in the matter of:	the Resource Management Act 1991
and:	submissions and further submissions in relation to proposed variation 1 to the proposed Canterbury Land and Water Regional Plan
and:	**Dairy Holdings Limited** *Submitter*

Statement of evidence of Colin Glass

Dated: 17 October 2014

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STATEMENT OF EVIDENCE OF COLIN GLASS

INTRODUCTION

1 My name is Colin Glass.

2 I hold the position of Chief Executive, for Dairy Holdings Limited (*DHL*), a position I have held for 14 years.

3 Previously I held the positions of General Manager and Chief Financial Officer of the NZX listed company Tasman Agriculture Ltd for five years and the General Manager of Tasman Farms Limited with Tasmanian dairy farming interests for 7 years. I have been involved with both the New Zealand and Australian dairy industries over that time.

4 I am a qualified Chartered Accountant and hold a Commerce Degree in Farm Management, and a Post Graduate Diploma in Accountancy and Corporate Finance from Lincoln University. I was raised on a mixed farming and dairy property at Methven, and from employment on a number of farming properties (throughout New Zealand) prior to my 'professional life,' I have an extensive, hands-on practical knowledge of farming.

5 Prior to commencing the position with Tasman Agriculture Limited, I was employed as a chartered accountant with Price Waterhouse in Christchurch for four years.

6 Although I do not have expertise in nutrient management (this evidence is not being provided as an expert) I note that I have been directly involved in numerous resource consent and plan change proposals (many of which have directly addressed matters relating to nutrients) since the formation of DHL. I also have a very good understanding of dairy farm systems and how dairy farms ultimately run on a day-to-day basis.

7 In preparing my evidence I have read the evidence of:

7.1 **Mr Duncan Smeaton**, **Mr Ron Pellow** and **Mr Geoff Stevenson** (being called by DairyNZ/Fonterra);

7.2 **Mr Stu Ford, Mr Andy Macfarlane** and **Mr Hamish Lowe** (being called by Central Plains); and

7.3 **Mr Peter Callander** (in his capacity as a witness for DHL).

8 I am authorised to provide this evidence on behalf of DHL.

SCOPE OF EVIDENCE

9 In my evidence I provide:

9.1 an overview of DHL and its farm system;

9.2 an outline DHL's operations in the Selwyn Waihora Zone and its irrigation systems;

9.3 a discussion of the potential impacts of Variation 1 to the proposed Canterbury Land & Water Regional Plan (*Variation 1*) on DHL's operations focusing on good management practices and the possibility of further reductions; and

9.4 a discussion on the importance of the farm enterprise regime to DHL and the need to ensure that if, in the future, reductions are applied, they are done at the level of the farming enterprise and not the individual properties that form part of it.

OVERVIEW OF DHL

DHL's operations

10 DHL is a New Zealand registered company with 100% of its farming assets in the South Island of New Zealand. It is the largest closely-held dairy farming business in the country.

11 Its farming interests are all held through wholly owned subsidiary entities however for ease of reference I simply refer to these as 'DHL' in my evidence.

12 For the 2014/15 season DHL will operate 56 dairy units on ~13,523 effective hectares, milking 44,509 cows to produce approximately 15.77 million kilograms of milk solids. DHL farms employ approximately 340 people in its operations.

13 In addition, DHL owns or leases:

13.1 4 large scale special purpose heifer grazing blocks covering a total area of ~1,352 ha that rear and grow out around 7,500 in-calf heifers each year;

13.2 12 grazing and dry stock blocks covering ~3,131ha that are utilised for carryover cows and winter grazing; and

13.3 1 bull unit (a farm with an area of 271ha) that supplies 1,200 service bulls to the dairy farms.

14 DHL's farms are principally located in the Canterbury, Springs Junction (West Coast), Waitaki, and South Otago/Southland regions.

15 The general 'DHL farm system' is based on research conducted through Ruakura and more recently the Lincoln University Dairy Farm that provides the base system for successful and profitable dairy farming. This system was initially promoted by Dr Campbell McMeeken and subsequently by Dr Arnold Bryant, continues to be supported in higher comparable stocking rate systems[1] by DairyNZ.

16 In this regard, comparable stocking rate is often regarded as a better measure than cows per hectare as, for example:

16.1 Cows are not the same weight (noting that from an N-loss perspective the industry understanding is that smaller cows produce smaller urine patches which in turn results in reduced N-losses per hectare);

16.2 Not all hectares grow the same amount of feed; and

16.3 Imported feed is not directly counted when using cows/hectare but still influence N-losses.

17 In this regard, the company is focused on achieving consistent and repeatable levels of profitability predicated on simple, pasture based management systems. For DHL, this means a relatively low input system that has:

17.1 a reduced reliance on supplementary feed being brought on to farm;

17.2 centralised wintering of non-lactating cows and replacement young stock raising;

17.3 careful nutrient budgeting and fertiliser applications that are aimed at producing maximum pasture (with minimum fertiliser being 'lost' in the system); and

17.4 lower stocking rates (on a per hectare basis) but a higher comparable stocking rate (in terms of the stocking rate relative to the feed available) than those which might

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[1] Comparable stocking rate is a measure used within the industry to measure effective stocking rate relative to the amount of feed cows consume. In this regard 'cows per hectare' is often an inadequate description of this balance, and can be misleading when comparing farms which vary in the amount of brought in feed/ha, or have different breeds (e.g. Holstein -Friesian versus Jersey). Comparable stocking rate, along with other indicators, improves the estimation of the balance between annual feed supply and feed demand.

Comparative Stocking Rate is calculated as:

$$\frac{\text{Average lwt (kg/cow) x no. cows/ha}}{\text{total feed (t DM/ha)}}$$

typically be seen on other farms within the same relevant area where systems with increased supplementary feeding are adopted.

18 On the basis of this pasture-focused farm system DHL is budgeting on producing ~1,263 kg of milksolids per hectare for the 2014/15 season from its Canterbury and Waitaki dairy units.[2]

19 For the Selwyn Waihora zone this level of milk solid production is about 100 kg lower than what might be seen on many other farms in the area. (The 2012/13 North Canterbury production per hectare was 1,363 kg MS/ha in the New Zealand Dairy Statistics). It is however important to again remember that this system provides a high level of resilience and good levels of profitability relative to the inputs prescribed. I also note that the general DHL farm system aligns well with good management practice – as has been advised by the South Island Dairying Development Centre (*SIDDC*),[3] maximising pasture growth ensures that, as much as possible both available soil nitrogen and the rain/irrigation water hitting the soil is taken up by plants rather than draining below the plant roots, carrying N with it.

20 This simple pastoral based farming approach has already enabled a significant number of the Group's 340 farm staff to progress through the Group's employment structure to Contract Milking, Lower Order Sharemilking and 50/50 Sharemilking positions, and subsequently farm ownership.

21 In this regard, approximately one-quarter of DHL's New Zealand farms are operated by 50/50 or Variable Order Sharemilkers that own greater than 50% of the herd on the farm. The balance of the farms are operated by Managers, Contract Milkers and Lower Order Sharemilkers. This structure ensures all operators remain focused and motivated while growing their businesses within DHL.

22 DHL also considers that a simple pasture based dairy system is ultimately the best in terms of recognising the international competitive position of the New Zealand dairy industry (where seasonal calving has been successfully adopted to closely match milk production throughout the season with pasture growth). This has resulted in the New Zealand dairy industry maintaining an international cost advantage and generally having a higher level of resilience than it otherwise would have to downturns in dairy sector returns. While the need to achieve acceptable environmental outcomes is of course accepted, it is important it is done in a way

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[2] Noting that the West Coast and Southland farms are largely self-contained for their wintering requirements.

[3] SIDDC, Lincoln University Dairy Farm, Focus Day notes, 11 July 2013.

that does not put New Zealand agriculture's international pastoral advantage at risk.

SELWYN WAIHORA ZONE – IRRIGATION SYSTEMS

23 DHL has 22 farming properties within the Selwyn Waihora zone.

24 These comprise of 20 dairy farming operations and two support blocks (referred to as 'the Saunders and Luporini Properties', which are owned and leased respectively).

25 The location of each property is set out in **Figure 1**.

26 The majority of these properties were acquired shortly after DHL was incorporated (March 2001) through the acquisition of Tasman Agriculture Limited and Dairy Brands Farm Investment Limited. At that time, those properties that were principally irrigated through borderdyke and Rotorainer systems with, in some cases, the irrigation systems having been in existence for a large number of years.

27 Following the acquisition of the above, DHL has acquired a number of further properties which, if not already irrigated, were converted to irrigation and dairy operations (or dairy support in the case of DHL's one dairy support property).

28 For the purposes of discussion, all of DHL's Selwyn Waihora properties can be divided between those that are irrigated by less efficient borderdyke and Rotarainer systems and those that are irrigated with spray irrigation systems. In practice there is some overlap between the two but this does not affect the general comments set out.

Borderdyke and Rotorainer properties

29 These properties (generally being the first Selwyn Waihora properties acquired by DHL) are mainly located below State Highway 1 with intakes from the Rakaia River. This includes takes that are held by small irrigation scheme entities of which DHL is the sole or majority member (or shareholder) – Northbank Irrigation Limited, Fereday Irrigation Group, Rakaia Dairy Limited and Northbank Irrigation Partnership.[4]

30 These properties all straddle the Rakaia Selwyn and Little Rakaia groundwater allocation zones. They are among some of the last borderdyke properties in the Selwyn Waihora area (with all, or almost all remaining borderdyke properties being located at the southern-most edge of the zone, well away from the Selwyn River

[4] In a limited number of instances the properties also have individually-held surface water or groundwater takes.

and the other lowland water body catchments that drain into lake Ellesmere).

31 Since owning these properties, DHL has been in the continuous process of progressively upgrading the older, inefficient irrigation systems. This has included:

31.1 lowering the application rates on Rotorainers and reducing return times (so land is irrigated more often with 'smaller' applications of water, increasing overall efficiency);

31.2 upgrading both borderdyke systems and already 'improved' Rotorainer properties to (mainly) high efficiency centre pivots with sprinklers in corners etc; and

31.3 de-commissioning deeper ground water bores and changing to water sourced from surface water schemes.

