SOLUTIONS FOR A SUSTAINABLE LAKE ROTORUA: THE FARMERS' PERSPECTIVE

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Abstract

The Government's Freshwater National Policy Statement requires all regional councils to establish environmental limits for significant waterways. Parallel signals from Cabinet papers and the Land and Water Forum have emphasised collaborative approaches and potential for industry-led audited self-management. The Lake Rotorua catchment provides a useful case study for the practical application of these approaches. Levels of nitrogen and phosphorus in Lake Rotorua are well above recognised sustainable load levels needed to deliver community-agreed outcomes. Improved management of farm nutrient losses is a key method to achieve community expectations for lake water quality.

The Bay of Plenty Regional Council (BoPRC) has already regulated Rotorua farms by capping nutrient losses to no more than the average that occurred from 2001 to 2004, based on Overseer® benchmark analyses. BoPRC has also signalled its intent to reduce annual catchment nitrogen losses by about 300 tonnes through prioritising land use change over improvements in farm management.

Rotorua dairy farmers collaborated informally for several years before establishing the Lake Rotorua Primary Producers Collective in June 2011. Membership has expanded to drystock farmers with the aim of the Collective representing the owners of around 80% of pastoral land in the catchment, including land managed by the Maori Trustee. The Collective also has a Memorandum of Understanding with the Lakes Water Quality Society, the leading local environmental group. This MoU, signed in July 2011, was facilitated by local MP Todd McClay and is referred to as the Waiora Agreement.

The Collective aims to be at the forefront of sustainable nutrient management in New Zealand by putting farmers at the centre of nutrient policy development and implementation whilst also protecting members' economic interests. The Collective presented its preferred path on nutrient management to BoPRC in October 2011, emphasising:

- Acceptance that the pastoral sector contributes to Lake Rotorua's nitrogen load and that the sustainable annual nitrogen load target is 435 tonnes;
- Farmer responsibility to achieve defined nutrient management 'best practice' at their own cost;
- Pastoral sector nitrogen reductions should be a three-way mix of nutrient management best practice, major farm system changes and land use change;
- Broad collaboration on policy development, funding and implementation that will give an enduring and cost-effective package to achieve a clean lake with better economic, social and cultural outcomes.

Background
The farmers around Lake Rotorua have been at the centre of a complex and contentious debate about nutrient losses from their land, the associated negative impacts on the lake and what to do about it. The history and causes of water quality decline have been documented by BoPRC and numerous scientific reports (e.g. BoPRC, 2010; EBOP 2009). Before covering the farmers' perspective, it is useful to recap the key physical situation facts.

Lake Rotorua catchment – the physical context
Lake Rotorua is one of 12 lakes in the Bay of Plenty region. Most Rotorua lakes have degraded and/or declining water quality, with nutrient losses from current and historic land use being a key driver of excessive algal and lake weed growth (e.g. see Park and MacCormick, 2009).

Lake Rotorua is about 8000 ha and relatively shallow with an average depth of 11m. The surface land catchment is about 42,000 ha with an estimated additional 4400 ha contributing to the groundwater catchment (Rutherford *et al.*, 2011). There are major groundwater lags with mean groundwater travel times ranging from about 16 years to more than 100 years in different sub-catchments flowing into the lake.

This eutrophic lake is subject to nuisance algal blooms, particularly following irregular stratification events which occur about three times per year. Both N and P are important in limiting algal growth in the lake. Water quality deteriorated markedly since the 1960s and has remained poor; although there has been a slight improvement in recent years. The main sources of catchment nutrient inputs are pastoral farming, treated sewage, septic tanks and geothermal/geological springs.

Prior to 1990, most urban sewage was discharged to the lake following basic treatment. The major sewage upgrade and forest irrigation scheme commissioned in 1991 was expected to fix the lake and initial trends were encouraging as the annual nitrogen and phosphorus inputs dropped substantially. However, rising nitrogen inputs from pastoral land effectively cancelled out these reductions and net nitrogen loads are trending upwards (Rutherford, 2008).

