualised feeding requires an electronic identification (EID) system, to identify individual cows in the bail, herd management software and a process controller to regulate how much supplement is allocated to each cow. The proportion of feeding systems that are capable of individualised feeding is likely to increase as EID systems become more common and farmers invest more in animal monitoring technologies (e.g. milk meters, automated weighing systems) that enable the feeding of cows individually or in groups according to pre-defined criteria, such as weekly changes in milk yield or liveweight.

The practices and perceptions of farmers using individualised feeding systems were examined in a scoping study. Farm advisors were also included. The most common motivations for installing these feeding systems were to; improve herd productivity (80%), reduce feed costs (56%) and manage body condition score (56%). Two-thirds of respondents had used their individualised feeding system to feed cows as members of distinct groups, while one third used the system to feed cows as individuals. Criteria for determining the amount of supplement to allocate to individuals or groups were most commonly based on; milk yield (58%), breed (50%), age (50%), liveweight (42%), stage of pregnancy (40%) and BCS (37%), and these depended upon the stage of lactation.

Farmers surveyed generally believed that individualised feeding provided additional value compared with flat-rate feeding; however, it is difficult to quantify this on commercial farms. Farm advisors interviewed considered that there was limited farmer knowledge in the profitable use of these systems, a lack of advisor capability in this area and inadequate after-sales support by technology suppliers. This is compounded further by the influence of feeding strategies commonly used in housed systems overseas and a lack of recent research on the potential benefits of individualised feeding in pasture-based dairy systems.

International individualised feeding research

A recent review specifically investigated the likely benefits of individualised feeding strategies relevant to rotational grazing management systems in which pasture tends to be slightly restricted[2]. The review identified Australian research comparing flat-rate feeding of a commercial dairy pellet (5.0 kg/cow per day) with individualised feeding of the same pellet based on cow milk yield (range 3.0–7.0, average 5.0 kg/cow per day), when grazing a limited allowance of lucerne[3]. The results indicated a 3% increase in milk yield and a 7% increase in milk fat and protein yield in the individually fed cows. However, a limitation of this study was that maize silage was fed as an additional supplement (target 7.2 kg DM/cow per day) and may have influenced the milk production response between the herds[2].

More recent research from Ireland[4] compared flat-rate with individualised feeding of concentrate supplement, where cows were group fed according to milk yield. The cows were managed in a loose housed barn and fed an individual allocation of grass silage and maize silage as a base feed. Two supplement feeding levels were used. Flat-rate fed cows received either 4.0 or 7.0 kg DM/cow per day and cows that were group fed according to milk yield received between 2.3 and 5.7 (average 4.0) kg DM/cow per day or between 5.3 and 8.7 (average 7.0) kg DM/cow per day. No significant difference in total dry matter intake, milk yield, milksolids yield, or energy balance was reported when comparing flat-rate and individualised feeding. A similar study was conducted in the UK[5], but with grazing dairy cows. In this study, cows were allocated pasture under rotational grazing management over 122 days and offered concentrate supplement at either a flat-rate or according to milk yield. The same total amount of supplement was fed daily in each feeding strategy. The amount of supplement offered was adjusted five times during the study according to available pasture, with daily supplementation ranging from 1.5kg to 5.5 kg for the flat-rate fed multiparous cows, (1.0 - 2.5 kg and 1.0 – 10.0 kg for feed-to-yield). The study concluded that allocating concentrate supplement in a pasture-based system using a feed-to-yield strategy as opposed to a flat-rate strategy had little effect on animal performance when pasture was relatively unrestricted (grazing residuals ~6 cm).

In summary, international research relevant to New Zealand's rotational grazing management does not support the practice of individualised feeding in place of flat-rate feeding. Further research was recommended to better understand the potential of individualised feeding compared with flat-rate feeding, when cows are marginally feed-restricted in a rotational grazing system typical of New Zealand dairy farming.