32 To date, this strategy has resulted in a saving in energy costs per hectare (especially when moving from deep ground water bores to surface water) – however, the move from borderdyke systems to spray has generally only been viable on the basis that DHL was able to take any surplus water (i.e. that gained through irrigation efficiency gains) to other properties that are either not irrigated or that are irrigated through inefficient groundwater systems.

33 DHL is well advanced in the implementation of its 5 year business plan that includes a programme of irrigation system improvements throughout Canterbury (noting that DHL has a number of existing border dyke properties in mid Canterbury, south Canterbury and north Otago as well) along with associated dwelling and dairy shed upgrades. The programme has however been prioritised by DHL in Selwyn Waihora zone given the environmental pressures in that catchment (as well as the ability that has existed to use some of that water elsewhere which has ensured conversion to more efficient spray is viable).

34 The cost of this programme is significant and for DHL it will require 'multiple millions' to see the programme through to completion. It is something DHL is committed to and within its current 5 year business plan DHL has provided, for example, for the installation of 19 pivots this year and 10 last year. At the end of next year the conversion of DHL's Selwyn Waihora farms should be complete (which will allow DHL to continue the programme on its properties in the mid Canterbury, south Canterbury and north Otago areas).

35 Given the scale of DHL's operations (which almost inevitably result in very large amounts of money being required), it is perhaps most useful to look at the actual cost from a per hectare perspective. In this regard, our experience from the Canterbury farms converted to

date is that upgrading borderdyke irrigation systems to pivot irrigation (with sprinklers in corners) has generally required DHL to outlay around $5,000 per hectare depending on the farm configuration.

36 It is also important to recognise that further upfront costs accrue following the conversion– in that the actual farm area increases by approximately 10% (through the 'filling in' of headraces etc). To ensure effective and efficient pasture utilisation it is necessary to increase cow numbers (with consequential effects on labour requirements, dairy shed capacity, electricity and farm housing etc).

37 Although stocking rates might increase slightly following conversion to spray, DHL's experience to date suggests that the overall investment in converting to spray is enhanced where the water efficiency savings can be spread over new dry land, and this value is captured by the farm owner.

38 I discuss this further later in my evidence in the context of DHL's interest in the farming enterprise regime (paragraphs 75 to 87).

Spray irrigation systems

39 Consistent with the above, DHL has already undertaken considerable investment in the installation of spray irrigation systems on its farms.

40 These properties are irrigated from either groundwater or surface water (in a number of cases, properties are able to be irrigated from both sources). DHL has a strong preference for reliable surface water irrigation. Increasingly the company is reducing its take of groundwater as surface water has been made available through the conversion of borderdyke properties, as discussed earlier in my evidence.

41 In this regard I also note that six properties that are owned by DHL will be delivered water that is conveyed by the Central Plains irrigation scheme. Of these properties, three are currently supplied water that is distributed by the Glenroy Community Irrigation Scheme (a small irrigation scheme entity with intakes taking water from the Rakaia River at Te Pirita) (the *Glenroy Scheme*). The Glenroy Scheme is to retain its irrigation take and use consents but the water will be supplied to the Glenroy Scheme from the Central Plains main canal under contract. The other three DHL farms will become Central Plains shareholders following the transfer of an irrigation take consent to Central Plains.

42 Under the agreement reached between DHL and Central Plains, the three DHL farms within the Glenroy scheme will continue to operate under DHL's irrigation take and use consents. However, for the three DHL farms that are to Central Plains shareholders, they have

the ability to either use water under the Central Plains use consent **or** to continue to use water under their existing DHL use consents (noting that the Central Plains Scheme will effectively now be conveying the Glenroy water for the specific benefit of DHL rather than Central Plains shareholders more generally).

43 Central's proposal to allow existing irrigation within the Central Plains Scheme to continue according to the individual reduction regime is therefore preferred by DHL. It would allow reductions to applied at the per-property or per-farming enterprise level without impacting on the overall certainty and N-load required for 'new irrigation' within the Central Plains Scheme area.

FARM N-LOSS/MITIGATION

44 Without doubt, the most significant gain that DHL can make in the Selwyn Waihora zone is the conversion of existing borderdyke properties to spray irrigation systems. This is likely to result in a significant reduction of N-loss – although, as set out, it does come at considerable cost to DHL, and the OVERSEER analysis completed to date on these properties suggests that the N –loss concentration to groundwater may increase. It is nevertheless something that DHL has committed to (well prior to even the notification of Variation 1) and something that it is committed to following through.

45 In the context of Variation 1 it is however useful to discuss:

45.1 good management practice and the extent to which it is already being implemented by DHL; and

45.2 the ability for further reductions to occur (including a discussion on wintering systems).

46 Each is discussed below.

Good management practice

47 Variation 1, as notified, requires farmers to comply with the "*Good Management Practice Nitrogen and Phosphorous Loss Rates*" from 1 January 2017.

48 Although DHL does not know what the formal good management regime might entail, I note the suggestions provided by **Mr Ford** (Central Plains) (at para [92]) where he notes that good management practices are likely to include matters such as:

48.1 Compliant effluent systems;

48.2 Fertiliser being applied in accordance with industry code of practice;

48.3 Fertiliser recommendations being generated from a budgeting tool;

48.4 Stock exclusion from waterways; and

48.5 Irrigation efficiencies > 80%.

49 Even on DHL's borderdyke properties, the company is highly compliant against the first four matters set out. Following the completion DHL's programme of converting borderdyke properties to spray irrigation (such that all of DHL's properties in the zone are spray irrigated), there would only be very limited exceptions where an 80% irrigation efficiency might not quite be met.

50 In this regard, *slightly* lower irrigation efficiency is likely to arise only where the property layout (including features such as waterways, powerlines, or farm infrastructure) prevent the full use of pivots on the relevant property such that additional, slightly less efficient K-line or Rotorainers needed to be used on parts of the property. In terms of an average irrigation efficiency across the zone, I consider it likely that an 80% efficiency requirement would be met by DHL.

51 That limited exception to one side (and emphasising that DHL does not yet have a full appreciation of what good management practice might be), I agree with the evidence of **Mr Smeaton** (Fonterra/Dairy NZ) that a reduction in N loss is likely to arise through the formal requirement to comply with good management practice - but that any actual reduction is also likely to be relatively modest - he suggests 5%. I agree further noting that most of the dairy conversions in the zone have been undertaken within the past 10 to 15 years and therefore have relatively modern infrastructure and systems compared with other dairy regions, particularly in the North Island.

52 In terms of actually measuring any improvement I also note my understanding that OVERSEER already incorporates a number of assumptions around good management practice already being implemented. Good management practices are therefore things that we should all be doing – but ultimately good management practice (as assumed by OVERSEER) is perhaps best seen as both:

52.1 something we should continue to strive to meet; and

52.2 as a starting point for whatever other changes we may need to assess.

53 For DHL I consider good management practices are already being met (or will be following the full conversion from borderdyke to spray).

Further reductions

54 In terms of the opportunities for N-loss reductions I agree with **Mr Smeaton** that every farm is different, noting that:

54.1 even within the DHL group of farms there are some properties (the most obvious being those that are irrigated with borderdyke systems) where significant reductions in N loss can occur – albeit at considerable cost to the farm owner; whereas

54.2 for DHL's spray irrigated properties, the opportunity for further reductions in N loss are, at least for the majority of the properties, likely to be relatively limited. In simple terms, and as set out earlier in this evidence, the optimal DHL farm system is already founded upon high efficiency irrigation systems, lower stocking rates given a greater reliance on a pasture diet, careful nutrient budgeting and reduced supplementary feed. For such properties, a requirement for further reductions is likely to have a significant impact on farm profitability and more than likely require a significant departure away from 'New Zealand's competitive advantage' of a principally pastoral based system to advanced (and very expensive) mitigation such as herd homes.

55 Leaving the existing DHL borderdyke properties to one side, DHL is therefore concerned with the proposal in Variation 1 of a further 30% reduction (over good management practice) being achieved by 1 January 2022.

56 Although we do not know exactly what the starting point is (given the absence of advice on exactly what a formal good management practice requirement might entail), for the DHL spray irrigated properties I am particularly nervous around the extent to which further reductions might be able to be made without having a significant impact on farm viability and profit. DHL is already running a relatively 'lean' farm system which does not provide the opportunities that might exist on other properties to, for example, reduce excessive fertiliser or supplement use.

57 With reference to the evidence of **Mr Ford** (at para 101) I understand that the Council proposes that the 30% reduction regime would be achieved as follows:

57.1 Up to 11% - the use of DCD's and improved nutrient and effluent management;

57.2 Between 12 – 20% - improved genetic stock and reducing autumn fertiliser; and

57.3 Between 20 – 30% - off grazing

58 Both **Mr Ford** and **Mr Smeaton** go on to discuss these in their evidence.

59 In the context of DHL's operations and wider experience I generally agree with their findings, noting that:

59.1 In terms of the 'low hanging fruit' (i.e. reductions up to 11%), DCD's are currently not an option. Appropriate nutrient and effluent management are already being generally implemented by DHL and, subject to the conversion of the remaining borderdyke properties to spray, improved nutrient and effluent management may deliver some small improvements. Although as I have noted earlier in my evidence DHL is already generally operating at what I consider to be good management practice with a relatively low input system providing limited opportunities for actual improvement;

59.2 With regard to further mitigations, the only ones that appear to be potentially viable, from a DHL perspective, are those associated with:

(a) active water management. I go on to discuss this later in my evidence but in simple terms it involves irrigation system management that assumes soil moisture is optimised with an ideal irrigation system. Although it is something we should, as good farmers, aim towards it is likely to require the adoption and development of technology that currently does not exist or which cannot be properly assessed in an OVERSEER framework. DHL has recently partnered with ReGen/NEC to develop irrigation decision support software for various on-farm irrigation systems. While this technology could potentially enable irrigation efficiency gains, it is currently a long way from achieving significant savings from reduced losses to drainage As discussed, DHL already operates high efficiency irrigation spray systems and I consider 'active water management' to be an ideal rather than something that can be fully achieved at the present point in time; and

(b) a reduced autumn N application, which in turn also accommodates:

(i) a reduction in cow numbers to compensate for reduced autumn N (and/or shorter lactation length); and

(ii) a redistribution of supplement use to compensate for reduced N fertiliser use.