The Trophic Level Index (TLI) is a NZ-wide lake water quality measure that integrates concentrations of nitrogen, phosphorus, chlorophyll-a and water clarity. The TLI targets for all 12 Rotorua lakes are set in the Regional Water and Land Plan. Lake Rotorua's TLI target is 4.2, compared with the recent average of 4.7 (BoPRC, 2010).

The catchment land use is shown in Table 1. Note that the approximately 20,000 ha in pasture comprises about 5000 ha of dairy and 15,000 ha of drystock land.

Table 1: Lake Rotorua catchment land use (adapted from EBOP, 2009)

Land Use	**Area, ha**
Pasture	20,112
Native forest and scrub	10,588
Exotic forest	9,463
Urban	3,267
Lifestyle	556
Cropping, horticulture	282
Total	**44,268**

Lake Rotorua catchment – the current regulatory and policy context

The wider policy context is given in the Strategy for the Lakes of the Rotorua District (EBOP, RDC and Te Arawa, 2001), the objectives and policies within the Regional Water and Land Plan (EBOP, 2008) and the Proposed Regional Policy Statement (BOPRC, 2010a). The latter document refers to a sustainable catchment nitrogen load of 435 tonnes of nitrogen per year for Lake Rotorua. If current land uses were to continue unchanged indefinitely (or at least longer than the oldest groundwater lag times), the resulting "steady-state" nitrogen load has been estimated at 755 TN/year (Palliser *et al.*, 2011). The implied reduction target of 320 tN/year will therefore require substantial actions and interventions.

For farmers, the key element of the current regulatory regime is "Rule 11" which caps nitrogen and phosphorus losses to no more than the annual average losses that occurred during the benchmark period between July 2001 and June 2004. BoPRC is progressively working with farmers to complete the nutrient benchmarking process using farm input data, combined with slope, soils, rainfall and so on. This information is used in the Overseer® model to determine annual losses that are averaged over the benchmark period for the entire property i.e. the combined losses from pasture, fodder crops, bush, forestry and house septic tanks where applicable. The Collective has established protocols with BoPRC on carrying out Rule 11 benchmarking while maintaining confidentiality of farm data.

The evolving policy context

Due to the complexity and size of the nutrient reduction challenge in the Lake Rotorua catchment, there are multiple policy documents and policy development processes that must be considered. The key policy development initiatives impacting farmers include:

- The non-statutory 2009 Lakes Rotorua and Lake Rotoiti Action Plan which included targets for nutrient reductions, including from land use (BoPRC, 2009).
- The Proposed Regional Policy Statement (BoPRC, 2010b), with deliberations underway and a decision expected later in 2012.
- Catchment, lake and economic modelling work to underpin policy development work, notably NIWA's ROTAN project (Rutherford *et al.*, 2011) and the related economic and planning analysis (Beca *et al.*, 2011).
- New RMA rules development with a focus on options to both cap and reduce nutrient discharges, and the subsequent plan change process. While BoPRC has adopted a "streamlined Resource Management Act plan change process" with no draft Plan state, it is not clear what this means for farmer participation.
- Funding of mitigation initiatives e.g. the $750,000 Lake Rotorua Nutrient Reduction Fund, although the current status of this fund is not clear (BoPRC, 2011a).
- The development of a new Rotorua Lakes Strategy to replace the 2001 strategy agreed between BoPRC, Rotorua District Council and the Te Arawa Lakes Trust (BoPRC, 2011b).
- Proposed increased funding for land use interventions from $9.5m to $45.5m, subject to negotiating changes to the $72.1 Funding Deed (Government's 50% share agreed with BoPRC and RDC) and BoPRC's Ten Year Plan (see BoPRC, 2012).
- Multiple reports to BoPRC's various committees and the wider Rotorua Te Arawa Lakes Strategy Group providing updates on the above and seeking feedback and decisions (e.g. BoPRC, 2011).

