Dairy Farm Practices and Management Report

An analysis of three policy options for future nutrient management on Taranaki dairy farms

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Executive Summary

The purpose of this report is to provide an opinion on three policy options identified by Taranaki Regional Council that need to be examined for the dairy farming industry in Taranaki.

The three policy options examined were:

- Status quo- business as usual with on-going encouragement of farmers to achieve good management practice on farms
- On farm mitigation requiring mandatory fencing and riparian management for all waterways, land based effluent disposal in all but exceptional circumstances and encouragement of farm good management practices
- Nitrogen cap plus other farm mitigation

Effluent management aside, Options one and two are similar in expecting water ways fenced and riparian margins managed with timeframes to have this work completed before a regulatory regime is implemented for those yet to meet the deadlines. The major difference between these two policies is implementing land based effluent irrigation in all but exceptional circumstances.

In relation to the first two policy options, this report finds that:

- If the rate of fencing experienced in the past two years continues fencing of waterways will be completed by 2020
- The past two years planting rate of 300km per year will need to double to achieve 90% waterway riparian planting completion
- A long payback period would be required if the cost of irrigator systems is weighed up against the nutrient benefit. It should not be assumed that land application is a zero cost or economically advantageous for dairy farmers
- A policy of discharge of FDE to land only, other than in exceptional circumstances, is workable and can be implemented in the majority (but not all) cases with moderate ease and minimal cost in respect of being able to utilise existing pond storage systems.
- Those farms with high rainfall and large catchment areas and or high risk soils will struggle to implement a solely land based effluent irrigation system and in some cases will never be able to meet the requirements of land only application
- A universal discharge to land policy is not practically workable. The consequences in practice would see some farmers forced out of dairying on their land

The third policy option of an introduced N cap of either 48kgN/ha/year or 30kgN/ha/year was also examined. Insufficient data was held of farms with leaching above 48kgN/ha/year to allow any meaningful analysis of the impact of this policy. Therefore this report focuses on the 30kgN/ha/year nutrient cap.

- Use of a nutrient cap is rejected for a number of reasons outlined in the report, particularly because farmers would feel obliged to manage their farms according to Overseer instead of according to good management practices, a sound understanding of their land and landscape, and the day to day changes and demands of farming activity
- A nutrient limit on land use would be inequitable, carry high implementation and high compliance costs, and be unable to achieve the desired outcomes on a sub-regional or

regional basis, because of variation in soil characteristics, topography, hydrology, and weather patterns, from farm to farm. Many of the factors driving a relatively high rate of nutrient loss are outside a farmers control on a day to day basis
- There are a relatively large number (40%+/-) of farms which simply would be unable to achieve a 30kgN/ha/year Overseer limit. The consequences of such a limit in practice would be farmers forced off their land and loss of land productivity
- Even for those farms able to meet a 30kgN/ha/year cap, in some cases the extent of changes and attendant costs to existing farm practices and farm productivity may mean costs are substantial and benefits negligible
- There is a considerable financial cost to the industry of meeting a N cap of 30kgN/ha/year.

The report compares Taranaki with the rest of the country and finds Taranaki's dairy farming practices are different. In general, the region is wetter, farms are smaller, there is less capital investment and infrastructure is older.

It should be noted that this analysis is for the Taranaki Region only. It should not be taken as having application in part or whole to any other region or to the content and implementation of any regional plan elsewhere.

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Introduction

Taranaki Regional Council (TRC) is currently undertaking a review of its Regional Freshwater Plan. TRC have identified three possible policies that need to be examined for the dairy industry. The purpose of this report is to consider and express an opinion on three policy options suggested by TRC in regards to maintaining and enhancing water quality on land where dairying occurs.

The three options investigated are:

Option One – *Status Quo*

This option involves continuation of the voluntary Riparian Management Programme which involves the following initiatives (note: the Council has proposed that the fencing target will increase to 100% in the 2015-2025 LTP):

- Eventual completion across an anticipated 90% of the region of existing voluntary fencing of waterways
- Eventual completion across an anticipated 90% of the region of existing voluntary planting of waterways
- On-going liaison and support
- Encourage the existing trend of increasing disposal of farm dairy effluent to land
- Encourage good management practices (GMP) on dairy farms (including feed pads and nutrient budgeting)
- Control the application of farm dairy effluent onto or into land not exceeding 200kg N/ha/yr and with separation zones between application areas and waterways

Option Two – *On-farm Mitigation*

This option involves the regulating the effects of land uses by:

- Making fencing and riparian management mandatory for all waterways through intensive pastoral land use
- Requiring timely full completion of the Riparian Management Programme
- Requiring land disposal of dairy farm effluent in all except exceptional circumstances
- Encourage good management practices (GMP) on dairy farms (including feed pads and nutrient budgeting)
- All by 2020

Option Three – *Nutrient Cap plus other on-farm mitigation*

This option involves a scenario for setting nutrient caps e.g.:

- Set a nitrogen baseline of either 48 kg N/ha/year or 30 kg N/ha/year (defined as the discharge of nitrogen below root zone as modelled by OVERSEER expressed in kg/ha/yr) and any activity (i.e. any farm) that causes the nitrogen baseline to be exceeded is a discretionary or even non-complying activity

Regional Overview

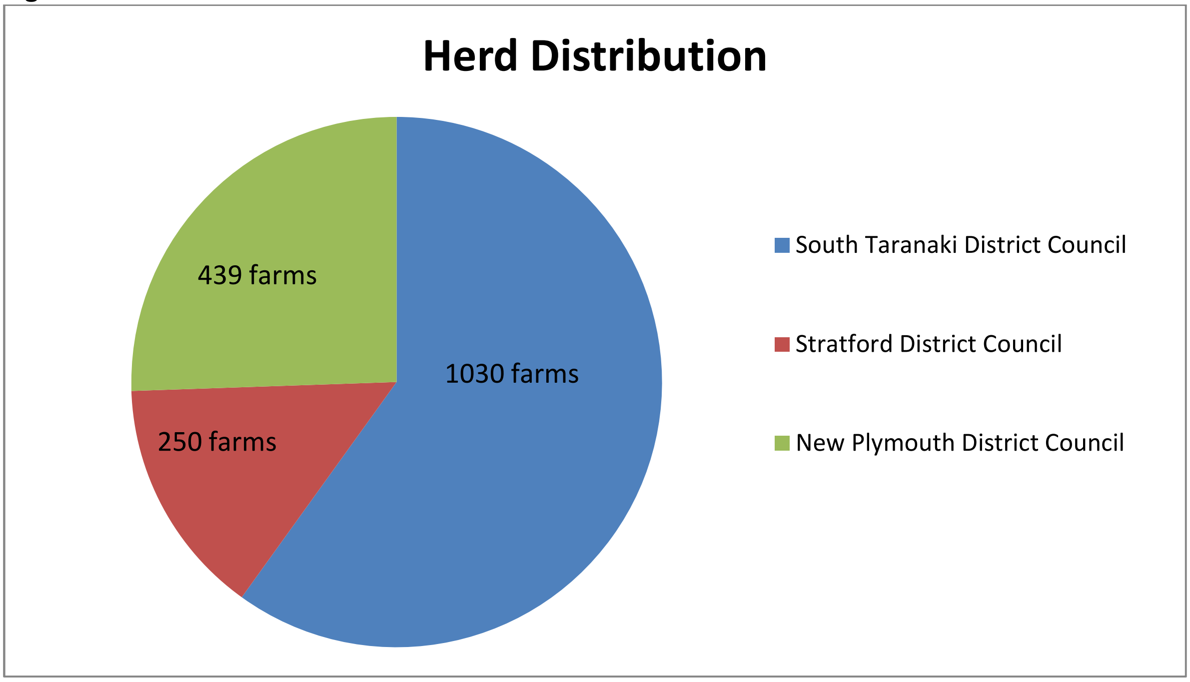
Dairy farming in Taranaki has been established for many decades and comprises 13% of Taranaki's GDP. The dairy industry employs 4085 people in Taranaki which accounts for 8.3% of the total Taranaki employment. In the 2013-2014 season the region produced 184 million kgs milk solids with a value of $1.4 billion to the regional economy[1]. The region is known for its free draining, fertile soils and reliable rainfall. Mount Taranaki at 2,518 meters in height has a significant influence across the province creating many microclimates around the ring plain. Climatic conditions can have large variations across the province meaning there is no typical Taranaki Farm. With an average effective area of 101 ha and average herd size of 287 cows, by national standards, dairy farms in Taranaki are small when compared with North Island figures of 122ha and 338 cows and National figures of 144 ha and 413 cows.