60 On the basis of the above it appears that the only properly viable mitigation is reduced autumn N application with associated changes to cow numbers (and/or a shorter lactation length) along with a redistribution in supplement use. This is set out by **Mr Smeaton** (para 22) and is also consistent with the findings of **Mr Ford** (based on his para 106, Table 4).

61 While DHL is supportive of these mitigations, I suggest that some caution needs to be applied with respect to the N-loss reductions that may be able to be achieved from these practices. The interrelationship between production and feeding levels has been determined based on the widely used Farmax model. It is important to note that this is a theoretical model and the actual impacts on production from implementing the suggested practices may be quite different for individual farms, especially for larger farms as typically exist in the Selwyn Waihora zone. As in the past, DHL will be looking to the Lincoln University Demonstration Farm to implement the proposed mitigations and determine the critical areas for such practices to be successful, before adopting across our extensive farming operations. This demonstration will show just what N-loss reductions are *in fact* possible 'on-farm'.

62 I also further note that there is one other key mitigation potentially available without significant capital expenditure but I consider it would be very difficult for DHL (and the vast majority of farmers in the Selwyn Waihora zone) to implement. This is potential to reduce stocking rate combined with increases in per cow production. As noted by **Mr Smeaton** (para 23.2) this is likely to be beyond the capability of most farm managers as cows in the Selwyn Te Waihora zone already perform at high levels of production per cow relative to the national average. In the particular case of DHL it also has a relatively low stocking rate to begin with and for all farmers further reductions in stocking rate are likely to result in increasing difficulty achieving adequate, high pasture utilisation which would lead to subsequent negative impacts on pasture quality.

63 Based on work done at the Lincoln University Demonstration Farm (pers. comm. **Mr Ron Pellow**) and my own experience from elsewhere it is also important to emphasise that a reduction in stocking rate but having more efficient/higher producing cows is **not** 'the answer' to reducing **N-loss** leaching.

64 In this regard work done to date suggests, consistent with my comments in paragraph 16.1, that larger cows produce larger urine patches which are a much greater risk in terms of N-loss leaching. Information from the Lincoln example shows that actual N-losses on the dairy platform remain relatively unchanged following a move to larger and high producing dairy cows on the assumption that overall farm productivity remains the same.

65 Overall , the wider catchment is therefore no better off in terms of a move to larger and higher producing dairy cows. This is quite different to the benefits from higher genetic merit cows which are more tangible. The higher the live weight per unit of feed available or comparative stocking rate (the much better measure of stocking rate) the better a farm system is at utilising the pasture grown on farm. The ultimate N losses do not tend to vary greatly as higher comparable stocking rate farms de-stock more aggressively during the later lactation period than lower comparable stocking rate farms.

66 Following on from the above, the only other options that are currently available to reduce N-loss would be restricted autumn grazing and winter housing. These are very capital intensive and I agree with **Mr Ford** that they could only be funded by increases in stock numbers, stocking rate and significantly increased production which, at least to some extent, would defeat the purpose of building such structures (if the purpose is to reduce N-loss).

67 In this regard, it is important to remember that indoor wintering does not alter the total amount of N produced by cows from the relevant farm it just replaces the N lost from wintering cows that would normally be grazed elsewhere at a much lower cost. Because an indoor wintering facility collects the urine and stores it, they can reduce N leaching per cow because the N can be applied evenly and at a time of the year (late spring-summer) when the plants can use it - however, as is DHL's experience, there is a destructively high capital cost to the indoor facilities and associated effluent collection system. Ongoing operational costs are also considerably higher.

68 Offsite wintering in itself also provides its own set of issues from an N loss perspective. As I noted earlier in my evidence, DHL owns one wintering property within the Selwyn Waihora zone (the 'Saunders Property'). Under the notified version of Variation 1, properties involved in dairy support would be required from 1 January 2022 to reduce their N-loss by 22% (where N-losses are over 15kg N/ha/yr).

69 Quite how this would be achieved is not clear to DHL (given that a number of the core mitigations available to a dairy milking operation and not available to a support operation), however I make the following general comments:

69.1 the number of cows that are wintered in a catchment is generally a reflection of the number of cows that are ultimately milked in a catchment. It is important to look at both together as viable wintering operations are critical to a successful and viable dairy operation. If wintering operations become uneconomic this will ultimately affect the returns on the dairy platforms;

69.2 Wintering systems differ in the area of crop required to feed each cow over the winter, stocking density, urinary nitrate concentration, and the extent of overlap of urine patches – all of which affect the intensity of nitrate leaching. In this regard, it is DHL's experience (informed by work provided by SIDDC and elsewhere[5]) that although a lower yielding crop might on its face provide less losses of N per hectare, on a per cow basis it is necessary to have a larger area available for support operations – meaning that from an environmental effects perspective, centralised support operations with specialised high-yielding winter crops generally have a reduced overall environmental footprint **per cow** (and therefore in total) than the same number of cows being spread across a much wider area; and

69.3 Consistent with the need to look at the 'big picture' it is important that if dairying is enabled within an area then dairying support also needs to be enabled. The alternative could potentially see cows taken out of the catchment for wintering purposes which will only lead to unintended environmental pressures in other catchment(s). This is particularly relevant in the Selwyn Waihora context where adjoining catchments also have their own environmental pressures and a requirement, at a per property level, to comply with a nitrogen baseline (meaning there may be limited opportunity to accommodate further cows in those catchments).

70 From reviewing **Mr Ford's** and **Mr Smeaton's** evidence it appears that little in the way of farm system modelling has been done for wintering operations. For the reasons I touched on earlier I consider it may be difficult to make significant reductions in N-loss for individual wintering properties (provided the relevant wintering property is already using fertiliser sensibly – which appears to be the only matter that is able to be controlled that also influences N-losses). The only way that material reductions might be able to occur is through running less stock however that is simply 'transferring' the problem to either another property or to another catchment. However, the operation of farm enterprises can enable efficiency gains from wintering to be achieved based on the inter-

[5] See for example, SIDDC, Lincoln University Dairy Farm, Focus Day notes, 11 July 2013

relationships between winter crop yields and the number of cows that can be wintered as outlined in paragraph 69.2above.

71 In terms of the modelling of farm systems that has been done it is also important to remember that time will be required to determine the actual inter-linkage between modelled outcomes and the actual impacts on profitability. It may be that modelled outcomes assume a greater degree of mitigation is possible (with a smaller impact on profit) than what actually occurs in reality.

72 Overall, DHL strongly agrees with **Mr Smeaton's** observation that every farm is different. With regard to that observation DHL has properties at both ends of the spectrum – i.e. borderdyke properties on the one hand where significant reductions in N losses are already being made through DHL's conversion of such properties to spray irrigation systems – and on the other hand, relatively low-input pasture focused spray irrigated properties where there appears to be very limited opportunity to make material reductions while maintaining a reasonably level of profitability and overall farm viability.

73 At both the wider DHL level (i.e. across its 22 properties) and at a wider catchment level, I anticipate that small reductions **on average** will be possible – but significant care needs to be taken when looking at reductions at an individual property level to ensure overall farm viability (including the viability of support operations) is maintained.

74 The ability to implement any reduction regime will also be incredibly important. As it stands at the moment there is relatively limited technical expertise available to even prepare and assist with matters such as farm environmental management plans (appreciating that a very large number of properties in Canterbury are, or shortly will, require one). Where farm system changes are required, time will be needed to ensure appropriate training and people are available to the industry.

FARM ENTERPRISE REGIME

75 DHL has a particular interest in the provisions in Variation 1 relating to farm enterprises.

76 This primarily derives from resource consent CRC143288 that is discussed in detail in **Mr Callander's** evidence. This resource consent allows the use of land for farming and the associated use of water and nitrogen leaching across a group of farms, referred to in the resource consent as a 'Nutrient Management Group' – although in function it is very similar to the farm enterprise regime proposed under Variation 1.

77 As noted in **Mr Callander's** evidence, at the time of granting the consent the group was made up DHL's 22 farms comprising 6,186 hectares (including six properties that will eventually either have water conveyed or directly supplied by the Central Plains' Scheme as outlined earlier).

78 The consent conditions allow for further properties to be added or removed from the Nutrient Management Group, with potentially up to 10,000 hectares forming part of the group. In this regard, and despite my comments in paragraph 76 above, the Nutrient Management Group regime is a slightly wider concept than a farming enterprise – as it also allows properties owned by unrelated entities or persons to join the Nutrient Management Group.

79 The consent requires a high standard of farming practice with the implementation of audited Farm Environment Plans and annual reporting of water use and nitrogen leaching. In this regard it is at least to a large extent aligned with the general consent framework anticipated under Variation 1.

80 The consent specifies a combined nitrogen leaching total for the group determined from OVERSEER simulations averaged over the period 01 July 2009 - 30 June 2013 (i.e. consistent with the definition of nitrogen baseline). This provides a load of 376,337 kg for DHL's existing properties based on version 6.1.1 of OVERSEER with a formula for this to be recalculated following the release of a further version of OVERSEER based on the properties (covering up to 10,000 hectares) forming part of the group at the relevant time.

81 The appropriate use of OVERSEER was a key issue that was discussed in the application process. Of particular concern was ensuring that any load limits could be updated against any future version of OVERSEER. The conditions expressly record (at condition 3) that:

> "…the nitrogen baseline calculation is defined as the annual average nitrogen loss to water, as modelled with OVERSEER®, or equivalent model approved by the Chief Executive of Environment Canterbury, averaged over the period of 01 July 2009 – 30 June 2013, and expressed in kg. The current version of OVERSEER® shall be used and the inputs shall be updated where relevant to reflect the current Overseer Best Practice Data Input Standards, but they must still describe the same baseline scenario."

82 The ability to recalculate load limits based on a subsequent version of OVERSEER **using the same inputs** is key as earlier versions of OVERSEER are generally not accessible.