- The concurrent Rotorua District Plan change work, some of which may influence the viability of rural subdivision and some alternative land uses. All changes are currently "draft" with a formal notification of the proposed plan flagged for August 2012 (Rotorua District Council, 2012).
- The Government's Freshwater National Policy Statement and its requirement for regional councils to adopt and notify an "implementation programme" by 12 December 2012 on measures to improve water quality for water bodies that do not meet water quality objectives – this presumably applies to Lake Rotorua not meeting its TLI target.

Lake Rotorua Primary Producers Collective

The Lake Rotorua Primary Producers Collective (the "Collective") formally established as an incorporated society in June 2011 following several years of informal collaboration amongst the 24 dairy farmers in the Lake Rotorua catchment, with input from DairyNZ, AgResearch, Federated Farmers and others. During this informal phase, farmers focused on:

- negotiating with senior BoPRC staff on:
    - an overall nutrient management package that protected farmer interests, potentially via a "collective consent" approach
    - Rule 11 implementation procedures, including farm data confidentiality
    - Rating proposals
- data gathering and analysis, with Overseer analyses completed for all dairy farms and three drystock farms in 2007 (Smeaton and Ledgard, 2007)
- support of research initiatives such as the SFF project on Ngati Whakaue Tribal Land's Wharenui farm which assessed nutrient mitigation cost-effectiveness for dairy and drystock (Ledgard *et al.*, 2008)

The farmers' decision to establish a formal united group in the Lake Rotorua catchment was driven by a desire to gain more influence over land and nutrient policies being developed by BoPRC. This also meant a need to extend the membership beyond dairy farmers. The Collective has been actively recruiting large-scale drystock farmers, including land blocks administered by the Maori Trustee. The membership goal is to represent the owners of at least 80% of the pastoral land in the catchment, making its participation vital to the successful design and implementation of any land use and nutrient policy package.

The Collective's Vision

The Collective's vision can be summarised as **a clean lake and a prosperous community** which is achievable through a combination of:

- Collaboration with BoPRC, Lakes Water Quality Society (LWQS) and others to develop the total policy package through a shared work programme
- Achievable nutrient reduction targets and timeline
- Cost-effective farmer-centred solutions with flexibility on reduction methods
- Equity on costs and benefits.

The core of the Collective's proposed nutrient reduction strategy will be based on a three-way approach as shown in Figure 1 below:

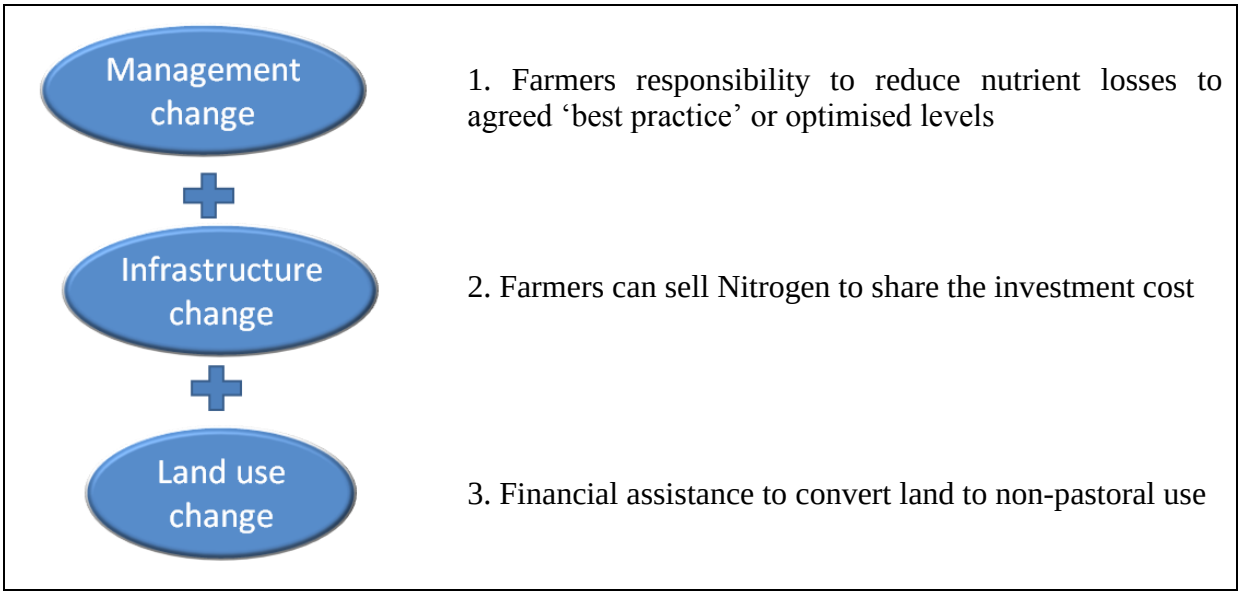

Figure 1: The Collective's preferred three-way approach to nutrient reduction

SFF Project

As the Collective was being formalised in early 2011, it also sought and obtained Sustainable Farming Fund support for project titled "Meeting nutrient loss targets on dairy farms in the Lake Rotorua catchment". The three project components are:

1. Establishing field trials on a monitor farm to measure biophysical responses to interventions and mapping the farm to model management options
2. Using farming systems models to show impacts of changes to the farm system and management practices on farm productivity, profitability, N and P loss and GHG emissions
3. Establish discussion groups within the catchment to act as 'learning forums' where farmers will meet regularly with each other, scientists and regional council staff to test the efficacy of the intervention strategies (MAF, 2011).

The Collective is keen to ensure linkages between the SFF project, policy development and potentially longer-term MSI-funded science programmes.

Waiora Agreement

The first public initiative of the Collective was the signing of the Waiora Agreement in July 2011 with the Lakes Water Quality Society (LWQS), the major local environmental group (The Daily Post, 2011). The MoU was facilitated by the local MP for Rotorua Todd McClay following a meeting between catchment farmers and the Minister for the Environment Dr Nick Smith. Arguably, the farmers and LWQS have been at odds for many years about actions needed to protect Lake Rotorua. Despite their differences, both groups recognised that they had common interests and these were captured in their joint Agreement as follows:

- To work cooperatively to achieve a clean and healthy Lake Rotorua through reduced nutrient emissions.
- To provide greater insight and involvement in policy development to achieve a sustainable long-term solution to restoring Lake Rotorua.

- To cooperatively develop and agree on processes that will achieve the total load target of less than or equal to 435 tonnes of nitrogen (RPS Policy WL 3B) and 6 tonnes of phosphorus entering Lake Rotorua.
- To support a sustainable and viable rural sector as an important part of the Rotorua economy.

Collective – BoPRC engagement
The Collective gave its views to BoPRC's Operations, Regulation and Monitoring Committee in October 2011 (BoPRC, 2011c). Key messages included:

- Farmers will be responsible for achieving "nutrient best practice" at their own cost
- The total nitrogen load reductions from the pastoral sector should come from a three-way mix of nutrient management best practice, major farm system changes (e.g. new infrastructure) and land use change
- Collaboration on policy development, funding and implementation is much more likely to result in an enduring, equitable and cost-effective package that not only achieves the desired water quality outcomes but also enhances economic, social and cultural outcomes in the catchment.

The presentation was well received by Councillors and subsequent engagement between the Collective Executive and senior staff has been positive, with the Collective aiming to develop a more detailed proposal by March 2012. This will involve input from LWQS as well as individual farmers, plus efforts to explore synergies with the SFF project described above.

Despite this promising recent engagement with BoPRC, the farmers remain concerned that parts of BoPRC's evolving policy package may limit options for creative and flexible solutions. In particular, BoPRC released two position papers on land use and land management change with a strong preference for funding land use change (rather than land management change) due to the large nitrogen load reductions needed (BoPRC, 2011).