Modelling individualised feeding strategies

The use of a range of individualised feeding criteria was compared with flat-rate feeding using the DairyNZ Whole Farm Model (WFM) to identify potential for an improved response to supplement. Modelling simulations were undertaken for Farming Systems 3, 4 and 5 over five consecutive years and replicated with ten herds, where all herds received the same total amount of supplement.

Herds in the WFM simulations were either flat-rate fed (3kg DM/cow per day) or individually fed. For individualised feeding, cows were assigned to one of three groups according to their ranking in the herd (top 25%, middle 50% and lowest 25%) for each of the following criteria: BCS, milksolids, genetic merit or age. These groups were fed between 0 and 6kg DM/cow per day according to a matrix of feed allocation rules, including simulations where the highest ranked cows received the most supplement and simulations where the lowest ranked cows received the most supplement. The total amount of supplement fed was the same for all the herds (average 3kg DM/cow per day). A total of 170 modelling simulations were completed per farm system. The key performance measures were: Dairy Operating Profit (NZ$/ha per year), milksolids (kg/cow per year), mean lactation length (days), total pasture intake per year (kg DM) and empty rate per year (%).

The modelling results indicated that there was no benefit in individualised feeding over flat-rate feeding using any combination of feed allocation and feeding criteria (Gregorini, unpublished). The difference in Dairy Operating Profit (excluding depreciation on the in-shed feeding systems) between flat-rate feeding and the best performing individualised feeding simulations in each farming system is presented in Figure 1.

The reliability of the modelling results was tested by replicating an individualised feeding experiment conducted on a DairyNZ research farm (see next section). There was very close agreement between the model predictions and the experimental results, providing confidence in the modelling study.

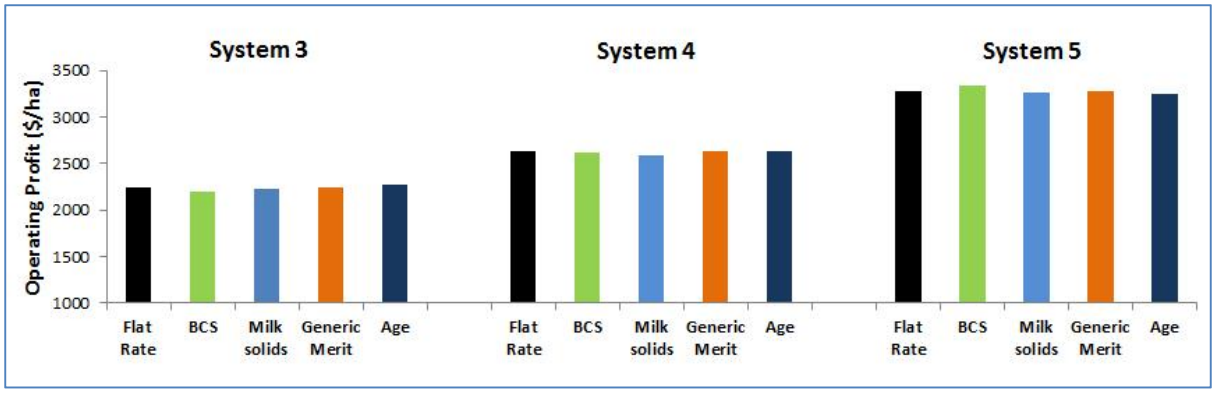

Figure 1: Comparison of Operating Profit for flat-rate feeding (black bars) and individualised feeding criteria (coloured bars) in Farming Systems 3, 4 and 5. Each coloured bar represent the best outcome from a matrix of feeding allocations for that criterion.

DairyNZ individualised feeding experiment

An experiment compared the milksolids response to supplement feeding using flat-rate and individualised feeding in a typical New Zealand rotational grazing system near peak production in spring. For individualised feeding, more of the concentrate supplement was fed to higher yielding cows and less to lower yielding cows. The total amount of supplement offered was the same for all herds.