83 A further issue which arose in the application process was the appropriate use of OVERSEER, including the importance of

complying protocol "The Overseer Best Practice Data Input Standards (August 2013)" (Best Practice Standards). All loads were calculated using 'Method Only', except for borderdyke properties where DHL held information on actual irrigation volumes by month for prior years. I understand that 'Method Only' allows the user to nominate the type of irrigation system on nominated months with OVERSEER applying the correct and least amount of water required.

84 If "*Method Only*" were not available under Variation 1 then the relative interrelationships for any mitigation will be different and the percentage N reductions will need to be recalibrated. In this regard, and as **Mr Lowe** has already emphasised the importance of using OVERSEER as a relative tool and not an absolute tool, and care needs to be taken when looking at the actual numbers in determining actual losses.

85 Going forward, the resource consent will be a critical component in the conversion of DHL's remaining borderdyke properties to spray and management of nutrient more generally by DHL. In this regard:

85.1 following the conversion of properties from borderdyke to spray, spare water (often surface water) is made available. To assist in offsetting the costs of conversion, DHL to date has sought to transfer this water (either by way of a formal transfer or by way of a water users' group) to dryland, groundwater irrigated properties, or properties with currently inadequate or lower reliability surface water takes. To the extent that reductions are able to occur elsewhere, the nutrient management consent enables 'N-losses' to be transferred to other properties that need it; and

85.2 more generally, and consistent with my comments around matters such as wintering, DHL is seeking to manage the nutrient losses at a group level. In this regard, I also note that the nutrient management group is not just about irrigated properties and there may be instances where, for example, wintering on dryland is supported through the nutrient management group so that the full effects of DHL's N-loss footprint can be managed in an integrated manner.

86 Overall, what consent CRC143288 does is, as set out in the evidence of **Mr Callander**, it allows DHL to manage its use of water and its N-losses in a manner that ensures the 'unders' and 'overs' are shared between the properties that form part of the nutrient management group.

87 How N-loss reductions are applied to DHL is also of particular importance to the company. Having moved nutrients between properties that form part of the nutrient management group/farming

enterprise and potentially undertaken changes on a property in reliance on that having occurred, it is critical that any reduction regime is applied at the level of the farming enterprise.

88 The alternative would see a property having to make reductions from its original and no longer relevant individual nitrogen baseline. This could effectively – but unintentionally - see a property being penalised twice which would have a more significant adverse impact on the relevant individual property.

CONCLUSION

89 DHL is generally supportive of the vision for Variation 1 and the extent it seeks to enable viable farming within the Selwyn Waihora zone.

90 DHL does however have major concerns around the extent to which the proposed reductions are actually achievable on **some** properties (noting that at the present point in time there appears to be limited effective mitigations available – with the mitigations that are being generally modelled and not as yet demonstrated in 'real life', especially on larger size dairy operations such as those operated by DHL). In the case of its spray irrigated properties, DHL is also already likely to be doing much of what is anticipated under any possible good management regime. Care accordingly needs to be taken in ensuring that outcomes are actually able to be met before mandatory compliance is required.

91 The farm enterprise regime is of particular interest to DHL. DHL is very supportive of continuing provision being made to farm enterprises but considers it critical that if reductions are applied, they are able to be applied at the level of the farming enterprise.

Dated 17 October 2014

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Colin Glass

Weathering the future:

Resilience to weather events, sustainable systems and decision rules

Kevin Macdonald, Senior Scientist, and Phillipa Hedley, Business Developer, DairyNZ

Summary

- Have a clear strategy for the future and understand what the business needs to achieve it
- Develop a farm policy and set of decision rules based on sound knowledge
- Ensure that the farm policy and systems on farm minimise the environmental foot print
- Excellence in execution has a greater influence on results than the initial strategy
- Put systems in place/create the farm infrastructure to reduce the number of decisions needed allowing time to focus on the key activities i.e. grazing management; mating, financial analysis of the business
- Condition score 5.0 for mixed age cows and 5.5 for first and second calvers is not negotiable and critical for managing adverse weather
- Do a sensitivity analysis on the key factors that affect the viability of the business – production, interest rates, FWE and payout – take the rose tinted spectacles off
- Base decisions on fact not intuition
- Have a plan to manage the worst case scenario

What are the farm business risks that dairy farmers face?

The key farm business risks faced by dairy farmers are:

- Cashflow and viability
    - Milksolids production – weather and management capability
    - Payout
    - Farm working expenses, Plant replacement
    - Debt servicing
    - Routine drawings
- Compliance
    - Effluent use, fertiliser use, water, food safety standards
    - Community perception and animal welfare
    - People

To manage the risks these factors place on the business requires implementing a farm policy and a set of decision rules for each factor. A key tool to manage risk is “knowledge” as it allows development of a robust farm policy and decision rules – a farm plan. However, implementation and execution of a farm plan are more important than the initial strategy (Penno, 2003). Knowledge can be learned or expertise employed.

“The great end of knowledge is not knowledge but action” T H Huxley

A set of decision rules for running a well stocked farm has been developed from research conducted at DairyNZ (Macdonald & Penno, 1998). These rules allow repeatable and sustainable production, and profit, between years (see appendix for a brief summary). This is the same for any commercial operation, not only to attain high profitability, but to ensure that the profitability is repeatable over time.

Cashflow and viability

Milksolids production

Dairy farming is a relatively simple farming process with total milk production determined by the amount of feed available and by the proportion of that feed that is utilised or eaten by the milking herd (Penno, 2003). Therefore, achieving good milk production requires management and utilisation of the variation in pasture supply and feed inputs offered to the herd.

The major risks in achieving the target MS production are adverse weather and management capability. Both these can be managed by having a farm policy suited to the farm’s resources e.g. farm dairy, race system, water supply, availability and cost of supplements, labour structure of the farm, and systems and processes on farm that result in excellence in implementation of the farm policy.

Management Capability

Regardless of the policy and written decision rules, unless the farm has the management capability, the business is very much at risk. The management capability required depends on:

1. The number of judgement decisions required on a daily/weekly basis and
2. Systems and farm infrastructure

With a feed surplus, the manager is faced with balancing feeding the cows well every day and having high quality feed to offer next time the cows graze the paddock. High supplement and low stocked systems are in this position everyday – how much supplement to feed and pasture to allocate. For high stocked systems the decision is how to best allocate the feed on hand rather than how to manage a surplus.

Systems and infrastructure can also affect the number of judgement decisions. Farms that have a lot of paddocks eg from 1-5 ha, are much harder to manage than a farm with 30, similar sized paddocks. Routine, processes and discipline also help. For example, grazing in a block rather than going all over the farm.

Farmers that spend a lot of time in the cowshed are often behind on other jobs and grazing management is not given the time and thought it deserves.

Having clear decision rules and systems/processes that can be easily communicated and executed will result in more consistent and repeatable production. This involves the discipline of regular monitoring and planning of grazing management.

Farm Policy: System

High input systems tend to be more difficult to run as they require more management decisions and are generally better suited to owner operators where the skill and motivation are high. Risk areas that need to be managed in these systems are controlling the input price of feed (contracting feed; have own feed supply) and achieving high utilisation of the supplements and pasture grown.

Farm Policy: Stocking Rate:

Stocking rate **(SR)** is a key driver of feed utilisation. There is no one answer for SR given the variability in climate and the seasonality of annual pasture production (Fig. 1). This shows the 15-year average (and standard deviation) monthly growth (kg DM/ha/day) indicating how much it can vary. There is a huge variation on a Waikato dairy farm in annual pasture production between years. The summer is the most variable season, contributing the most to differences in annual DM production.

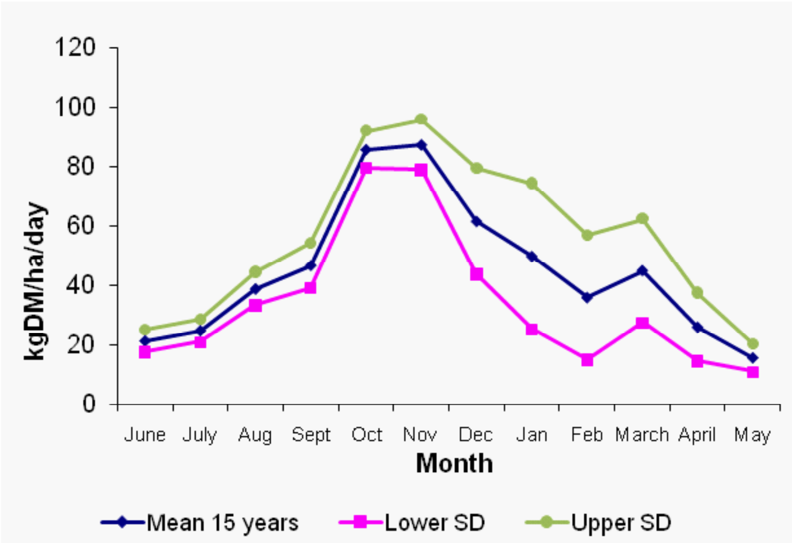


Figure 1. Mean pasture growth (with SD: standard deviations) for 15 years on a Waikato dairy farm

In a recent study (Macdonald et al., 2008) the operating profit from a range of SRs (fed largely pasture) was modelled using marginal analysis for all costs (either per cow, per ha or a combination). Fig. 2 shows that the optimum operating profit was attained at a SR of 3.1 cows/ha, the mid-point in the SR in the trial. Note that the operating profit was evenly distributed either side of the optimum SR.

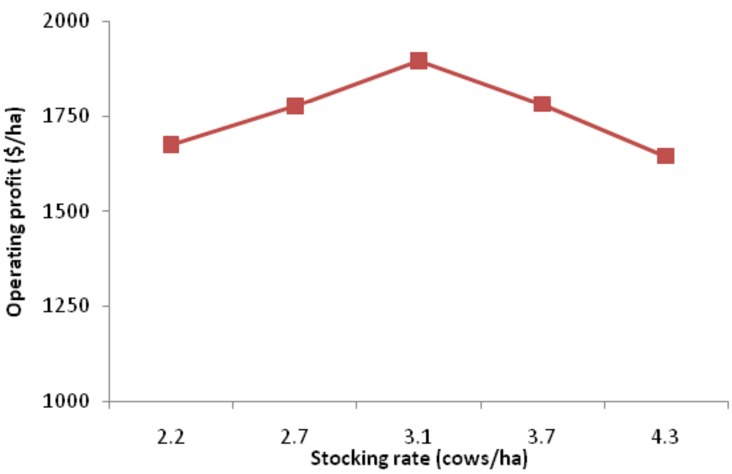


Figure 2. Operating profit for a range of stocking rates (adapted from Macdonald et al. 2008).