The region's dairy farms are diverse in nature ranging from sea level coastal terraces with sandy soils and 1200mm average rainfall in South Taranaki, to Central Taranaki at 400 meters above sea level with ash loam soils and rainfall up to 4 metres per annum. Most of Taranaki soils could be considered free draining apart from a small area around Eltham where some Peat soils are found.

Implementation by the Taranaki Regional Council of a voluntary riparian planting scheme has seen improvement to water quality at the Regional Council monitoring sites.

In Taranaki only a very small number of dairy farms are irrigated. These are mainly located in South Taranaki. With a number of conversions happening in South Taranaki, in areas where cows often went for wintering, winter grazing is now becoming scarce and subsequently expensive.

Figure 1: Herd Distribution in Taranaki



[1] http://www.dairyatwork.co.nz/media/16643/QuickStats-about-dairying-Taranaki.pdf

Table 1: Farm ownership or management in Taranaki:-

Total number of farms	Lower-order Sharemilkers/contract milkers	50/50 Sharemilkers	Owner Operators
1,719	356	345	1018

Table 2: Dairy Farm Statistics for Taranaki

. Region	Total herds	Total area (eff. ha)	Milk solids (kgs)	Average herd size	Average farm area (eff. ha.)	Per cow production (kg MS /cow)	Stocking rate (cows/eff. ha)
Taranaki	**1,719**	**173,022**	**184,823,225**	287	**101**	**375**	**2.85**
North Island	8,859	1,081,381	1,066,263,585	338	122	357	2.77
New Zealand	11,927	1,716,464	1,824,971,520	413	144	371	2.87

Regional Farming challenges

DairyNZ's Taranaki Regional team have identified challenges facing the dairy industry in Taranaki and have targeted these areas for on farm change. Reproduction performance and pasture persistence are not only a challenge to Taranaki farmers but are common challenges around the country and have a large impact on farm financial and environmental performance.

Succession planning and governance are seen as challenges for Taranaki. With small, old established farms in this region, it can be difficult to meet the growing cost of compliance and have the ability to make good long term decisions on future management and policy of the farming business. Succession planning can be difficult on these small family farms, where incomes generated can be small compared to the capital cost of the business and the subsequent difficulties in passing the land from one generation to the next

Below is a list of regional issues and challenges facing the dairy industry.

South Taranaki Summary

Farming type

- Very strong dairy farming area with some heifer support blocks in Whenuakura & Waverley.
- Stocking rates have been increasing over the last 10 years due to intensification. Stocking rates range between 1200kgLWT/ha to 1500kgLWT/ha with the average at 1300kgLWT/ha
- Farm systems range between 1 – 4 with the majority being a system 3[2].
- Most farmers are using supplements as a means of lifting production &/or using this to fill in feed deficits. Maize silage is common with concentrates being fed if the farm dairy is fitted with the necessary technology. Often farmers are feeding 400 – 600kgDM/cow/year of brought in feed. Proliq is not common in South Taranaki unlike coastal Taranaki.
- Approximately 2% of the farmers in the area irrigate the farm with fresh water (not including effluent irrigation).

[2] System 3 - Feed imported to extend lactation (typically autumn feed) and for dry cows. Approximately 10-20% of total feed is imported

- About 40% of farmers grow a summer crop, either chicory or turnips with a big shift from turnips to chicory in recent times. Increasing use of fodder beet.
- The coastal strip is mostly flat contour with often farmers being able to mow approximately 80 -90% of the farm. Closer to the east hill ranges this drops to 60 – 80% of the farm.

Major Challengers

- High land values which results in an extended amount of time for sharemilkers to achieve land ownership. This also complicates farm succession.
- Attracting labour due to the distance from the major city centres.
- Ability to find land for grazing replacement stock is getting more difficult and expensive due to recent conversions of grazing blocks in the Whenuakura/Waverley area into large dairy farms.

North Taranaki Summary

Farming type

- Predominantly dairy farming with a steady rise in lifestyle farming blocks.
- Stocking rates average 1260 kg LWT/ ha with higher stocking rates due to higher live weights in Friesian genetics-based herds.
- Farm systems predominantly fall into System 2 and 3.
- Supplements are used to a) boost production (PKE is major supplement) and b) allow resilience against summer dry period (PKE, maize silage, bought-in silage and summer crops).
- Irrigation does not occur on farms.
- Investment is taking place on some farms to upgrade effluent system to use nutrients.
- Wetter and higher altitude areas (i.e. Egmont Village south) are showing an increase in the number of animal shelters being built.

Land type

- Contour varies throughout the area but all land is on free-draining ash alluvial soils with good fertility and relatively low risk of pugging due to free-draining capacity.

Major Challenges

- Summer dry conditions are stated as the largest issue for North Taranaki farmers.
- The increase in lifestyle blocks pose some issues, including noise complaints from neighbours, as well as pushing up land prices.
- Availability of feed supply if relying on supplementary feeds to get through summer dry period.

Coastal Taranaki Summary

Farming Type

- Predominantly Dairy farming throughout the area, some dairy grazing blocks along the Wiremu Road and surrounding areas
- Coastal farming for the most part has not changed to the north of the area and under the mountain as the land is more challenging and costly to redevelop. Grass based farming with some PKE and grass silage brought. Closer to Manaia / Opunake there is intensification happening with farm systems growing more feed on farm or buying in supplementary feed to fill feed shortages and extend lactation as the summers can be harsh.

- Average liveweight can vary from around 1250kgLwt/ha – 2500kgLwt/ha (system driven) with the majority sitting around 1400kgLwt/ha
- Cropping is becoming more widely used to fill summer feed deficits, the crop of choice is still yurnips as this is a good opportunity for the beginning of the regrassing process

Land Type

- From Manaia through to Rahoutu the land is flat to rolling, the coastal areas having a lot of sand based paddocks. Further north lahars dominate the topography and higher up under the mountain the terrain is dotted again with lahars, rolling land and swamp area. Most farms in the coastal area will have one if not more streams and/or rivers running through them.

Major Challenges

- Land limitations, under developed farms further north need specific grazing management throughout the year as they are unmowable, the lahars super heat in summer and grass growth is slowed if not stopped for a period of time.
- Waterways and drainage are on almost every farm, management of these with fencing and riparian planting has been a big undertaking – but one that has been met well with the locals
- Due to the topography the ability to map out a large area for effluent irrigation is limited

Central Taranaki Summary

Farming type

- Predominantly dairy farming with a steady rise in lifestyle farming blocks.
- Stocking rates average 1100 kg LWT/ ha to 1500 kg LWT /ha
- Farm systems predominantly fall into System 2 and 3.
- Supplements are used to a) boost production (PKE is major supplement) and b) allow resilience against summer dry and extreme wet periods (PKE, maize silage, bought-in silage and summer crops).
- Irrigation does not occur on farms.
- Investment is taking place on some farms to upgrade effluent system to use nutrients.
- Wetter and higher altitude areas are showing an increase in the number of animal shelters being built.
- Many farms smaller in size with single operator, couple, or one employee
- Many farms have a multiple pond effluent system
- Crops grown on some farms (turnips & Maize)

Land type

- Contour varies throughout the area ranging gentle sloping under the mountain to steep hill country in the East
- Ratapiko and Ngarae have peat swamp areas.