On-farm experiment

The experiment was conducted at the DairyNZ WTARS Research Farm at Hawera, Taranaki, in spring of 2014. Eight herds were formed by ranking all cows into three production groups according to milk yield (High, Moderate and Low yield), and randomly assigning cows from each production group to each herd. The average daily milk yield was 32, 28 and 24L/cow per day, for High, Moderate and Low production groups, respectively. First calving heifers were excluded from this study due to uncertainty regarding their first season's production.

During the four week experimental period, four of the herds were offered concentrate supplement at a flat-rate of 4kg/cow per day. The four individually fed herds were offered an average of 4kg/cow per day of supplement, with High, Moderate and Low production groups offered 6, 4 or 2kg/cow per day respectively. Herds were grazed in the same paddocks separated by electric fences, where the pasture was of equivalent sward height, mass and quality (>12 MJ ME/kg). Pasture allocation targeted a pasture intake of 15kg DM/cow per day.

The supplement fed was a 4mm compound grain dairy pellet (Inghams Top Cow Dairy 12), specified to have a metabolisable energy (ME) of ~12.7 MJ/kg. Supplement was allocated through a computerised in-shed feeding system at the dairy where feed offered and refused was measured. Milk yield was recorded at every milking session and herd testing, liveweight and BCS were recorded weekly.

Results

In this experiment there was no increase in herd milk production, liveweight or BCS using individualised feeding compared with flat-rate feeding. Interestingly, there were also no significant differences identified between individualised and flat-rate feeding for the production groups, apart from a small difference in milk yield for the Moderate production group. The mean daily milksolids production over the four week trial period is presented in Figure 2 for flat-rate and individually fed herds.

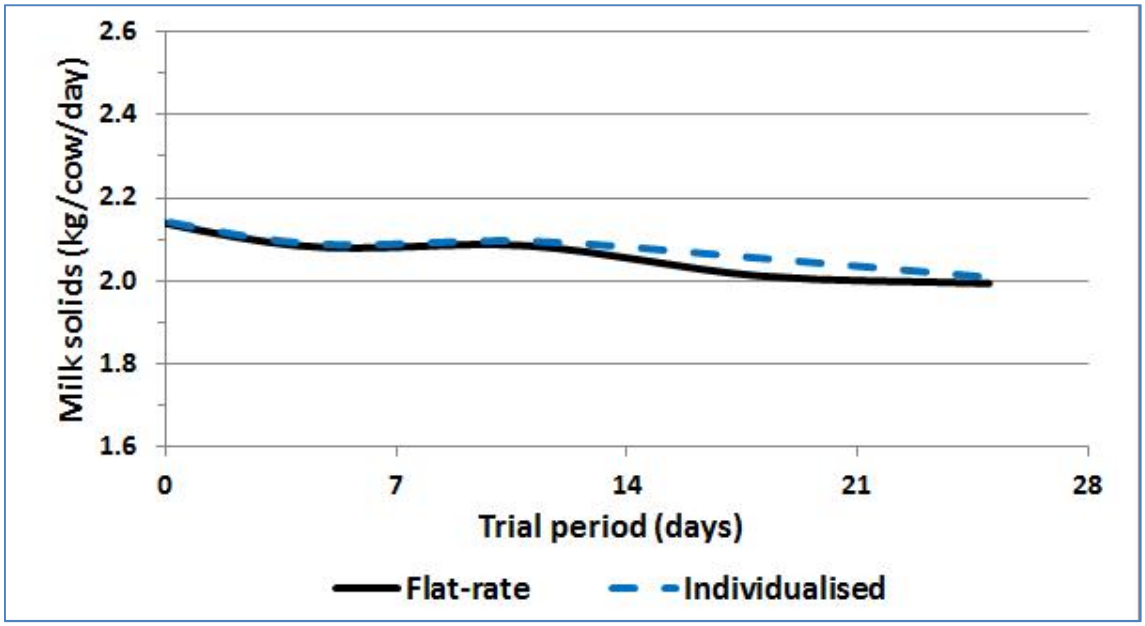

Figure 2: Mean daily milksolids per cow for flat-rate and individually fed herds over the 4 week trial period.