While there is the ongoing challenge for farmers (and others) to engage with and influence the multiple threads of policy development, recent discussions with BoPRC have led to the recognition that the farmers' contribution to developing catchment-wide options is critical to achieve a sustainable and enduring solution. The following section describes examples of Collective members in exploring, analysing and implementing nutrient mitigation actions. While more in-depth research is needed to test the effectiveness of a range of reduction strategies in the Rotorua catchment, the examples show the willingness of Collective members to invest in farm-level solutions.

Nutrient mitigation options on a Rotorua dairy farm
An options analysis was carried out for a dairy farm in the Rotorua catchment to look at the practical components of several options that broadly reflect the Collective's preference for a three-way mix of management change, infrastructure change and land use change. Modelling was carried out using Farmax® and Overseer®. Farm parameters for the base scenario and three options are described below with the main profit and N leaching results summarised in Table 2. The analysis was based on a hypothetical farm that drew on actual farm data[1].

[1] Actual farm data has been rounded.

Base scenario – key parameters: approximately 300ha of easy contour; peak milking about 800 cows, producing 945kg MS/ha or 335kg MS/cow; payout of $6.10/kg MS; 50% of cows wintered off for six weeks and all young stock grazed off; 20ha mixed maize and fodder crops; nearly 400t DM of imported maize and grass silage; 180kgN/ha of fertiliser nitrogen.

Option 1 with management changes – key parameters relative to base scenario: reduced stocking rate to 2.3 cows/ha; slight increase in MS/cow; production to 350kg MS/cow; calves kept until May; 10ha of maize grown, forage brassica discontinued; 90kgN/ha of fertiliser nitrogen.

Option 2 with infrastructure changes using a stand-off and feed pad – key parameters relative to Option 1: stand-off and feed pad costing about $330,000 plus maintenance; cows wintered on but kept off pasture during high periods for up to 20 hours per day; effluent area increased; improved feed utilisation and slightly lower winter maintenance requirements giving 360kg MS/cow; DCD applied; 65kgN/ha of fertiliser nitrogen.

Option 3 with partial land use change – key parameters relative to Option 2: 25% reduction in farm area but still 2.3 cows/ha on the balance; no stand-off/feed pad; maize crop reduced to 7ha.

Table 2: Scenario analysis for a Rotorua dairy farm

System	Base scenario	Option 1 with management changes	Option 2 with infrastructure changes	Option 3 with partial land use change
Leached kgN/ha/yr	51	39	32	26
EFS $/ha	$1,900	$2,000	$1,700	$1,300

Pro-active mitigation by farmers

Many Rotorua farmers have taken actions over several decades to protect native bush and to fence off and plant riparian margins, often with advice and financial assistance from BoPRC and its predecessor Catchment Commission (also with Government financial assistance). More recently, some farmers have decided to mitigate nutrient losses despite the ongoing policy uncertainty. A prominent dairy farm example is Oturoa Properties Ltd which has spent $258,000 on a range of measures, including a 90 day effluent storage pond, three stand-off pads and fencing/planting stream and wetland areas. The net result is higher production levels and an approximately 10% reduction in nitrogen leaching to 36kgN/ha/yr. The mitigation initiatives are illustrated in Figure 2 below.