These results indicate that a range of SR exist where profit can be optimised. Optimum profit will only be achieved where the farm is managed under a set of decision rules that ensure pasture is utilised to best advantage within the grazing system. This means that the SR is relatively unimportant; what is important is how the system is operated.

In practice few farmers achieve the modelled profit operating a low SR due to the increase in the number of judgement decisions required to maximise cow intake of high quality feed per cow (round length, harvesting of surplus, topping) As SR is set in the winter the feed available for some farms can vary greatly between seasons (Figure 1). Plans are required to minimise and manage these fluctuations in feed available. A high SR farm will possibly need to dry-off early but a low SR farmer will need to ensure maximum days in milk and this will require harvesting high quality pasture surpluses for use in late lactation.

The risks for any farm system need to be identified and minimised. For a low stocked farm, the risk is not achieving high MS per cow; in a high stocked farm the risks are around maximising pasture grown through sound grazing management and no soil damage.

Farm Policy: Calving Date

Calving date is important to match feed supply to demand. As shown in Figure 1 pasture production in the Waikato in the spring is relatively consistent. Therefore, production before Christmas is important to minimise the risk from dry summers. High MS production to Christmas can be achieved through a high SR, or moderate SR and early calving. For either system there needs to be a plan to manage a wet spring and/or a dry summer.

Rules of thumb for calving date are:

High stocked farms, all grass in the spring

- Calving date 50 days before balance date
  (when feed supply meets demand)

Moderately stocked

- Calving date 55-60 days before balance date

Low stocked or feeding high amounts of supplement in the spring

- Calving date 60-70 days before balance date

Feed supply

Macdonald et al. (2008), in a SR trial, demonstrated how climate affects the feed supply and also management. They found that the amount of pasture grown increased with increasing SR, and the quality of the pasture on offer increased linearly. Milk production/cow declined linearly with increasing SR primarily because of a lower peak yield and less persistent milk profile and a shorter lactation. However milk production/ha increased linearly, and there was only a small decline in the efficiency of converting feed energy into milk energy as SR increased. Stocking rate did not affect reproductive success because a proactive approach was taken to anoestrous cows.

Management can influence the amount of pasture grown by manipulating average pasture cover (APC). Average pasture cover affects pasture growth rate (Fig. 3). As low APC is usually the result of a fast rotation, managing rotation length is key to meeting APC and residual targets. Table 1 has decision rules on rotation length and pasture cover. Use of the DairyNZ spring rotation planner will ensure that grazing interval does not get too fast too early. Thus pasture growth should not be restricted by grazings being too frequent.

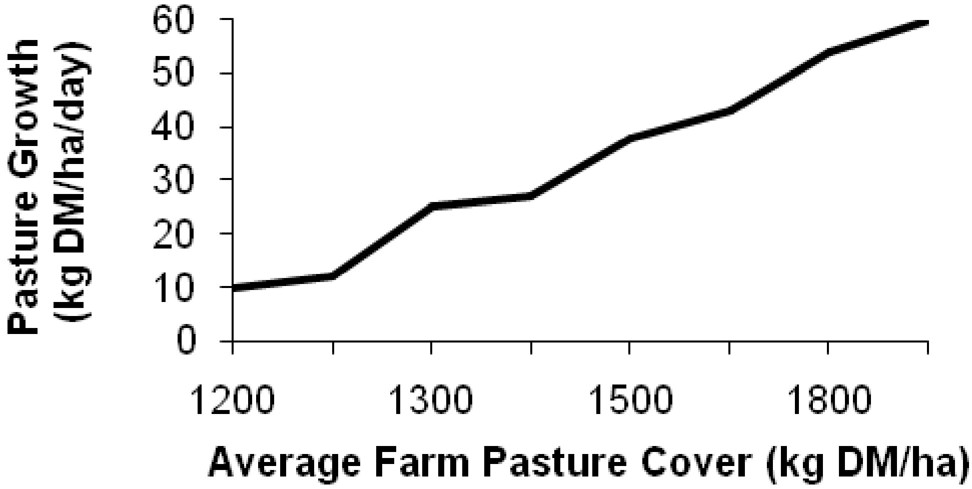


Figure 3. Average pasture cover and pasture growth rates in spring.

Weather

Drought

Dry summer management is well documented (Farmfacts 1.30 – 1.35). A huge variation exists between farms on the impact a dry period has on profitability. This variation relates directly to the planning leading up to a dry period and how proactive the farmer is in making decisions to balance the feed budget through to calving. Having a plan is particularly important for high stocked farms as it is a costly exercise to use cow condition to balance the feed budget. This can affect future MS production and reproductive performance. It also increases the risk to the business of not meeting the animal welfare standards.

Systems must be in place to allow for an early response to the changing situation. The aim must be to milk as many cows for as long as possible, but this should not be at the expense of lowering herd condition or APC to the extent that all the cows need to be dried off at the same time. The easiest way to reduce herd demand is by removal of the cull cows. Upon removing the 20% from the herd the remaining cows individually have 25% more to eat. On a well-managed high stocked farm, up to 80% of the annual MS production has been produced by the end of January. Thus, after January some high SR farms have already produced close to 1000 kg MS/ha and the emphasis should be on protecting next season's production - this may mean drying off cows to ensure they are at BCS 5.0 at the next calving.

On high SR farms there will be only a minimal amount of silage made so it is important not to squander this feed early on. It should be kept until after the autumn rains and enough saved for winter. There is very little that can be done to improve this year's production and it is essential that systems are in place to ensure that cow condition and feed supply are adequate at the start of next season. On lower stocked farms the aim will be to ensure that days in milk are maximised. Thus there may be a need to supplement the cows with silage or a bought-in feed. Whatever is used, it has to be part of the system. Normally the feed should be organised before the drought starts to avoid buying feed at a premium price.

Wet weather

The spring can be very stressful for farmers when the anticipated pasture growth does not occur due to extremely wet conditions. This has occurred in the Waikato several times in the last 10 years. The farmers who managed to get through with minimal lost production and pasture damage were those who had planned by having the infrastructure or system to prevent pugging damage, monitored APC and cow condition against defined targets for the farm over the winter and took action early to improve the situation. Cow condition at calving is not negotiable for any system and is the key to managing a poor spring (cows at BCS 5.0 at calving, first and second calvers BCS 5.5). Having quality feed (10.5 ME or better) either on hand or that can be purchased at 5% of milk payout or less should be part of the farm plan for farms prone to the wet, particularly those that are highly stocked and/or early calving.

DO NOT speed up the rotation in an attempt to feed the herd fully or reduce pugging. It may initially allow better feeding of the herd but will only exacerbate the lack of feed by reducing pasture growth through too short a grazing interval. Instead have areas to which the cows can be moved (stand-off areas) to reduce soil damage. Recent DairyNZ research (Clark et. al, 2010) has shown that cows can get 80% of their required intake in 2 – 4 hour grazings. So cows can be fed reasonably well if removed from pasture to reduce pugging, but the area must comply with environmental requirements.

Summary of risks to milk production

- There is a range of SRs where profit can be maximised, provided that a set of decision rules are applied to achieve the target MS production for both the current and next season and the farm has the management capability and systems in place to implement these decision rules.
- Attaining BCS at calving of 5.0 for cows and 5.5 for heifers and second calvers is critical in all systems to maintain a tight calving pattern with minimal intervention.
- The other key areas where seasonal rules need to be adhered to are APC pre and post grazing covers. Rotation length is a key driver of APC and residuals.

Payout

Because payout cannot be controlled, the farm business needs to be viable at a low payout. This requires doing a sensitivity analysis and having a realistic plan to deal with a low payout, poor season and higher interest rates. Before the $4.55 payout announcement in 2009 many farmers thought they had a strong business that was not at risk as they did not consider the downside aspect of payout. Even at $6.00 there are businesses at risk due to land purchases based on overly optimistic budgeting of payout, farm costs and/or milk production.

Farm working expenses and plant replacement

Regardless of the system, having control of farm working expenses (FWE) is critical. In times of good payout or production, plant replacement and capital work can be done to set the farm up well to weather a poor season. Often in the good times costs creep into the system that are hard to cut out in hard times. High input systems need to control or manage the purchase price of feed. Feed prices tend to track payout and feed deficits. Having the capacity to purchase feed when it is well priced rather than when it is needed and keeping it stored so it doesn’t lose quality (and pukekos and rats don’t eat it all!) can help manage this risk.

Debt Servicing

As with the production system, the business needs to have a set of decision rules for its financial structure. Target levels for equity and debt servicing should provide criteria for decisions around any new opportunities such as the purchase or sale of assets. It is also useful to develop a view on the range of payouts under which the business will need to operate. Do a sensitivity analysis to quantify the effects changes in interest rates, payout and production have on the business. External advice is valuable in providing a dispassionate view of the business and any new proposals. Those involved in the business often find it hard to remove emotions from their decisions particularly when it comes to purchasing land.

It is often said when purchasing land that it is always too expensive at the time but cheap in the long run. However, the business needs to be robust enough to weather the changes in payout, climate or interest rates that may occur in the short to medium term.

Interest rates are currently at historical lows and will increase over time. Farmers need to assess how a 2-3% increase in their interest rate will affect their business and start planning now to deal with this increased cost.

As discussed above, having the capacity to purchase feed when well priced can be an effective strategy to manage risk. However, it requires having financial funding arrangements in place to take advantage of these opportunities. The most cost effective way to do this is usually in the form of an available overdraft facility. Financial discipline is required to ensure this extra facility is utilised to take advantage of genuine opportunities rather than simply allowing loose cost control.

