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How might freshwater regulations provide
certainty for farmers to innovate?

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I wish to thank the Kellogg Programme Investing Partners for their continued support.

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Executive Summary

There has been a considerable amount of regulatory change in the freshwater space over the last 15 years which has been difficult to implement for both regulators and farmers. Whilst these regulations have lifted the bar on some practices impacting waterways it has also created some uncertainty for farmers.

The purpose of this research is to investigate the relationship between changing freshwater regulations and farmers appetite to innovate on farm to achieve freshwater improvements.

The aim of this research is to determine what impact changing regulation has had on farmers adopting innovative freshwater management practices on farm, to understand the scope of emerging and accepted mitigations to achieve freshwater outcomes through innovation and to develop practical recommendations for how freshwater regulations can be drafted to provide certainty to farmers whilst improving the quality of Aotearoa's waterways.

The methods of this research project consisted of semi-structured interviews with dairy farmers, a regulatory scan of current freshwater regulations under development, a thematic analysis of interview responses and a policy assessment of options against chosen criteria analysis to investigate how freshwater regulations can be drafted to provide certainty for farmers to innovate.

The findings showed that further regulations for freshwater management are required to implement the National Policy Statement for Freshwater Management 2020 within regional plans by the end of 2024. An approach to freshwater management that meets the criteria of flexible, enforceable, practical, and ambitious would provide certainty to farmers to innovate and meet regulatory requirements. Three options of regulatory approaches were analysed against these criteria: an input-based approach, a risk-based approach and a catchment collective approach. The options analysis showed that a risk-based approach which regulates through a farm planning regime like Freshwater Farm Plans is the most effective way to regulate for freshwater management whilst providing certainty for innovation. A mixed approach including input-based regulations and catchment collectivism is likely to be needed to meet all objectives of the NPS-FM, however a risk-based approach should be heavily relied upon by regulators.

The following recommendations were made in response to the research questions; *How might freshwater regulations provide certainty for farmers to innovate?*

- Regional councils should utilise a risk-based approach to regulations including the Freshwater Farm Plan scheme when implementing the NPS-FM 2020 in regional plans.
- Central government (in particular MPI and MFE) should support the implementation of Freshwater Farm Plans in a way that ensures they are flexible, enforceable, practical and ambitious.
- Political parties should avoid using freshwater regulation as campaigning tool, instead a non-partisan approach should be taken with any further regulation required (relating to freshwater) developed effectively outside of three-year political cycle.
- Farmers should utilise Freshwater Farm Plans to capture evidence of all mitigations implemented on farm, including those that were innovative or early-adoption.
- Processors should continue to develop and integrate recognition programmes for good practice and where possible provide a premium as a way to encourage and acknowledge early adopters of innovative practice.

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1. Introduction

The regulation of freshwater in New Zealand has evolved considerably in the last 15 years. In 2011 the National Policy Statement for Freshwater Management (NPS-FM) was introduced. This directed regional councils to regulate impacts on freshwater, including from agriculture, under the Resource Management Act 1991 (RMA). The NPS-FM was then amended in 2014, 2017 and 2020. Each amendment changed the way regional councils were required to manage freshwater in their region. In 2020 the Essential Freshwater package also introduced National Environmental Standards for freshwater (NES-F), Section 360 regulations for Stock Exclusion and legislation that added Freshwater Farm Plans to the RMA (MFE and MPI, 2020). All of these freshwater regulations are aimed at protecting, reversing, or enhancing the quality of New Zealand's surface freshwater bodies for environmental, recreational and cultural purposes. During this time a number of regional and catchment scale regulations have been introduced by regional councils which and has led to many changes in the way that farm systems operate in some regions.

Whilst these regulations have lifted the bar on some practices impacting waterways it has also created a considerable amount of uncertainty for farmers. The amount of amendments to regulations including shifting limits on nutrients, changes to activity standards combined with the inconsistency between central government and local government regulations have created uncertainty at the farm level. There has been a change in sentiment amongst farmers, with the Groundswell movement rejecting a raft of introduced regulations (Corlett, 2021), and 'consultation fatigue' with farmers less interested in engaging in consultation processes.