Major Challenges

- Traditionally the wet winter/spring period has been the greatest issue for Central Taranaki farmers.
- Radiating streams from the mountain means that most farms have many waterways
- Farms further out have limited cell phone coverage, and poor reliability of internet

- Cost of getting trades due to travel (e.g. electrician, machinery service technicians etc.)

Waterways and Effluent

The current situation

Waterways

TRC's riparian management programme was introduced in 1993 to address the degradation of water quality from diffuse source contamination. Council prepares riparian management plans and recommends both fencing and planting (where appropriate) for all waterways on a property. Council now has 2,500 riparian plans in place, including for 99.5% of all dairy farms.

In 2004, to supplement its current riparian management programme, TRC collaborated in the development of a Regional Action Plan (RAP) for Taranaki under the clean streams accord. The RAP has now been surpassed by the Sustainable Dairying Water Accord (SDWA). The SDWA only targets waterways wider than 1m and deeper than 30cm, therefore, Council's riparian programme captures up to 25% more waterways than the accords' targets. This is significant as generally first order streams are the first conduits for overland runoff which degrades water quality. Furthermore, the SDWA has a completion date of 2030 for 100% riparian management.

Since 2008, the focus has been on increased implementation of fencing and planting through one on one engagement. Table 3 below shows that to the end of June 2014, 3,558 kilometres of fencing and 1765 kilometres of planting have been established; taking into account pre-existing fencing and planting, this effort has to date resulted in 80% of all targeted waterways protected by fencing and 65% of all targeted waterways protected by appropriate vegetation. At the rate of fencing completed in the past two years (500-600 kilometres as shown in Fig. 2), fencing will be completed by 1 July 2020. The current planting rate will need to approximately double to attain 90% (2,322 kilometres) of remaining targeted waterways to be vegetated by that time. The planting rate has been steadily increasing, and Council's monitoring data suggests that this target is attainable without major impost on landowners, if a regular planting programme is followed. A regulatory programme is proposed for those that don't implement their riparian plans before 1 July 2020.

Table 3: Summary of the implementation of all riparian plans as at 30 June 2014

Implementation of all riparian plans	Kilometres completed	Kilometres to do	% of recommended works implemented	Protection status %
Fencing	3,558	2,742	56.5	80
Planting	1,765	3,638	32.7	65

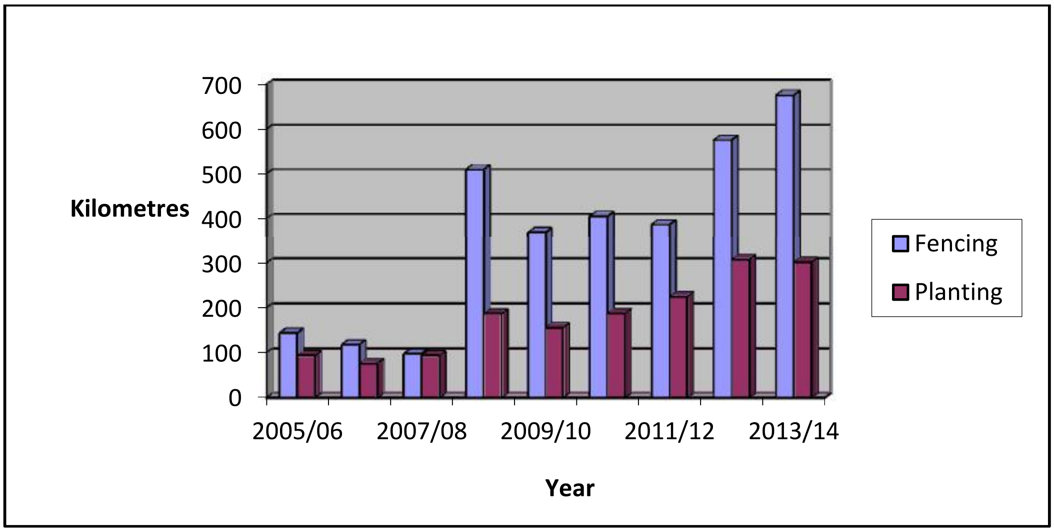


Figure 2 Increase in annual implementation rates of fencing and planting

Effluent

Dairying has been established in Taranaki for a considerable amount of time and Taranaki could be known as an "old established" dairying region. Due to this, Taranaki's average herd size of 287 cows is one of the smallest average herd sizes in the county (only Auckland region has smaller average herd size), and due to these factors, in general, farms here have aging infrastructure. Coupled with this is Taranaki farmers' ability to continue to discharge FDE to water via treatment ponds- an activity that has become discouraged or prohibited in many other regions throughout New Zealand. The result of this is there will be a considerable infrastructural spend in Taranaki on both effluent storage and new effluent reticulation systems if farmers are encouraged or legislated to move from discharging to water to land based effluent irrigation.

Table 4 below shows the breakdown of farms discharging to land, to water or with dual discharges (to land and water).

Table 4: Breakdown of FDE discharge types[3]

Discharge type	Number of farms	% of farms
Discharge to land only	774 farms	44%
Discharge to water only	786 farms	44%
Dual discharges	209 farms	12%
Total discharge consents	**1769 farms**	

Implementing land based FDE systems

Dairy farms in Taranaki have a range of pond types - either for storage of FDE for land based irrigation, or multiple ponds as part of their pond treatment for those discharging to water. Although not an exhaustive data search, TRC's analysis of compliance records suggest there may only be 261 farms in their region with insufficient/no storage. These 261 farms only have a sump or small holding pond which in most cases would be too small to enable deferred or deficit irrigation to take place

[3] Data supplied from TRC compliance team

Existing treatment ponds

After some modelling with the Dairy Effluent Storage Calculator (DESC) of required storage volumes for land irrigation, and comparing these to TRC's guidelines for treatment pond sizes, it could be reasonable assumed that if ponds constructed for discharging FDE to water are sized according to the guidelines, then regardless of herd size these ponds should be a suitable size for FDE storage ponds for land based irrigation for most of the 75% of farms on. The remaining 25% farms (approximately 480) on High Risk soils and those on Low Risk soils and very high rainfall (>3500mm) will however need to invest in either larger ponds, and/or extra infrastructure around the shed to reduce effluent generation and/or low application depth effluent irrigation systems that will allow reduced storage requirements.

Some of these ponds will be many years old and the construction techniques used when they were built are unknown. Therefore, due to this and the nature of the free draining predominantly ash soils, it could be assumed that a number of these ponds will have permeability rates greater than $1x10^{-9}$m/s (accepted standard nationwide for earthen lined ponds).

Tonkin and Taylor's Dairy Effluent Pond Guidelines Update report to TRC identifies soils found in Taranaki's dairy regions and the permeability of those soils. They also conducted site visits on seven soil lined ponds. Of these, five (71%) were described as unlined and three (43%) appeared to be a whole dug in the ground as opposed to a constructed pond with a compacted clay liner.

Storage requirements

To try and understand the impact on the regions farmers of implementing land based effluent systems, storage calculations have been modelled with the DESC on a series of farms typically found in Taranaki.