Drawings

Personal drawings seem to be a taboo subject. However, in tough times this is an aspect of the business the bank and you will need to focus on. Bankers often quote "very rarely do drawings go down". Know what your drawings are and the impact they have on you achieving your goal. In the good times remember the saying: "this too, shall pass", which means the good or bad times will not last forever. So plan using the best information you have.

Compliance

Effluent, fertiliser, water

Increased attention, both locally and internationally, is being focussed on the sustainability of modern agricultural production systems, including New Zealand's dairy industry. To ensure New Zealand retains its present 'clean green' image, it is essential that effluent, nitrogen and phosphate use on dairy pastures and the grazing of stock have minimal detrimental effects on the wider environment. In most dairying areas of New Zealand concern has been expressed about the impact of dairy cows on ground and surface water quality, particularly in relation to elevated levels of nitrogen or phosphate.

In evaluating the performance of the current farm system and any changes in farm policy the environmental impact needs to be considered. For nutrients this can be done by using Overseer. Changes in farm system need to maintain or improve the environmental foot print to the farm to remain viable.

Farmers need to have systems in place to ensure that water use, effluent, fertiliser and soil management comply with environmental rules, now and in the future. Unfortunately this is new ground and currently it can be difficult to get good advice as to what is the best option as the rules are changing regarding effluent, standing cows off, acceptable nitrogen applications etc.

The first step to managing this risk is being aware of what is required, not just currently but requirements likely in the future. If you are not aware of impending compliance issue, or choose to put your head in the sand, the risk to your business is greater. Farms with higher SRs may be more at risk especially when wintering cows.

Community Perception and Animal Welfare

There has been increasing concern about the perceived 'thinness" of NZ dairy cows. There is no doubt that today's cow is bred to milk for longer at the expense of body condition. As there is a range of condition scores within a herd, the average herd BCS should not go below 3.5 to ensure that there are no cows less than BCS 3.0 in the herd. The key way to address this is to calve mixed cows at BCS 5.0 and first and second calvers at BCS 5.5. This recommendation has been around for 30 years. Farmers often achieve the optimum herd BCS in June but fail to remember that in the last month of pregnancy the unborn calf requires 3-4 kg DM/day. If the cow allowance is not increased to accommodate this, the calf effectively becomes a parasite, causing the cow to mobilise energy to meet demands and therefore will lose condition. Farmers need to manage their farm to achieve this.

The recent issue of extremely thin cows at a number of saleyards highlights the fact that farmers are mismanaging the situation and this has to change. DairyNZ produced a booklet "Fit for Transport" (2009) which is designed to help farmers decide if a cull cow is fit for transport. In the introduction it states "making bad decisions about when to send cull animals for processing puts you and your transport operator at risk of prosecution." So the onus is on you the farmer to ensure that this does not happen. If farmers ignore the recommendations they will breach their animal welfare obligations and the resulting poor publicity affects the credibility of the dairy industry.

People – Staff

Increasingly, employers are at risk if they do not comply with employment legislation, health and safety requirements on farm or provide a good work environment that retains employees. Being a good employer is important if the farm is to attract and retain capable staff.

The farm business also needs to invest in its own capability. As farming becomes more complex (compliance, staff etc) it will be increasingly important to "work on the business" and not just "in the business". This will require continued investment in the capability of all involved in the business.

Summary

For farms to succeed in the future, be resilient to adverse weather events, and have sustainable systems, they need to:

- have the infrastructure and systems to minimise the daily/weekly judgement decisions and carry out the work efficiently, and
- there must be sets of decision rules.

These are rules that govern basic farm management as well as finances. Having systems in place reduces the risk to any business. It is all about planning and knowing what you want to achieve and having the ability to get there. Remember the old adage: Failing to plan is planning to fail.

Table 1. Management to achieve high performance from a range of stocking rates (decision rules).

	Stocking Rate		
	Low	**Medium**	**High**
System Focus	Quality Cows offered quality feed and able to maximise intake	Quality and quantity Cows offered quality feed and intake optimised	Quantity (quality looks after itself) Cows offered sufficient feed to meet their requirements
Topography	Flat (as need to top or have dry stock to follow)	Flat – rolling	Flat – hills
Climate	Not summer dry		
Grazing Residuals Milking cows	Cows offered quality feed and well fed by - selective grazing - topping - conservation - fast rotation lengths (used to suppress growth at peak growing times)	Cows graze to a consistent and even residual. If left uneven for one grazing can restore quality by bringing cows back sooner, or top/conserve (if necessary)	Need to leave no more than 7-8 clicks 1500 -1600 kg DM/ha to prevent pre-grazing cover being too high and canopy closure
Pre-Graze Cover	2100-2400 kg DM/ha	2500-2800	3000-3100
Wintering	Low	Moderate	High demand for grazing off and/ or conservation
Rotation Length	Fast rotations 'from when pasture growth gets ahead of herd demand (balance date) to autumn; 10 days peak growth Early Spring – fully feeding cows is the driver, not rotation length Winter –faster rotation than conventionally stocked systems	Min rotation length 18 days Use spring rotation planner (SRP) to allocate feed	Minimum rotation length 21-23 days Autumn – round length rules e.g. 40 day by 15th March Spring -Need to use SRP Winter – most cows off as need bank of feed
Planned Start of Calving to magic day (when pasture growth gets ahead of herd demand- balance date)	55-60 days	55-60 days	50-55 days
Cover at calving	Keep less than 2200 kg DM/ha to ensure that pre-graze cover not too high	22-2300 kgDM/ha	2400-2500 kg DM/ha plus some supplement for poor spring
Harvesting supplement – length of closure	Max 40 days	Max 40 days	Harvest at time taken out of round and no more than a week out of the round
Supplements		Need spare supplement for adverse events	Need spare supplement for adverse events
Culling	Minimal culling, low producers only to maximise DIM	Summer dry – cull early	Summer dry – cull early; all culls gone early autumn
Drying off	Production per cow and days to calving	Cow condition and feed cover Need to have clear decision rules especially if summer dry	Cow condition and feed cover Need to have clear decision rules especially. if summer dry

	Stocking Rate		
	Low	**Medium**	**High**
Environment	Milking later into autumn and winter. Risk of pugging.		Higher risk as more cows wintered and prone to pugging damage More effluent to manage Grazing residual and effluent application
Adverse weather	Medium	Medium	High
Financial risk	Need to achieve production targets Cost control	Cost control	Cost control Poor season flows onto following season
Skill	Hardest time to manage a farm is in a feed surplus; farm in feed surplus for at least 50% of the season Anticipation of spring pasture surpluses		Sticking to management rules and not pugging Prediction of deficits and acting early e.g. drying off autumn
Reproduction	Need tight calving spread to maximise DIM Top reproduction management – high stockmanship		Cows not CS 5.0 at calving; poor allocation of spring feed cows < CS 4.0 at mating

References

Clark, C.E.F. McLeod, K.L.M. Glassey, C.B. Gregorini, P. Costall, D.A. Betteridge, K. Jago J.G. 2010. Capturing urine while maintaining pasture intake, milk production, and animal welfare of dairy cows in early and late lactation. J. Dairy Sci. 93: 2280-2286.

Macdonald, K. A.; J. W. Penno, J. A. S Lancaster, and J. R. Roche. 2008. Effect of stocking rate on pasture production, milk production and reproduction of dairy cows in pasture-based systems. Journal of Dairy Sci: 91: 2151-2163

Macdonald, K.A., and Penno, J.W. 1998. Management decision rules to optimise production on dairy farms. Proceedings of the New Zealand Society of Animal Production 58: 132-135.

Penno, J. 2003. Farm systems that work for you. Proceedings of the 1st Dairy3 Conference. 1: 125-132.

Further reading

DairyNZ Farmfacts. 1-2. Principles of Grazing Management. 2008. http://www.dairynz.co.nz/file/fileid/6973

DairyNZ Farmfacts. 1-12. Spring Rotation Planner – Principles.2008. http://www.dairynz.co.nz/file/fileid/8956

DairyNZ Farmfacts name. date. Web address.

DairyNZ Farmfacts. 1-13a. using the Spring Rotation Planner. How to calculate area grazed. 2008. http://www.dairynz.co.nz/file/fileid/8943

DairyNZ Farmfacts. 1-13b. Using the Spring Rotation Planner. How to allocate feed. 2008. http://www.dairynz.co.nz/file/fileid/8953

DairyNZ Farmfacts. 1-30 Summer Management Overview. 2008. http://www.dairynz.co.nz/file/fileid/4344

DairyNZ Farmfacts. 1-31. Summer management Plan. http://www.dairynz.co.nz/file/fileid/4345

DairyNZ Farmfacts. 1-32. Setting up for a dry summer. http://www.dairynz.co.nz/file/fileid/4346

DairyNZ Farmfacts. 1-33. Management in a dry summer. 2008. http://www.dairynz.co.nz/file/fileid/4347

DairyNZ Farmfacts. 1-34. Summer Nutrition. 2008. http://www.dairynz.co.nz/file/fileid/10889

DairyNZ Farmfacts. 1-35. Summer deficit feed budget – how many cows to milk. 2008. http://www.dairynz.co.nz/file/fileid/19761

DairyNZ. Condition Scoring. 2008. http://www.dairynz.co.nz/page/pageid/2145836848

DairyNZ. Is it fit for transport?. 2009. http://www.dairynz.co.nz/file/fileid/18854

DairyNZ. The InCalf Book. 2008. http://www.dairynz.co.nz/page/pageid/2145838461

Appendix:

A brief summary of a set of decision rules (adapted from Macdonald & Penno, 1998).

Cow condition:

Cow condition provides a measure of the amount of energy stored as body fat on cows within the herd. Likewise, average herbage mass provides a measure of the amount of feed energy available within the farm systems at any given time. Meeting the required cow condition and average herbage mass targets is more important in spring than at any other time of the year as severe underfeeding at this time can impair herd performance for the remainder of the season. So, all management decisions need to be geared around these two points to ensure a profitable and sustainable system in used on the farm.