A trend in recent freshwater regulation, especially from central government, is that the policy frameworks are based off of good practice that is occurring within farming systems. This means that regulators identify what is working well to reduce the impact of farming on water quality and develop regulations that require this type of practice from all farmers. This process is well intended and applies what is known to be a successful approach more broadly to achieve improvements. However, it can lead to unintended consequences. For example, through a voluntary approach led by the dairy sector, 98 per cent of farms had fenced their waterways by 2019 (Dairy Tomorrow Partners, 2022), this approach worked well to reduce nutrients and *e. Coli* entering waterways from cows accessing them as well as reducing stream bank erosion. Through the Essential Freshwater package, central government intended to apply the same approach to exclude stock from waterways, however the proposed regulations required that stock be excluded by an average of 5 metres from the stream bank. The majority of farmers who had already fenced their waterways had done so at a minimum of 1 metre from the stream bank, meaning to be compliant they would need to shift their fences back a few metres by 2025 (MFE, 2020). Through consultation it was decided that existing fences would not need to be shifted, due to the unnecessary cost required to shift the fence for a marginal benefit. This was a practical result, but it raised the issue of how early adopters of good practice can be disadvantaged when regulations for the same activity are introduced.

Many farmers see themselves as care takers of the land and want to leave it in good condition for future generations. This leads them to implement good practice or leading practice on their farms. However, due to the uncertainty created by changing regulations, early adopters of farm mitigations are more frequently penalised by going early when new regulations stipulate different requirements or 'grandparent' from recent baselines. Early adopters are crucial to leading behaviour change and play a valuable role in shifting the agricultural sector towards more sustainable systems. Regulations need to be drafted in a way that encourages innovation of mitigations to achieve freshwater outcomes not stifle them.

The NPS-FM 2020 requires all regional councils to update (or redraft) their regional plans to implement the new freshwater management requirements by the end of 2024 (MFE and MPI, 2019). This means that there is a further round of regulatory change occurring in each region. Regulations do offer an important opportunity to lift the bar on poor practice and set a strong direction of travel within catchments. With this new round of regulations, it will be crucial to get the balance of regulations that achieve the desired freshwater outcomes but also allow enough flexibility to reward early adopters not penalise them. This research project looks at this issue in depth.

2. Purpose and aims of this research

6.1. Purpose

The purpose of this research is to investigate the relationship between changing freshwater regulations and farmers appetite to innovate on farm to achieve freshwater improvements. This research examines what regulatory approaches could be taken that would provide certainty to farmers to innovate whilst meeting regulatory requirements and freshwater objectives.

6.2. Aims

The overall aim of this research is to understand how freshwater regulations could provide more certainty for farmers looking to innovate on farm. To achieve this aim, there are three sub-aims of this research:

Firstly, to determine what impact changing regulation has had on farmers adopting innovative freshwater management practices on farm.

Second, this research aims to understand the scope of emerging and accepted mitigations to achieve freshwater outcomes to illustrate the opportunity that could come from innovation.

Finally, the research aims to develop practical recommendations for how freshwater regulations can be drafted to provide certainty to farmers whilst improving the quality of Aotearoa's waterways.

6.3. Scope of research

The scope of this research is primarily on dairy farming and freshwater quality. Whilst there will be considerable cross over with other types of farming especially sheep and beef and other issues facing regulation such as biological methane emissions or biodiversity, the scope of this project has been kept to one type of farming and one environmental issue to allow for a deeper investigation of those issues.

7. Literature Review

A literature review was undertaken to understand what existing knowledge was available on implementation of freshwater regulations in New Zealand. This literature highlighted what freshwater regulation has been put in place, how it differs from international approaches and what challenges and opportunities have arisen through implementation. A second theme of literature review was undertaken to understand what mitigations are available for farmers to reduce their farms impact on freshwater quality and what mitigations are emerging (innovation).

When carrying out a literature review on the topic of freshwater regulation for dairy farming, four key themes of research appeared. These were the link between dairy farming and freshwater quality in New Zealand, what regulation has been put in place in New Zealand, what are international examples or alternative ways of achieving freshwater outcomes and what can be achieved through mitigating dairy farming's impact on freshwater. These themes are expanded on in the following sections.