The DESC is a tool developed by Massey University and Horizons Regional Council to help determine what storage requirements a dairy farm requires. The model utilises local climatic data (rainfall and evapotranspiration), and individual farm's input data. Data entered includes soils risk for effluent irrigation (determined by soil drainage characteristics and slope), effluent catchment areas, storm water diversions, water use in the dairy shed, herd size, feedpad use, effluent irrigation depths and flow rates etc. The benefit of using the DESC is not to determine FDE generation but to determine the number of days per season that FDE irrigation could take place. This is done by utilising approximately 30 years of daily- area specific- climatic data (rainfall and evapotranspiration) to calculate a soil water balance and determining which days FDE irrigation could take place

In general, of all the inputs to the DESC soil risk, rainfall and dairy shed water use have the greatest impact on storage requirements. Of these inputs, the farmer has no control over rainfall, little control over soil risk (their only control is if they have a variation of soil risks on their farm which then gives them the option of choosing where to irrigate their FDE), but they do have more control over the volume of water used in the dairy contributing to FDE.

To try and understand the impact of changing farmers FDE discharge from land to water (either through a voluntary or a mandatory process), DESC modelling has been done to try and determine what storage requirements would be and how many might already have suitable sized ponds. The modelling was done on the two parameters that in general would have the greatest impact on storage- rainfall and soil risk.

After discussion with TRC around soils found in the Taranaki, it was assumed for the purposes of this report that most farms in Taranaki have some areas of well drained or moderately well drained soils on their farm. Therefore, the only impediment to these farms from a soil risk perspective would be slope. With this in mind, slope has been one of the variables utilised to try and determine approximate storage volumes. Any soil, regardless of soil drainage characteristics, with slope greater than 7^0 is classed as high risk. Council data was used to generate the following three tables which allows the farms to be categorised into groups by rainfall and soil risk.

Table 5: Farms with discharge to land only

Slope^0	Average annual rainfall			
	<1500mm	1500-2500mm	2500-5000mm	>5000mm
0 to 7^0	390	177	51	1
>7^0	70	55	15	0

Table 6: Farms with discharge to water only

Slope^0	Average annual rainfall			
	<1500mm	1500-2500mm	2500-5000mm	>5000mm
0 to 7^0	226	206	102	3
>7^0	87	110	26	0

Table 7: Farms with dual discharge consents (land and water)

Slope^0	Average annual rainfall			
	<1500mm	1500-2500mm	2500-5000mm	>5000mm
0 to 7^0	62	50	26	4
>7^0	23	34	6	0

From the above tables we are able to calculate that approx. 1300 farms (75%) will have sufficient low risk soils for effluent irrigation. The other approximately 480 farms will need to practice deficit irrigation onto High Risk soils.

Tables 8 and 9 below show storage volumes required for an “average” farm in Taranaki. Appendix 2 shows the input data used for modelling FDE storage requirements and subsequent pond dimensions.

Table 8: Storage requirements for farms with Low Risk soils

Low Risk Soils			
Ave annual Rainfall	Volume(m^3)	Pond Length(m)	Pond Width(m)
< 1500mm	400	20	20
1500 - 2500mm	779	26	20
2500 – 5000mm	1690	31	30
>5000mm	Unable to be modelled due to lack of climate site at this rainfall		

Table 9 Storage requirements for farms with High Risk soils

High Risk soils					
Rainfall	Volume(m^3)	Length(m)	Width(m)	Irrigation type	Pump rates
< 1500mm	3759	41	41	Traveller	average
1500-2500mm	4399	50	40	Low rate sprinklers	High
2500 – 5000mm	Land based irrigation not achievable due to high rainfall				
>5000mm	Land based irrigation not achievable due to high rainfall				

For all farms with effluent irrigation blocks on slope less than 7^0, the only farms required to build new storage should be those with no current storage. TRC data suggest currently there are 261 (15% of Taranaki dairy farms) dairy farms with no storage beyond their sump.

It can be reasonable assumed from the above data that all farms (with the exception of those with excessive rainfall ->3500mm) on low risk soils will be able to practice deferred irrigation with moderate ease in Taranaki. It can also be assumed that those on High Risk soils and rainfall below 1500mm will be able to practice deficit irrigation reasonably easy. However those farms with higher rainfall (1500mm - 2500mm) could incur significant expense in building large ponds, increasing the pumping ability and installing low depth irrigation.

Any farm with effluent blocks on slopes greater than 7^0 and annual average rainfall greater than 2500mm will be unable to practice deficit irrigation without extensive modification to effluent systems such as:

- Significantly reducing dairy shed water use- possibly with green water yard washing and/or,
- Having high pump rates on their effluent systems to maximise daily irrigated volumes and/or,
- Install very low depth irrigation systems to try and take advantage of small soil water deficits and or,
- Covering their yards.

After exploring the above options some farms will still find it impossible to practice deficit irrigation. These farms are the most vulnerable to any changes in discharge requirements.

From council data shown in Table 10 it suggests that:

- 1290 farms would be on Low Risk soils and able to implement deferred irrigation with relative ease. Some of these farms would need to install storage of up to 2000m^3 depending on rainfall, catchment area and herd size
- 180 farms would be on High Risk soils and rainfall <1500mm, and would be able to implement deficit irrigation relatively easy albeit with larger ponds of up to 3700m^3 FDE storage
- 199 farms would be on High Risk soils and would be able to practice deficit irrigation, however, they would incur a large capital spend to enable them to build storage of approximately 4500m^3, install low depth irrigation and larger pumping systems

- 55 farms would be in unable to comply with deficit or deferred irrigation rules due to their high rainfall and would be unable to continue dairying without significant capital expense or discharging some effluent to water a certain times of the year.

Table 10: The number of farms in each soil risk/ rainfall category

	# farms	% of farms
Farms with Low Risk soils and rainfall<3500mm	1290	74.8%
Farms with LR soils and rainfall >3500mm	8	0.5%
Farms with HR soils and rainfall < 1500	180	10.4%
Farms with HR soils and rainfall 1500-2500mm	199	11.5%
Farms with HR soils and rainfall >2500	47	2.7%

Irrigation reticulation systems

Nearly half (44%) of all Taranaki dairy farms discharge FDE solely to water and therefore would be required to install an effluent irrigation reticulation system if they were to move to good practice or be required to by legislation.

The cost of installing FDE reticulation systems can be extremely expensive and highly variable depending on many site specific factors. Almost any new system will require a supply of electricity to the pond, possible a new sump, pumps, stirrers, several to many hundred metres of effluent mainline (depending on topography and herd size), hydrants, an irrigator(s) and fail safe devices. Often the cost of the full reticulation system can be much greater than the cost of storage. Whilst there are some nutrient benefits of applying FDE to land, in general, the capital and maintenance costs of a land based system outweigh the nutrient benefit unless a longer pay back period is allowed for.

The value of FDE

FDE contains valuable nutrients that when spread well can offset fertiliser costs. Manawatu Wanganui's 2007 "A guide to managing Farm Dairy Effluent" has suggested volumes of nutrient collected annually in a farms effluent system. As shown in Table 11, for a grassed based system this equates to approximately $2400.00 per 100 cows. For the average Taranaki herd of 287 cows this equates to an annual value of spread nutrient of approximately $6900.

Table 11: FDE nutrient volumes and values collected annually/100 cows

Nutrient	Product	Volume(kg)	$/t spread[4]	$ value
Nitrogen	Urea	1300	755	981
Phosphorus	Superphosphate	700	475	332
Potassium	Muriate of Potash	1100	835	918
Magnesium	Magnesium Oxide	200	855	171
Total Value per 100 cows				$2402

[4] Fertiliser products taken from Ravensdown price list February 2015. Freight and spreading costs of $155/t were added to the product cost.