The target calving condition score for all cows is 5.0 (1 to 10 scale) for older cows, and 5.5 for 2 and 3 year old cows. An increase of one body condition score unit has been shown to increase production by 15 kg MS/cow and be worth approximately $40/cow in reproduction benefits.. Thus a decision has to be made on when to cease lactation to allow the cows adequate time to get back to BCS of 5.0. Rules on days required to allow for this and feeding levels to achieve this are needed.

Pasture management:

Autumn/winter management. – Set up the farm to achieve the desired pasture cover at calving. Target APC for calving is 2200-2400 kg DM/ha, depending on the comparative stocking rate and date of calving relative to when pasture growth will get ahead of herd requirements.

Winter grazing rotation length controls dry matter intake by altering the pasture allowance of the dry herd. Therefore, longer rotations result in more pasture being available at the end of winter.

Spring rotation planner - Feed requirements generally exceed pasture production for several weeks after calving. Therefore, the aim of spring grazing management must be the allocation of pasture to optimise pasture and milksolids production. This is done by ensuring the grazing interval does not get less than 20 days before growth exceeds herd requirements.

Spring management - From when pasture growth exceeds herd requirements in spring, surplus pasture must be removed from the grazing area to maintain appropriate post grazing herbage mass, pasture quality and subsequent milksolids production. At the same time the herd must be generously fed to maximise milksolids production, and meet reproductive performance objectives. To ensure pasture quality is maintained, and the herd properly fed, surplus pasture is identified and harvested according to a formula or set of decision rules.

Summer management - The key is to have a plan and to make timely decisions based on the best available information. Having no plan, coupled with indecision, leads to unnecessary stress and lower profit. Whatever the summer conditions, the first management rule is to use spring pasture fully and efficiently before dry and hot conditions reduce the growth and quality of pasture.

The use of supplements - Supplementary feeds are of greatest benefit when the carry-over effects of substituted pasture mass, and spared cow condition, are captured within the system or in severe feed deficits. In a seasonal dairying system the period of greatest feed deficit is invariably late autumn/early winter when pasture growth is declining, rotation length is being extended and the potential lactation length of many cows is unmet. Therefore, greatest benefits come from using supplements to extend the grazing rotation immediately after summer rains.

Reproduction - To achieve high pasture utilisation in early spring, a concentrated calving pattern is required before the onset of spring growth. The combined effect of an early planned start to calving and a concentrated calving period may add 25 more days in milk for each cow, right at the start of the season. The primary cause of poor fertility in NZ dairy herds are anoestrous cows and poor heat detection. Having MA cows calve at BCS 5.0, and first and second calvers at BCS 5.5 is the second greatest way to prevent anoeustrous cows other than a compact calving. Heat detection is a critical job and deserves the time and cost to ensure all cows on heat are mated. Training (showing not telling) of all staff needs to be done annually. The best results are achieved with paddock observations and use of aids – tail paint or heat/mounting detectors. To enable a compact calving spread (6 weeks) it is necessary to ensure that 95% of the herd is inseminated within 28 days of the PSM. Use the InCalf approach to plan how to improve reproductive performance on your farm.

DairyNZ farmfact

Comparative Stocking Rate (CSR): Definition and link to farm performance and Operating Profit (1-4a)

Comparative Stocking Rate (CSR) provides an alternative to the traditional measure of cows per hectare (ha). It is a method of assessing the balance between feed demand and supply on farm. As farms now import significant amounts of supplements, cows per ha is an inadequate description of this balance, and can be misleading when comparing farms which vary in the amount of brought in feed/ha, or have different breeds (e.g. Holstein -Friesian versus Jersey). CSR, along with other indicators, improves the estimation of the balance between annual feed supply and feed demand.

Comparative Stocking Rate is

$$\frac{\text{Average lwt (kg/cow) x no. cows/ha}}{\text{total feed (t DM)}}$$

where

Average liveweight (kg per cow) is for the herd (including first calvers) as measured or estimated two months before calving starts.
and **total feed** is the total amount of feed supplied to the herd over 12 months including pasture, crops and any bought in supplement or cow grazing. This is best expressed as t DM/ha (see Penno, 1999).

Why use CSR instead of cows/ha?

Describing stocking rate in terms of cows/ha is popular because it uses real measures, cows and hectares that can be made easily. But cows/ha has the following inadequacies.

1) *Cows are not the same weight*

Liveweight impacts on the feed requirements per cow and changes feed demand per ha. For a similar level of milksolids (MS) production per cow a smaller cow has a lower annual feed requirement than a heavier one (*see Table one*).

Table 1: The feed requirements (t DM/cow) of three dairy breeds if each is producing 400 kg MS/cow

	Friesian	Crossbred	Jersey
Average herd liveweight (kg/cow)	500	450	400
Annual Feed Requirements to produce 400 kg MS per cow.*	5.5	5.3	5.0

* assumes average energy content of feed eaten of 11.0 MJ ME/kg DM.

2) Not all hectares grow the same amount of feed

Pasture production per ha across New Zealand can vary two-fold within and between dairy farms. The range is approximately 10 to 20 t DM per ha. A farm at the lower end of this range could be appropriately stocked by fewer than two typical Jersey cows per ha, and not rely on significant purchased feed (*see Table 1*). Using the cows/ha indicator means that commonly this farm could be considered under-stocked rather than appropriately stocked.

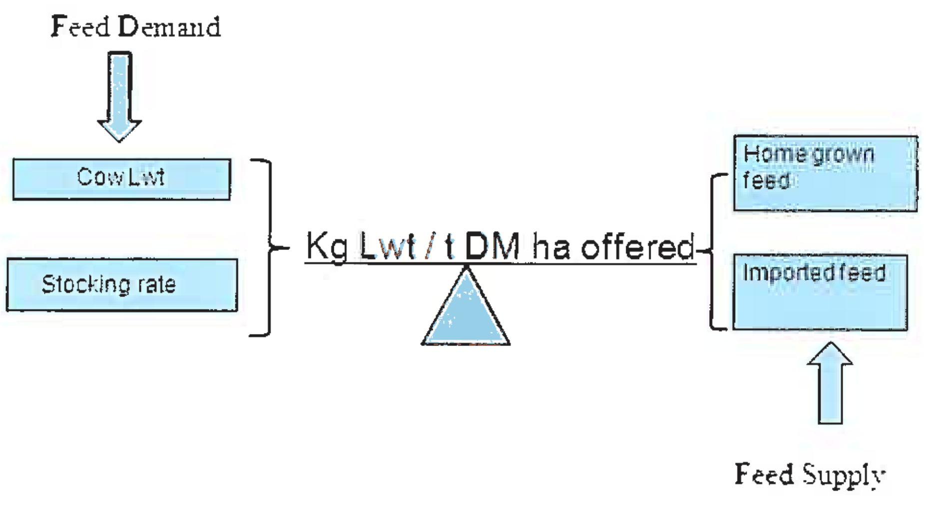
3) Imported feed/ha is not counted using cows/ha.

Imported feed per ha varies widely between farms, from none (system 1) to more than 40% of total feed (system 5). Farms adding large amounts of imported feed can increase stocking rate to more than 5.0 cows/ha and still provide adequate annual feed per cow.

Using CSR to balance feed supply and feed demand

Comparative stocking rate describes the balance between the total feed supply and the feed demand on a farm. When the feed supply and feed demand are well matched a balance occurs (think of a balanced seesaw, Figure 1). Where an imbalance occurs, physical and economic inefficiencies result, e.g. cows not well fed, extra costs incurred, insufficient milk revenue. Adjustments need to be made to restore balance. A CSR calculation can be used retrospectively to confirm (along with other indicators) if the feed supply and feed demand are in balance. Improved information will result when several successive years can be analysed for the farm. CSR can also be used to predict how proposed changes in feed demand and supply will impact farm performance in the future.

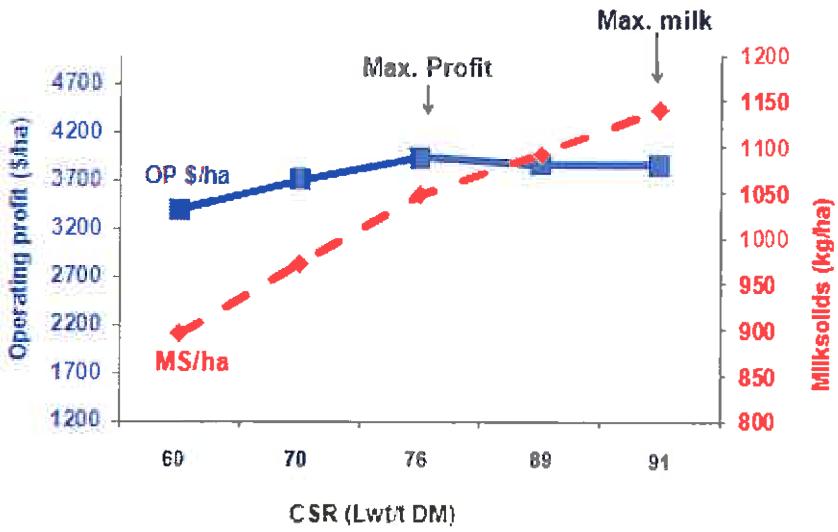
Figure 1: The components of CSR which need to be balanced for efficient and economical milk solids production



Optimum CSR for Maximising Profit

A research farmlet trial (Macdonald et.al. 2008) identified that there is an optimum CSR for operating profit /ha. This is less than the CSR required to maximise MS production/ha (Figure 2). The trial compared five herds over a range of CSR from 60 to 91 kg Lwt/ t DM for three years. Operating profit was maximised at a CSR of 76, while MS/ha was maximised when CSR was 91. The drop in profitability was not large as CSR changed either side of the optimum. This indicates other important management decisions can reduce the impact of not optimising CSR.

Figure 2: The relationship between CSR, operating profit /ha and MS production /ha from farmlet trials near Hamilton, 1998-2001. (Macdonald et.al. 2011)



Managers of a new farm could use an estimate of optimum CSR to determine the herd size and annual feed requirements. The optimum CSR for a dairy farm can change over time and is influenced by changes in cow genetic merit, input costs, feed grown and milk price. While a farm's CSR may not need to be changed frequently, it is important that farmers regularly (annually) calculate CSR as one indicator of the farm's likely efficiency and profitability. Factors that are likely to impact on feed supply and feed demand and, therefore, CSR are:

1. Improved genetics (Breeding Worth) leads to higher annual feed requirements per cow, increasing feed demand even with a constant herd size. For example there is evidence that 20 years of genetic gain in the NZ Holstein-Friesian reduced CSR at the point profit /ha was optimised. As a herds breeding worth ($BW) increases, they require increases in annual feed allowance per cow over time to optimise profit.