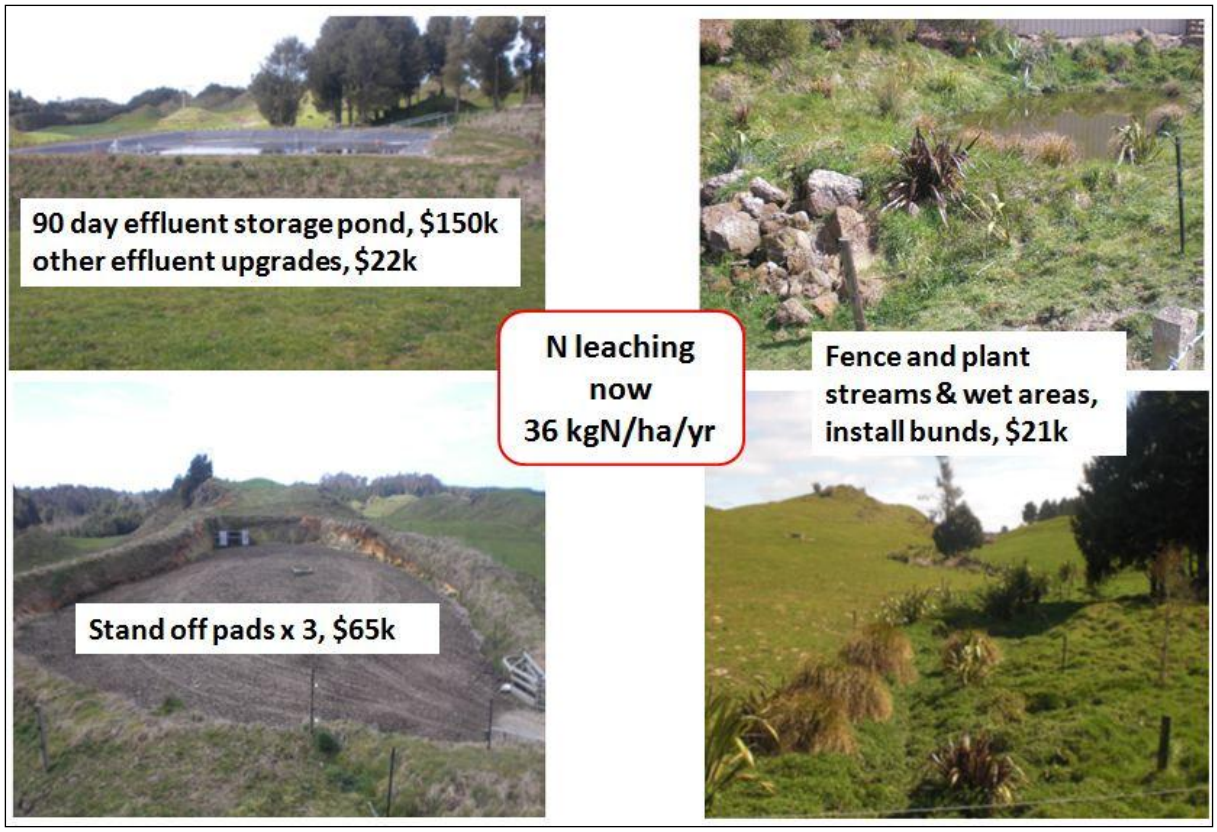

Figure 2: Mitigation initiatives at Oturoa Properties Ltd, a Rotorua dairy farm

Analysis of dairy farm nitrogen losses

Collective dairy farmer members have worked with AgResearch, DairyNZ and local farm consultants to assess their own nitrogen loss rates. In 2007 the then 26 dairy farms underwent Overseer assessments, focusing on the dairy platform only and the 2001-2004 period which matches BoPRC's Rule 11 benchmarking period. These Overseer files were then reassessed in 2010 using the latest Overseer version and more specific soil types and other data inputs. New farm information was also collected in 2010 (for 19 farms) and analysed to show what changes had occurred since the 2001-2004 period. The mean N leaching rates are summarised in Table 3:

Table 3: Mean N losses from Rotorua dairy farms

	Area weighted mean N loss on dairy platform, kgN/ha/yr	Number of farms
2001-2004 original	56	26
2001-2004 reworked	48	19
2010 new data	41	19

The comparable results for 17 farms (two farms could not be sensibly compared) are summarised in Figure 3, where the x-axis value is simply the farm sequential numbering based on ascending N losses from the original 2001-2004 results.