Pond sealing

Effluent leaking through the bottom of an unsealed/poorly sealed pond can amount to a significant volume of nutrients and pathogens leaving the farm and potentially contaminating ground or surface water. Good management practices would require ponds be constructed and lined in accordance with IPENZ Practice Note 21 version 2. To meet the Practice Note's requirements, any soil used as a compacted clay liner will need laboratory testing to verify its suitability to meet the maximum permeability of $1x10^{-9}$m/s.

As with the reticulation systems, pond construction and lining costs can vary significantly depending on site conditions, topography, size and liner choice. Red Jacket Ltd.'s report to TRC on the cost benefit of dairy effluent ponds also concluded the huge variation in cost. They reported that the cost of ponds could be between $15,000 and $120,000.

Nutrient management.

Nutrient management has come a long way since the signing of the Clean Streams Accord and the RAP in 2004. With the expiry of the Clean Streams accord, the new Sustainable Dairying: Water Accord was developed with requirements for the industry to achieve multiple targets around nutrient management and losses from farms were agreed.

Of particular relevance to this section of this report is the nutrient management section. There is an expectation that the industry will manage N and P loss from dairy farms and pursue continual improvement in nutrient use efficiency. Reporting modelled N loss and N conversion efficiency on every dairy farm in the country is required by May 2015, including reporting back to each individual farm on their number and benchmarking to see how well they are doing. P and sediment loss is also targeted with reductions expected from good effluent management, stock exclusion from waterways, and Good Management Practices (GMP's) around infrastructure, races, bridges culverts etc.

There is an expectation that with the nationwide push on GMP's around nutrient use, and the large effort and resources being put into farmer awareness and education that farmers use of nutrients will get more efficient. As farmers begin to understand where the "hot spots" are around their farms, and that their daily management decisions have implications to nutrient losses, we will see less poor practices being used and the subsequent uptake of new methods of farming and feeding cows replacing the high loss activities.

Nitrogen leaching cap

Introduction

The purpose of this section of the report is to assess the implications of introducing a cap on nitrogen leaching of 48kgN/ha and 30 kg N/ha. Nitrogen is targeted for this nutrient cap since it is envisaged that the good management practices outlined elsewhere in this report will make significant gains in reducing phosphorus losses, through reducing direct losses to water and overland runoff.

Due to an extremely small data set of farms with current leaching greater than 48kgN/ha/year, it was deemed inappropriate to model these farms then try and extrapolate the modelled data up to a regional impact. Therefore, this section only relates to a 30kgN/ha/year Nitrogen cap.

In undertaking to set nutrient limits through Option 3, TRC would need to rely on the use of Overseer to assess farm level information in order to generate an estimate of nutrient loss.

While Overseer is a valuable tool in aiding farm nutrient management decisions, its use as a regulatory tool in achieving regional or catchment-based nutrient caps requires careful construction of the policy, and is still likely to face significant difficulties. Particularly important are model version updates, which are likely to alter the absolute values of leaching estimated by the model, and potentially alter the order and impact with which particular on-farm variables influence nitrogen leaching. An example is given by the update from Version 5 to Version 6 of the model, where the updated drainage model within Overseer resulted in significant changes for particular soils. Where such changes to the model are made, it is very difficult for policy makers to define a 'fair' policy for dealing with changes, particularly where the order of influence of different on-farm variables may change, altering the order in which farms are ranked (in terms of increasing leaching).

Other difficulties include the reliance on Overseer to produce a point estimate for leaching, and assessing this estimate against a set limit. The model version updates discussed above provide difficulties, since setting this limit at a level corresponding to the relevant model version is required, so when the model changes the limit must change. Also, the estimate given by Overseer is indeed an estimate, and so the credibility of this estimate must be impeccable if stakeholders are to place faith in using it as a comparison against a set limit. The degree of uncertainty surrounding the Overseer estimate (and indeed the outputs of any model) suggest difficulty in placing this much importance on the point estimate. The design of Overseer is as a long-term average model predicting trends and direction of movement rather than a definitive number, so a valid estimate to be compared against a limit cannot be constructed from short-term farm data. User protocols and data validity must be carefully monitored if the tool was to be used in such a policy. There are therefore significant practical implications for the use of Overseer in such a policy.

A broader implication of introducing a nutrient cap is that some farms will be affected by a much greater degree than others, often due to factors outside of the farmers' control. This is often seen as unfair and can cause significant unrest within the affected community, and often goes against the policy makers' desire to include all farms in the policy. This will be seen in the results below.

Methodology

This analysis has been conducted on 15 farms included in the DairyBase database with valid Overseer files. Due to the project time constraints, a relatively simple analysis has been required without the use of detailed farm systems models. For this reason, simple options for reducing leaching have been investigated, with the main focus being the nitrogen fertiliser used, as previous studies have indicated a strong correlation between nitrogen fertiliser use and nitrogen leaching. Where nitrogen fertiliser use has been altered, feed supply and feed demand have been balanced on the basis of kilograms of dry matter offered, based on assumptions regarding pasture response to nitrogen fertiliser use:

- 10 kg DM/kg N – April, May, June, July
- 15 kg DM/kg N – January, February, March, August, November, December
- 20 kg DM/kg N – September, October5

The price of nitrogen fertiliser has been assumed to be $1.95 per kg N, including cartage and spreading. This is made up of an average urea price6 of $740/t, and cartage and spreading calculated at approximately $10 - $12 per hectare for applications of 25 – 35 kg N per application.

Where nitrogen fertiliser has been removed, the resulting feed deficit has been filled either with the importation of additional supplementary feed, priced at $0.40 per kg DM (includes all costs – purchase price, freight, wastage during storage, feeding out costs, wastage during feeding out)[7], or the reduction of cow numbers. For the purposes of Overseer, this additional imported supplementary feed is treated as pasture silage, although for the financial analyses it could be any supplementary feed at the above price. Differences in metabolisable energy between the supplementary feed imported and the nitrogen boosted pasture being replaced are not explicitly accounted for, and are instead factored into the uncertainty surrounding the pasture growth response to nitrogen fertiliser.

In the case of a reduction in cow numbers, a basic assumption has been made that the reduction in overall feed supply can be met with a reduction in peak cows milked based on annual feed requirements. This is over-simplistic in that the profile of feed requirements across the season (as determined by cow numbers and production at each time of year) will now not necessarily match feed supply across the season (as influenced by the removal of N fertiliser at one, or a few, times of the year). In order to generate more realistic matching of feed demand and feed supply, it is recommended that farm systems modelling software should be used, which was outside the scope of this project given time constraints. With a reduction in stocking rate, a reduction in pasture utilisation and therefore pasture eaten throughout the season is likely to result (over and above the reduction related to lowered fertiliser use), which again is difficult to assess without the use of a more sophisticated farm systems model. A further limitation is that a reduction in cow numbers is likely (depending on the size of the reduction) to reduce the number of replacement calves that are raised, and the change in this cost has not been included due to the level of information required to properly assess it. As well as changes to feed supply, the loss of milksolids production is valued at $6.00 per kg MS, and the removal cows is also accompanied by a reduction in operating costs of $200 per cow8.

Results

In order to generate an estimate of the total cost to Taranaki's dairy farmers of implementing a 30 kg N/ha nutrient loss limit, the individual analyses for the 15 farms have been scaled up according to the following regional breakdown:

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[5] Assumptions developed with the aid of Taranaki Regional Council's Nutrient Management handbook http://www.trc.govt.nz/assets/taranaki/environment/land/dairying-environment/issues/3.pdf

[6] Average price 2011-12, 2012-13 and 2013-14 dairy seasons from DairyNZ database.

[7] DairyNZ Economic Values for cultivar selection for pasture silage is given as $361/t DM.