7.1. Perception of the impact of dairy farming on freshwater in New Zealand

Dairy farming in New Zealand faces a difficult perception issue from the New Zealand public and in some cases the overseas market due to its high input high output nature and link with degradation to waterways (Warne, 2017). General perception amongst both dairy farmers and the wider public is that New Zealand's freshwater resources have high intrinsic value and should be protected. The role of a farmer is often likened to being a caretaker for the land for future generations, whilst also operating as a profitable business.

For this reason, the pattern of increasing regulation for freshwater management is not surprising and has at times heavily focussed on dairy farming. For example, many freshwater regulations are aimed at dairy farming land uses such as the nitrogen cap or intensification rules introduced through the NES-F 2020 (MFE and MPI, 2020). Considerable effort by the whole dairy sector has gone in to reducing the environmental footprint of dairy farming including investment in research, development of tools and mitigations, on farm practices and management changes. However, these steps have associated costs and research has confirmed that for example mitigating nutrient loss does reduce farm operating profit (Muler & Neal, 2017).

As regulation has been introduced there has been considerable debate around the true costs of freshwater degradation and reducing the environmental impact of dairy farming. Through community consultation New Zealand societies need to weigh up the economic benefits (and the lifestyle implications) of increased dairy production against the environmental costs of reduced water quality and loss of native biodiversity. While the benefits of dairy exports to the national economy are large, the environmental costs tend to be regionally localised, and many of the environmental costs remain subtle, complex, long-term, and hard to quantify (Jay & Morad, 2006). The complexity of public perception, costs of mitigation and gaps in scientific information will continue to play out for dairy farming. For regulations to be successful through to implementation they will need to be perceived as 'just' by farmers and wider society (Knickel et al., 2011).

7.2. Freshwater regulation within New Zealand

This research investigates the regulatory context for freshwater management in New Zealand. There has been considerable change to the way freshwater resources have been regulated in New Zealand over the last 15 years. The most significant change is the shift from regulations being developed at the regional or local level through regional councils towards a more nationalised approach from central governments direction through the iterations of the NPS-FM (Fenemor & Kirk, 2021). The NPS-FM provides a more consistent approach throughout the regions however considerable discretion is still held by regional councils on how specific water bodies are addressed. The NPS-FM was first introduced in 2011 and then updated in 2014, 2017 and 2020 (Kirk et al., 2020). The 2014 update to the NPS-FM was largely driven by the recommendations of the Land and Water Forum, a collaboration of industry groups, environmental and recreational NGOs, iwi, scientists, and other organisations with a stake in freshwater and land management (Larned et al., 2022). The four updates to the NPS-FM in consecutive 3-year political cycles has made it challenging for regional councils to implement the required changes through the regional planning process (Kirk et al., 2020). The full effects of implementing an NPS-FM were not seen prior to a further update being brought in which makes assessing their effectiveness and achieving change difficult.

The latest update to the NPS-FM was made in 2020 as part of the Essential Freshwater Package which implemented a suite of changes aimed at improving New Zealand's freshwater quality within a generation. The Essential Freshwater Package included new National Environmental Standards for Freshwater (NES-F) and several technical amendments to RMA Section 360 regulations aimed at excluding stock from waterways. The Essential Freshwater Package also brought in mandatory and enforceable Freshwater Farm Plans by introducing a new Part to the RMA (Resource Management Act 1991, Part 9A). Whilst these changes set a clear direction around practices that impact waterways on farm, there was considerable push back from the farming community on the practicality of the regulations (Corlett, 2021). This led to multiple iterations of some of the NES-F standards to get the settings right, especially the Intensive Winter Grazing and Stock Exclusion regulations.

The NPS-FM 2020 requires all regional councils to update their regional plans to implement the changes made in the NPS-FM 2020 by 31 December 2024. This was to ensure further degradation of water quality did not occur due to delayed implementation by regional councils however it has put considerable pressure on regional councils to carry out a full regional freshwater planning process in four years. It will be critical that the regulations made by regional councils through the freshwater planning process to provide certainty to farmers and allow flexibility for innovative practices.