Estimated pasture eaten was similar for flat-rate and individually fed herds (Figure 3). The results by herd feeding strategy (flat-rate & individualised feeding) and production group (High, Moderate & Low yield) are presented below. Within each production group, milk production was the same and therefore, where more supplement was eaten, less pasture was consumed, resulting in the same dry matter intake.

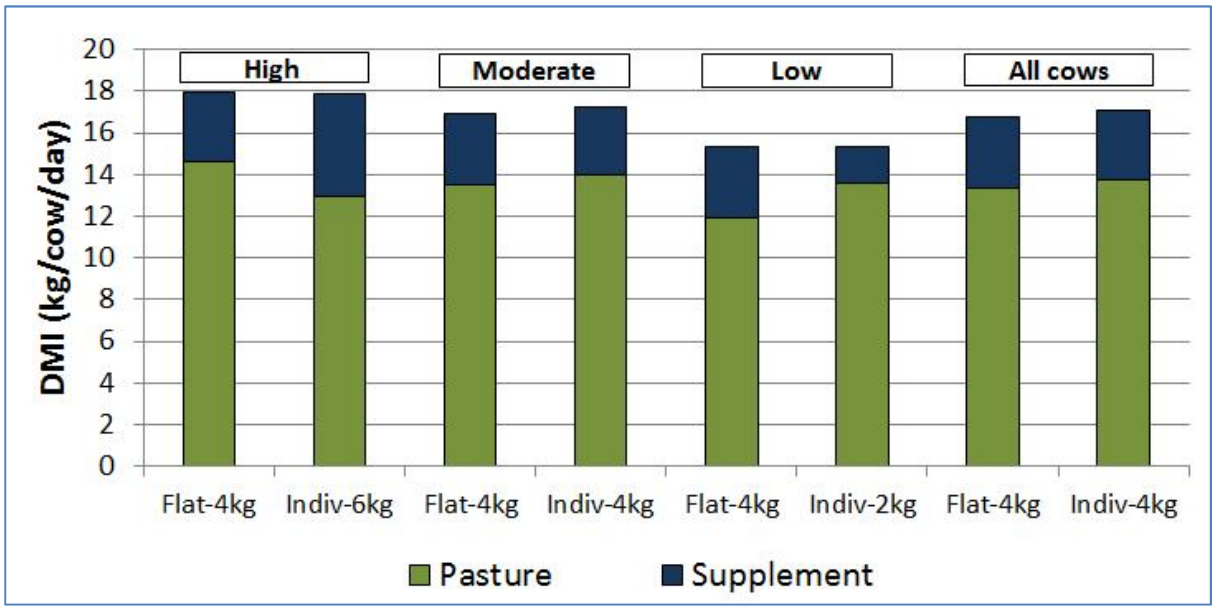

Figure 3: Estimated dry matter intake (DMI) for each production group (High, Moderate & Low yield), in the flat-rate and individually fed herds, calculated from the amount of supplement and pasture eaten.

What does this mean for farmers considering individualised feeding in a pasture-based system?

Individualised feeding systems represent a larger capital investment and results in more management complexity than flat-rate feeding. From an economic perspective, the literature review, modelling and experimental components of this project provided no evidence that individualised feeding improves profitability or milk production response to supplements compared with flat-rate feeding in New Zealand pasture-based farm systems.

The literature review identified evidence that both cow-level parameters (e.g. genetic merit for milk production) and management (e.g. pasture allowance) influence the individual cow response rate to supplements and, therefore, the impact of individualised feeding. However, the current inability to accurately measure parameters, such as individual cow pasture intake, that affect milk production and BCS response to supplements and the rate of substitution of supplement for pasture in grazing situations limits the potential to identify individual cows that may benefit from individualised feeding.

In summary, the findings of this project highlight that farmers should carefully weigh up the economics against any non-financial benefits associated with such feeding regimes before investing in these systems.

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