[8] To cover variable stock expenses such as animal health, breeding, farm dairy, electricity (average derived from the 2012-13 DairyNZ Economic Survey).

Three categories of rainfall were selected: <1,500 mm, 1,500 – 2,500 mm, >2,500 mm. Two other categories were proposed, encompassing farms on peat soils, and irrigated farms, but the data to enable the inclusion of these categories was not able to gathered within the specified timeframe. Seven of the farms used in this analysis are in the <1,500 mm category, and are used to represent 89,100 hectares (12,730 each). Six of the farms are in the 1,500 – 2,500 mm category, and are used to represent 64,700 hectares (10,780 each). Two of the farms are in the >2,500 mm category, and are used to represent 25,700 hectares (12,850 each). Hectares of dairy land in each rainfall category are derived from Taranaki Regional Council data, and totals 179,500 hectares across the three categories. The estimated per hectare financial effect has been multiplied by the number of hectares 'represented' by each of the farms in this analysis to generate a total estimated cost. The financial data given in this report is on a per effective hectare basis as is customary with farm economic data, so has been scaled down by a factor of 0.96 when multiplied by the number of (total) hectares that each farm is representing[9].

The cost of this nutrient loss limit is assessed independently of the effluent system changes investigated in part (b) of this report, as these costs are required in order to implement option (ii). Therefore the costs should be acknowledged as additional to those in part (b), if the nutrient loss limit of 30 kg N/ha is implemented according to option (iii).

The total cost to Taranaki dairy farmers, based on the assumptions outlined above and the assumed regional breakdown, has been estimated as at least $52 million per annum. This is in the form of a reduction in operating profit, in most instances through an increase in operating expenditure. Many of the farms in this analysis would find it extremely difficult to reach the 30 kg N/ha leaching limit, and the farm system changes required on these farms to reach the limit were outside the sensible scope of the changes investigated in this relatively simple analysis. In order to include these farms in the regional representation, the operating loss sustained was taken as the farm system change option closest to achieving the 30 kg N/ha limit, and therefore the estimated cost given above is likely to be a lower bound of the possible costs. Further detail is given below. A significant increase in demand for supplementary feed would also be likely to increase the price of that supplementary feed, which again lends this estimate to be very much a lower bound of total cost.

In the <1,500 mm category, 3 farms were below 30 kg N/ha leaching so did not need to make further operating changes, 1 farm could not reach 30 kg N/ha with the system changes investigated, so would likely face a cost of more than $395 per hectare, and the other 3 farms had costs to reach leaching of 30 kg N/ha of $25 per hectare, $111 per hectare, and $158 per hectare. In the 1,500 – 2,500 mm category, 4 of the farms could not reach 30 kg N/ha with the system changes investigated, so would likely face costs of more than $283 per hectare, $322 per hectare, $965 per hectare, and $1,249 per hectare, and the other 2 farms had costs to reach leaching of 30 kg N/ha of $226 per hectare and $398 per hectare. In the >2,500 mm category, 1 farm could not reach leaching of 30 kg N/ha with the system changes investigated, so would be likely to face a cost of more than $651 per hectare, and the other farm was already below 30 kg N/ha leaching.

Sources of uncertainty surrounding this estimate include the assumptions outlined above, the simple feed balancing nature of the analysis, the linear nature of the farm system changes investigated

[9] New Zealand Dairy Statistics 2013-14 gives total effective hectares in Taranaki as 173,022, which when divided by 179,500 total hectares gives an effective/total ratio of 0.96.

(beyond a certain degree of change in a biological system parameters are likely to alter and result in a non-linear relationship10), and the regional breakdown used to scale up the results.

The 15 farms are labelled A to O as outlined below.

Farm A: With rainfall of approximately 1,700 mm, and an original level of leaching of 88 kg N/ha, likely driven by a high total application of nitrogen fertiliser. With the installation of an effluent holding pond estimated leaching drops from 88 kg N/ha to 87 kg N/ha. Farm A would find it extremely difficult to reach a level of nitrogen leaching less than 30 kg N/ha. Even with removing all nitrogen fertiliser and replacing with imported supplementary feed, at an estimated additional operating cost of $108,600 per year ($1,249 per ha), leaching is still estimated at 33 kg N/ha. There can be some gains made by removing applications during critical periods, but this still comes at a cost. For example, it is estimated that leaching can be halved from its original level at a cost of approximately $39,700 per year ($456 per ha). With the assumptions outlined above, a reduction in cow numbers was investigated as a substitute for importing additional supplementary feed (after the removal of nitrogen fertiliser at critical times as above), and the result was similar for both profitability and nitrogen leaching.

Farm B: With rainfall of approximately 2,100 mm, and original leaching of 45 kg N/ha, with an effluent discharge to water. After installing an effluent holding pond and effluent irrigation infrastructure, and no application of nitrogen fertiliser on the effluent block (removing applications totalling 81 kg N/ha made possible by the nutrients added in effluent – 142 kg N/ha), nitrogen leaching drops to an estimated 39 kg N/ha. It is estimated that it is then possible to reduce leaching to 35 kg N/ha at a cost of approximately $5,100 per year ($51 per ha), but then a further increase in operating expenditure of $27,100 ($271 per ha) results in reducing leaching to 32 kg N/ha. It has not been possible to reduce leaching to 30 kg N/ha with the removal of all nitrogen fertiliser, meaning changes to the cropping regime or a further expansion of the effluent area may be required, or some other farm system change, at additional cost.

Farm C: With approximately 1,300 mm rainfall, and leaching of 36 kg N/ha. With the installation of an effluent holding pond, leaching does not change. With the removal of an April nitrogen fertiliser application (27 kg N/ha), and replacement with imported supplement at an estimated cost of approximately $4,200 per year ($55 per ha), it is possible to reduce leaching to 31 kg N/ha. To achieve 30 kg N/ha, a September nitrogen fertiliser application is reduced to 10 kg N/ha from 27 kg N/ha, at an estimated additional cost of $7,700 per year, meaning a total additional operating cost of $11,900 per year ($158 per ha) to reach 30 kg N/ha.

Farm D: With approximately 1,600 mm rainfall, and leaching of 39 kg N/ha. With the removal of nitrogen fertiliser applications in July and March, totalling 49 kg N/ha, leaching can be reduced to 32 kg N/ha at an estimated cost of $7,600 per year ($100 per ha). In order to achieve 30 kg N/ha, the September fertiliser application can be dropped to 20 kg N/ha from 38 kg N/ha, and the August application to 20 kg N/ha from 24 kg N/ha, at an estimated additional cost of $9,500 per year ($125 per ha). Therefore the increased cost to achieve leaching of 30 kg N/ha totals approximately $17,100, or $226 per ha.

[10] In order to more accurately model the nature of these non-linear relationships, a more sophisticated farm systems model is recommended.

Farm E: With rainfall of approximately 1,300 mm and leaching of 39 kg N/ha. After installing an effluent holding pond and effluent irrigation infrastructure, and the removal of nitrogen fertiliser on the effluent block (41 kg N/ha made possible by the nutrients added in effluent – 48 kg N/ha), nitrogen leaching drops to an estimated 31 kg N/ha. To reduce leaching to below 30 kg N/ha, the removal of the May nitrogen fertiliser application of 23 kg N/ha on the non-effluent block is estimated to increase operating expenditure by approximately $2,500 per year ($25 per ha), and achieve a level of leaching of 29 kg N/ha.

Farm F: With rainfall of approximately 1,100 mm, and leaching of 27 kg N/ha. No changes to the farm operation were required since nitrogen leaching is already below 30 kg N/ha. The installation of an effluent holding pond would be expected to meet GMP's around effluent management.