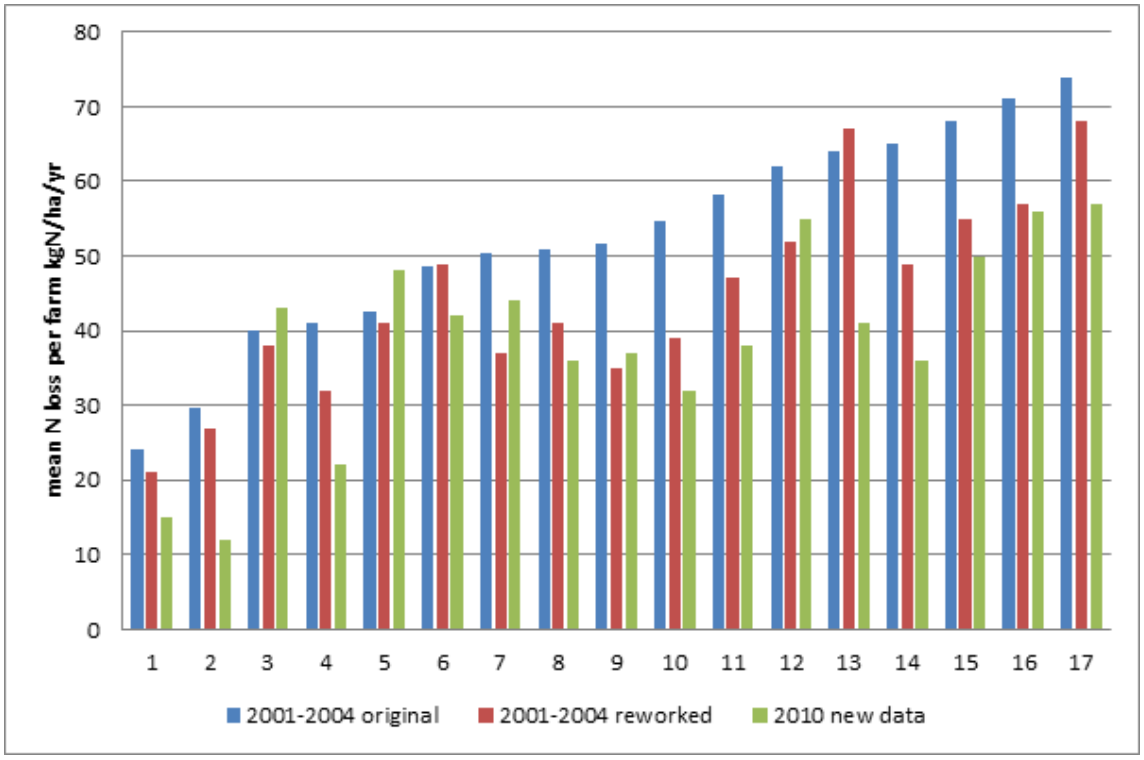

Figure 3: Nitrogen loss on 17 Rotorua dairy farms, 2001-2010

It is useful to look at what individual farms changed, particularly for those with the larger proportional decreases in N losses:

- Farm #4: increased wintering off, stock off farm at weaning and lower fertiliser N
- Farm #8: riparian planting, increased effluent block, stand-off pads
- Farm #14: lower cows/ha, increased effluent area, lower fertiliser N, increased MS/ha
- Farm #17: smaller platform, lower cows/ha, lower fertiliser N, increased MS/ha.

While this is an ad hoc and selective review of some farms, it does illustrate that some farmers are implementing a range of pragmatic mitigation measures and that some also achieve higher milk solids production i.e. there are some win-win optimisation solutions for at least some farms/farmers.

Conclusion

Farmers in the Lake Rotorua catchment are organising themselves, carrying out analysis and taking practical nutrient mitigation actions. While good progress has been made overall with lower N losses than previously thought, much remains to be done. Therefore the Lake Rotorua Primary Producers Collective has been established to provide a united platform to develop solutions that give effect to their vision of a clean lake and a prosperous community.

The Collective is seeking collaboration with BoPRC and others to develop a three-way nutrient reduction strategy that combined optimised farm management, infrastructure change and land use change. This will entail a combination of: applied local research; nutrient advisory services; solutions tailored to individual farms and their owners; ongoing monitoring with integrity; and a robust long term governance structure to manage implementation and funding.

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