2. Farming within nutrient limits will require some NZ dairy farmers to reduce farm N surplus, requiring a reduction in N input, (both fertiliser and additional feed). This will reduce feed supply/ha and force a re-examination of CSR for these farms if annual feed allowances per cow are to be maintained or increased.

Analysis of data from 20 years of farmlet research at DairyNZ has determined relationships between changing CSR and changes in farm performance. (Glassey et.al. 2012)

Reducing CSR by 10 units will result in

- Decreased pasture utilisation of 5%;
- Increased MS/cow of 45 kg MS/cow;
- Increased MS as a percentage of Lwt of 7.5%.

The study confirmed that a reduction in pasture utilisation/ha could be expected when reducing CSR, but the expected increase of 45 kg MS/cow could compensate for uneaten pasture provided pasture utilisation is maintained at more than 70%.

Managing a lower CSR can be challenging and will require changes to pasture management and feed allocation.

To optimise profitability, research suggests that CSR is 75-80 kg Lwt/ t DM offered.
Many highly profitable dairy farms already operate with a CSR in the range from 75 to 80 kg Lwt/t DM. Profit is expected to be maintained for well-managed reductions of CSR, where an imbalance between annual feed supply and feed demand previously existed (e.g. CSR more than 85 kg Lwt/t DM offered).

References:

Glassey ,C., Douglas,R., McCarthy,S., Macdonald,K., Hedley, P.,Brazendale . 2012 Impact of stocking rate and feed use on milksolids production and pasture utilisation in New Zealand pasture based farm systems. *Proceedings of the 5th Australasian Dairy Science Symposium, Melbourne, September, 2012 Pp174-176.*

Macdonald,K.A., Beca,D., Penno,J.W, Lancaster,J.A.S., Roche,J.R (2011) Effect of stocking rate on the economics of pasture based dairy farms. *Journal of Dairy Science* **94**, 2581–2586

Macdonald,K.A., Penno,J.W, Lancaster,J.A.S., Roche,J.R (2008) Effect of stocking rate on pasture production, milk production and reproduction of dairy cows in Pasture-Based Systems. *Journal of Dairy Science* **91**, 2151–2163

Penno, J. 1999. Stocking rate for Optimum Profit. Proceedings of the South Island Dairy Event, 1999. Pages 25-43.

DairyNZ farmfact

Calculating Comparative Stocking Rate - CSR (1-4b)

This Farmfact describes the calculation of Comparative Stocking Rate (CSR) for a farm, and how the result is interpreted. Farmfact 1-4a introduces and defines CSR and the following link - www.dairynz.co.nz/csrcalc - will take you to a purpose built CSR calculator at a farm level.

The CSR calculation is a check for the appropriate balance between annual feed supply and feed demand for a farm.

How to calculate CSR (kg liveweight /tonne dry matter) for your farm

You will require;

1) An estimate of pasture grown (tonnes DM per ha) for your farm. Ideally, annual pasture growth will have been estimated from farm walks on your farm or a similar farm in your district. If not, then estimates for your farm can be obtained from the pasture eaten calculation in DairyBase, or other similar estimates of pasture eaten based on energy requirements for production and maintenance. (See DairyNZ Facts and Figures, Cow feed requirements, page 7). Allow for any bought in supplements fed or winter grazing purchased. Divide pasture eaten/ha by 0.8 (80% utilisation) to obtain estimated pasture grown /ha. i.e. 14 tonnes DM/ha pasture eaten = 17.5 t DM/ha pasture grown. 80% utilisation represents good management. Be realistic and obtain other opinions on whether this figure should be used as a default or altered to suit your farm.

2) Actual or estimated average liveweight per cow for your herd. The recommended times of year for liveweight to use in the calculation are either 1) two months before start of calving, or 2) mid-lactation, usually early December. Either weigh a sample of your herd or use default values based on breed of cow. (NZ Dairy Statistics, 2011-12, Table 4.7, page27. www.dairynz.co.nz/dairy statistics

3) An estimate of the kg DM supplied in supplement or cow grazing supplied from outside the milking area.

In Table 1, data for an example farm are provided in column 1. In column 2 there is room to enter your farm data for a CSR calculation relevant to your farm.

Example farm assumptions

In addition to the pasture grown on the milking platform this farm uses the following feed

1.3 t DM/ha imported feed

2.5 t DM/ha winter feed

An assumption is made that pasture utilisation (% of the pasture grown) is high at 90%.

Table 1: The CSR calculation for the example farm with space to calculate this for your own farm

	Column 1 Example Farm-current situation	Column 2 Calculations required.	Column 3 Your figures
Hectares	100		
Cows	383		
Cows per hectare	3.83		
kg MS/cow	350		
kg MS/ha	1344		
Cow liveweight	500 kg		
Lwt/ha	1915	Cows/ha x cow liveweight	
Step 1) Pasture eaten per ha TDM/ha	16.1	Cow feed requirements Fact and Figures page 7 A 500 kg cow producing 350 kg MS needs to eat 5.2 TDM. 3.83 cows/ha x 5.2 =19.9 t DM/ha. Subtract the 3.8 t DM/ha from outside the milking platform, (see above assumptions) = 16.1 t DM/ha pasture eaten	
Step 2) Estimate of pasture grown	17.9	16.1 t DM/ha pasture eaten divided by 0.9 assuming 90% pasture utilisation	
Step 3) Imported feed t DM/ha	1.3		
Step 4) Winter Grazing	2.5		
Step 5) Total Feed Supply t DM/ha	21.7		
Step 6) kg Liveweight /ha	1915		
CSR calculation kg lwt/t DM	1915/21.7 = 88	Liveweight /ha divided by total feed supply /ha	

In the example farm a CSR of 88 kg LWT/t DM is calculated for the situation in column 1 of the table. The optimum CSR is between 75- 80 kg LWT/t DM.

The following is how to go about calculating the reductions in cows and or additions in feed required to achieve the optimum CSR:

1) Lower cow numbers

to reduce CSR from 88 to between 75-80 CSR.

- Feed supply x desired CSR = target kg Lwt/ha
- 21.7 t DM/ha x 80 kg Lwt/t DM = 1736 kg Lwt/ha
- 500 kg cow liveweight.
- New cows/ha = 1736/500 = 3.47 cows /ha
- New herd size = 100 ha x 3.47 = 347 cows.
- This is a maximum figure. The lower end of the range (75 CSR) calculates as 1628 kg Lwt/ha or 3.25 cows/ha or 325 cows.

2) Calculating the extra amount of purchased feed required to retain the same cow numbers.

The current Lwt/ha of 1915 kg is divided by the target CSR of 80 to provide the t DM/ha required.

1915/80=23.9 t DM/ha, an increase from 21.7 t DM/ha

So an additional 2.2 t DM/ha is required (23.9-21.7).

The profitability and farm performance of both these scenarios needs to be predicted to help determine which option will match the farms circumstances and objectives.

This can be done by using the relationships between CSR and farm performance determined by an analysis of 20 years of farmlet studies at DairyNZ (Glassey et. al. 2012).

In this study significant relationships were identified between CSR and:

- Annual pasture utilisation - a reduction in CSR of 1 unit resulting in 0.47% reduction in pasture utilisation
- Milksolids per cow - a reduction in CSR of 1 unit resulting in an increase in MS/ cow of 4.5 kg
- Milksolids production per kg LW - a reduction in CSR of 1 unit resulting in an increase in MS as % of LW of 0.75%.

From this it can be predicted that reducing CSR by 8 units (from 88 to 80) will result in

- Decreased pasture utilisation of 3.8 %; (from 90% to 86.2%)
- An increase of 36 kg MS/cow; (from 350 to 386 kg MS/cow)
- Increased MS as a percentage of Lwt of 6 %. (from 70 to 76%)

Table 2: Predicted outcomes of farm performance for the example farm, where CSR is lowered by 12 units, from 88 kg Lwt/t DM to 80 kg Lwt/t DM

	Example Farm (current situation)	Scenario 1 Reduce herd size	Scenario 2 Buy more feed
Description	88 CSR 3.83 cows/ha 1915 kg Lwt/ha	80 CSR 3.47 cows/ha, 1736 kg Lwt/ha	80 CSR same herd size 2.2 t DM/ha more feed, 3.83 cows/ha, 1915 kg Lwt/ha
kg MS/cow	350	386	386
kg MS/ha	1344	1339	1478
Pasture utilisation %	90	86	86

A reduction in CSR with no change in feed supply (scenario one; Table 2), would enable MS/ha to be maintained at current levels. Where CSR is reduced by importing additional feed (scenario 2) the prediction is an increase of 134 kg MS/ha. The consequences of choosing either alternative, requires information on how the economics and environmental indicators will perform.

Environment: Because more feed/ha is required to operate scenario two, nitrogen (N) loss/ha will increase compared with the base scenario, unless there is investment in N loss reduction strategies. Choosing scenario one would not be expected to change N loss/ha significantly compared with the base scenario. A slight reduction in pasture eaten/ha may occur.

Economics: Increased profitability of scenario one will depend on the magnitude of savings by having fewer cows on the farm. For a 350 ha farm, the reduction of 0.36 cows/ha equates to a 126 cow reduction in herd size and a potential saving of one staff member. Scenario two would incur additional costs of purchasing and feeding additional feed, possibly some infrastructure costs, and the variable and capital costs of retaining cows.

Reference:

Glassey, C., Douglas, R., McCarthy, S., Macdonald, K., Hedley, P., Brazendale. 2012 Impact of stocking rate and feed use on milksolids production and pasture utilisation in New Zealand pasture based farm systems. *Proceedings of the 5th Australasian Dairy Science Symposium, Melbourne, September, 2012 Pp174-176.*