Farm G: With rainfall of approximately 2,100 mm and leaching of 40 kg N/ha. Even with the removal of all nitrogen fertiliser and 10% of the herd, at an estimated loss of $49,500 per year ($283 per ha), leaching still sits at 32 kg N/ha, above the required 30 kg N/ha. It is extremely difficult for this farm to reaching leaching of 30 kg N/ha.

Farm H: With rainfall of approximately 3,900 mm, and leaching of 67 kg N/ha. With the installation of an effluent holding pond, leaching drops from 67 kg N/ha to 66 kg N/ha. It is extremely difficult for this farm to reach leaching of 30 kg N/ha, most likely due to the high annual rainfall. Even with all nitrogen fertiliser removed and replaced with imported supplement, at an estimated additional cost of $48,200 per year ($536 per ha), leaching remains well above 30 kg N/ha, at 42 kg N/ha. Even with a significant reduction in cow numbers of 15%, and a total reduction in operating profit of at least $58,600 per year ($651 per ha), leaching is still above 30 kg N/ha, at 36 kg N/ha.

Farm I: With rainfall of approximately 2,000 mm and leaching of 39 kg N/ha. With the installation of an effluent holding pond, leaching does not change. Leaching can be reduced to 28 kg N/ha with the removal of nitrogen fertiliser applications, replaced by additional imported supplementary feed, in March, April, August and December (28 kg N/ha per application). It is estimated that the increase in operational expenditure is $44,500 per year ($398 per ha).

Farm J: With rainfall of approximately 1,400 mm and leaching of 36 kg N/ha. With the installation of an effluent holding pond, leaching does not change. The removal of winter nitrogen fertiliser applications (27 kg N/ha in June and July), to be replaced with additional imported supplementary feed, contributes to a drop in estimated leaching to 29 kg N/ha, at an estimated cost of $5,600 per year ($111 per ha).

Farm K: With rainfall of approximately 1,200 mm and leaching of 27 kg N/ha. After installing an effluent holding pond and effluent irrigation infrastructure, leaching reduces to 23 kg N/ha. No other changes to the farm system were required since leaching is below 30 kg N/ha.

Farm L: With rainfall of approximately 1,100 mm and leaching of 20 kg N/ha. No changes to the farm operation were required since nitrogen leaching is already below 30 kg N/ha. The installation of an effluent holding pond is expected to meet GMP's around effluent management.

Farm M: With rainfall of approximately 3,000 mm and leaching of 29 kg N/ha. No changes to the farm operation were required since nitrogen leaching is already below 30 kg N/ha. The installation of an effluent holding pond is expected to meet GMP's around effluent management.

Farm N: With rainfall of approximately 1,400 mm and leaching of 47 kg N/ha. With the installation of an effluent holding pond, leaching drops from 47 kg N/ha to 46 kg N/ha. It is extremely difficult for this farm to reach a level of leaching of 30 kg N/ha or below. With all nitrogen fertiliser removed, and additional imported supplementary feed to fill the resulting feed gap, leaching remains above 30 kg N/ha at 40 kg N/ha, while resulting in an estimated increase in operating expenditure of $59,200 per year ($395 per ha). Removing 8% of the herd and the additional imported supplementary feed used to cover the removal of the nitrogen fertiliser results in a decrease in leaching to 37 kg N/ha, with a similar operating loss as above.

Farm O: With rainfall of approximately 1,800 mm and leaching of 61 kg N/ha. With a major system change in removing all nitrogen fertiliser and importing additional supplementary feed (almost 600 tonnes dry matter replacing almost 200 kg N/ha), and adding $159,200 per year ($965 per ha) in additional operating expenditure, leaching remains above 30 kg N/ha, at 39 kg N/ha. Removing this additional imported supplementary feed, and over one quarter of the herd results in a further net financial loss, with leaching still above 30 kg N/ha, at 31 kg N/ha.

Conclusion

This study has used basic linear farm assumptions to generate an estimate of the financial effect on Taranaki's dairy farmers of implementing a 30 kg N/ha leaching limit. The farm information of 15 dairy farms were used in the study, 6 of which could not reach the 30 kg N/ha limit with the farm system changes investigated (the more complex farm system changes that would be required were not within the scope of this study), 4 of which were already under the 30 kg N/ha limit so did not require any changes, and the remaining 5 could reach the limit with a range of financial costs. Of those that could not reach the limit, the cost to do so is likely to exceed the financial effect included here, meaning the estimate generated here is very much a lower bound for possible financial effects. Reinforcing this is simple supply – demand dynamics; with a significant increase in demand for supplementary feed a price rise would be highly likely, making the increases in operating expenditure generated in these analyses under-estimations.

The estimate generated is at least $52 million per annum, in the form of a reduction in operating profit, in most instances due to an increase in operating expenditure. Averaged across Taranaki's 1,719 dairy farms[11] this is $30,300 per farm per year, but as outlined above some farms would be far more heavily impacted than others, many of which would not be affected. This is unlikely to be considered fair by the farming community.

Sources of uncertainty surrounding this estimate include the assumptions outlined above, the simple feed balancing nature of the analysis, the linear nature of the farm system changes investigated (beyond a certain degree of change in a biological system parameters are likely to alter and result in a non-linear relationship), and the regional breakdown used to scale up the results.

There are also significant practical implications in attempting to implement such a policy, particularly regarding the use of the Overseer model as a regulatory tool.

[11] New Zealand Dairy Statistics 2013-14

Discussion

Options one and two

Options one and two in theory are similar in that it is assumed the end result for both of these, apart from the level of fencing and planting (90% as opposed to 100%) is the same. Both options have land based effluent irrigation as the preferred method and introduction of GMP's, therefore, over time the region should end up with comparable results. The main difference between these two options is the method of convincing farmers to implement the practices- particularly land based effluent irrigation.

Riparian Management

Since the introduction of Council's riparian management programme, over 3,500 kilometres of waterways have been fenced and 1,765 kilometres planted with over 3.5 million plants going in the ground. Now that virtually all dairy farms have a plan in place, the focus has been on one on one engagement which has significantly increased the rate of implementation. Currently, 80% of all waterways are fenced and 65% appropriately vegetated.

Under option 2, Council will achieve a higher level of implementation of both fencing and planting along all waterways to achieve a greater improvement in water quality, and completion of riparian management many years earlier than the rest of the country under the SDWA. TRC is the logical organisation to continue implementation of this policy due to its skills and appropriate specialised resources in riparian management, existing plan-holder relationships, and monitoring capacity to deliver the programme at this scale.

Effluent Management

Whether to continue to encourage or legislate for good management practices on farms FDE systems including feedpads and storage ponds, and continue the trend of ceasing discharges of FDE to water and increasing discharging of FDE to land then becomes a question of the speed of uptake desired.

On paper it could be assumed that the cost to a farmer would be the same for either option as they would all install a land based system over time. In reality, and recent experience has shown, that in Taranaki the uptake and implementation in a voluntary method can be very slow and take many years.

Whilst the end result for these two options is similar, the capital expense of option two to install effluent infrastructure and complete all fencing and planting needs to be meet within a short timeframe (by 2020) and for some farms- (particularly those with small herds and aging infrastructure) this could be quite onerous.

Regardless of the cost mentioned above, there are a number of farms in Taranaki that will never cope with solely discharging FDE to land. These will be those farms at higher altitude, close to the mountain receiving more than 3500mm rainfall/year regardless of soil type, and those on High Risk soils receiving annual average rainfall above 2500mm. According to TRC records there could be approximately 55 farms in this category.

It may be worth noting that an agreed effluent management system is in place in the Lake Brunner catchment on the West Coast whereby all soils are classified as low risk (regardless of actual soil risk) and covered storage and storm water diversions in place to reduce the amount of 'effluent' captured. Rainfall in this catchment is between 3,000 to 5,000 m^3 per year. Due the farms discharging into a sensitive lake catchment this was seen as a cost effective way of meeting desired environmental outcomes for farms that would otherwise be forced out of dairying. If this option was not explored for Taranaki high rainfall areas, the extra infrastructure and careful management required to meet existing rules of discharging to land may not be worth the environmental gain.

For the 44% of dairy farms in Taranaki presently discharging FDE to water the nutrient savings on an average Taranaki dairy farm of $11,500/year that they would get from a land based system could in most cases service the interest portion of any capital work required to build a new effluent system.

Due to lack of data and timeframes, no attempt has been made to determine the impact on those farms with feedpads or larger herds with subsequently larger catchment areas. There is the potential for those farms (particularly under higher rainfall) to be unable to meet storage requirements.

Nutrient cap

The data analysis of the 15 farms able to be undertaken in the short timeframes for this report show that there is a large variation in N loss from these farms. Overseer modelling suggested 40% of farms (6 farms) are unable to meet the 30kgNloss/ha cap without further investigations and farm systems modelling which may well involve significant system changes on farm. A further 33% of farms (5 farms) were able to meet the N loss cap after on farm changes of varying complexity and cost. It may well be the case that managing these five farms becomes difficult and in some cases beyond the capability of the farmers due to the removal of targeted nitrogen applications for times of feed pinch, lowered stocking rates and the subsequent pressure this puts on maintaining pasture quality and the reliance on purchased supplements. As purchased supplements (grass and maize silage) increases, and the reliance on scarce winter grazing to reach a lowered N target by wintering off increase so does the cost. It is quite probably that the cost of these mitigations is under estimated.

Overseer was developed as a tool for managing nutrients. It is regarded world class as a tool for modelling nutrient movement around the farm and transfers between blocks. It should be applauded as a tool for nutrient management above the root zone; however, its ability to accurately model losses from the root zone into water is not so well accepted. Overseer is a great tool for modelling trends of nutrient loss as farm activities and management are changed and subsequently educating farmers to farm with their nutrients more efficiently. The use of Overseer to produce a point target becomes increasingly difficult with on-going version changes and the subsequent variation in N loss modelled with no changes in farm management.

Lastly, there is a significant financial cost for some farms to meet the target and no cost for others. This could well be seen to be unfair by the farming community. Due to factors outside the farmers control (rainfall and soil type), farms of similar management could have significantly different N loss figures. At a conservative estimated cost of $52 million per annum for Taranaki's dairy farmers this equates to approximately $30,300 per year for every farmer in the region. For a number of the small farms in Taranaki this will be a significant hurdle.

Recommendations

Option Three

For all the above reasons stated, it would seem unlikely for a N cap policy to fairly and accurately allocate N loss throughout the region. It would be seen to be unfair and incur significant cost and pain on the industry for potentially little gain in water quality. It is therefore the opinion of the authors that Option Three not be pursued by TRC.

Options One and Two

Option two will see more resources directed at speeding up the implementation of planting within an expected timeframe and a regulatory regime as a backup. Fencing is well on track to be completed on time. Option two is recommended because voluntary implementation will be achieved by a significant majority before a regulatory regime is introduced. Therefore, plan-holders will take ownership of their riparian plantings and maintain them as farm assets into the future; rather than being indifferent after being forced into it. A backup, regulatory regime will capture the small minority who are always present in any population. For Taranaki, the best possible outcome will be achieved by Council through riparian management under option two which when finished, will achieve a higher level of water quality improvement than the rest of the country under the SDWA in a significantly shorter timeframe. Moreover, it will also avoid unnecessary duplication of resources by the dairy industry.

Effluent irrigation to land for those farmers on low risk soils and moderate rainfall can be implemented relatively easily if existing treatment ponds are suitable as storage ponds. The benefits of this include a large reduction (region wide) of nutrients and pathogens directly entering waterways, retaining farm nutrients on farm to be utilised by pasture and crops and an improved public image.

However, those high altitude, high rainfall farms and high risk soil farms will struggle to implement 100% land based irrigation. Some of these farms will be forced to cease dairying if they are unable to discharge treated effluent to waterways at times throughout the season when experiencing high rainfall and soils with soil moisture contents greater than field capacity. It is therefore vital for these farms to have the option of periodically discharging treated FDE to water.

To give farmers certainty, TRC will need to determine what “exceptional circumstances” means and be satisfied that the ponds used in these cases for both storage and discharge to water are capable of meeting the desired outcomes for both purposes- suitably sized for storage and providing sufficient treatment to meet desired discharge parameters.

Appendix

Appendix 1. Summary Regional Action Plan 2013-2014 report

Table 3: Summary Regional Action Plan implementation and monitoring

Target	2013/14	Are we on target?	Details
90% of dairy farms to have a property plan by 2010	99.5%	Achieved - target of 90% has been exceeded	99.5% of Fonterra supplier dairy farms in Taranaki have a property plan.
% of regular crossings with bridges or culverts on property plans prepared	98%	Achieved - target of 90% has been exceeded	98% of all regular stream crossing points at the regional level are adequately bridged or culverted.
100% of dairy farms to have a consent that complies with regional plans by 2004	100%	Achieved - target of 100% has been met	100% of dairy farms in Taranaki have a farm dairy effluent discharge consent that complies with the Taranaki Regional Fresh Water Plan
60% of regionally significant wetlands are to be fenced by 2005, 90% by 2010	96%	Achieved - target of 90% has been met	96% of regionally significant wetlands are fenced.
Fonterra to have 100% of dairy farms with systems in place by 2007	99.6%	Achieved - target of 100% has ostensibly been met	99.6% of Fonterra supplier dairy farms in Taranaki have a nutrient budget in place. Fonterra has since introduced its Nutrient Management programme which has superceeded this.
50% of the fencing on property plans to be implemented by 2010, 90% by 2015	79.9%	2010 target has been met, however unlikely to achieve the 2015 target without significant increase in rate of implementation by landholders	641 kilometres of fencing was completed in the 2013/14 year, constituting 21 % of the recommended new fencing remaining to be completed. A total of 3,201 kilometres of new fencing has now been completed, noting that 6,214 kilometres of fencing was recorded as already in place (existing) at the time of plan preparation. 79.9% (9,415 kilometres) of streambank is protected by new and existing fencing.
50% of the planting on property plans to be implemented by 2010, 90% by 2015	63.8%	2010 target has been met, however very unlikely to achieve the 2015 target without significant increase in rate of implementation by landholders	281.7 kilometres of new planting was completed in the 2013/14 year, constituting 8% of the recommended new planting remaining to be completed. A total of 1,522 kilometres of new planting has now been completed, noting that 4,125 kilometres of vegetation was recorded as already in place (existing) at the time of plan preparation. 63.8% (8,855 kilometres) of streambank that requires vegetation, is protected by new planting and existing vegetation.

Appendix 2. DESC input assumptions

- Herd size based on Taranaki average of 280 cows.
- Yard catchment area based on 1.5m2/cow plus 100m2 of other areas.
- Shed roof water diverted away from the effluent system
- Storm water diversion on the yard when cows are dry
- Wash water 70l/cow/day
- Season start 25th July, season end 15th May
- Low Risk soils 72m3/day pump rate in winter/spring, 36m3/day in Spring/autumn
- High Risk soils<1500mm rain. maximum 10mm application depth, 72m3/day pump rate all season
- High Risk soils 1500mm to 2500mm rainfall. 4mm application depth winter –spring, 8mm spring-autumn. 100m3pump rate all season
- Assumed ponds generally square, 2:1 batters, 0.3m sludge/unpumpable depth, 0.3m freeboard
- Emergency storage of 3 days