7.3. Other approaches to achieving freshwater outcomes

The research process highlighted multiple alternative approaches to achieving improvements in water quality both within New Zealand and internationally.

The concept of Collective Environment Management highlights the need for those being restricted or regulated to be close to the decision making and implementation of a strategy. This approach is beneficial for two key reasons, 1) the settings can be designed to be practical and achievable to those who must comply, and 2) the settings can be designed with sufficient knowledge about local conditions (Knickel et al., 2011). An example of collective environmental management is through the Quota Management System in New Zealand where fish stocks are managed via achievable quotas for those who utilise the resource.

Another pathway to achieving freshwater quality improvement is through subsidies. In international examples, such as in Europe, subsidies are paid on activities like landscape or ecosystem restoration to achieve environmental outcomes. However, the context in New Zealand is very different which makes subsidies less common. In Europe much of the unique biodiversity species that are being protected requires maintained landscapes associated with farming, these same landscapes have aesthetic benefits for the community as well (think rolling hills with stone fences), so the public are willing for money to be directed towards public good through subsidies. However, in New Zealand much of the indigenous biodiversity remains in uncleared or restored landscapes and focuses on the exclusion of pests and weeds (Knickel et al., 2011). Therefore a 'polluter pays' approach is the default. New Zealand has the lowest level of producer subsidies for agriculture out of developed countries (Swaffield, 2014). Some activities are becoming more commonly supported through funding often by central or local government particularly planting trees or riparian areas and fencing of waterways.

Non regulatory or voluntary methods of achieving environmental improvements have seen success in New Zealand. The Sustainable Dairying: Water Accord was developed by the Dairy Environment Leadership Group (DELG) (McWilliam & Balzarova, 2017). DELG includes representatives from farmers, dairy companies, central government, regional councils, and the Federation of Māori Authorities (Dairy Tomorrow Partners, 2022). It committed to all dairy farms achieving a number of land use practice changes (e.g., fencing, riparian planting, nutrient management) to improve freshwater quality. All metrics achieved high implementation rates. Similar non-regulatory approaches are being seen through the milksolid premiums provided for environmental management through

programmes like Synlait's Lead with Pride (Synlait, 2023) and Fonterra's Cooperative Difference (Fonterra, 2023). Processor level non regulatory approaches will possibly become more common to address the issue of reducing agricultural methane emissions.

One approach to reducing farming's impact on freshwater has been through farm planning. This involves carrying out an assessment of the farm and planning a suite of actions that can be undertaken on farm to mitigate the risk or impact of an aspect of the farm. Farm planning can be carried out at a whole farm system level (looking at environment, biosecurity, health and safety etc) or at targeted level on a specific issue for example freshwater. Regional Councils such as Environment Canterbury or the Hawke's Bay have implemented a regulatory approach to farm planning in parts of their region. As part of the Essential Freshwater package central government introduced Freshwater Farm Plans which are mandatory and enforceable for all farms over a certain threshold. Farm plans offer the opportunity to document the complexity of interactions between farming and the environment at the farm level (McDowell & Kaye-Blake, 2023). The fundamental approach of Freshwater Farm Plans is to provide a level of consistency and flexibility to adopt farm-specific, prioritised, timebound and auditable on-farm actions to improve water quality (Macintosh et al., 2021). However, this approach is resource intensive any there are many settings that need to be designed well to ensure successful implementation (Stokes et al., 2021).

Regional councils have the task of notifying a regional plan that implements the NPS-FM 2020 by the end of 2024. This requires regional councils to carry out the process identified in the National Objectives framework. One of these steps is to identify rules and limits on resources use or develop and apply action plans. This needs to be done to achieve the visions and values of the community. The Multi-Criteria Decision Analysis (MCDA) framework is one way to integrate community values into what actions or limits should be prioritised to manage water quality in a community's local area. Simone et al., 2018 applied the multicriteria decision analysis to implement the NPS-FM within a catchment whilst providing prioritisation of both regulated outcomes and community values. This highlights that not all of the 22 attributes included in the National Objectives framework will be implemented consistently throughout New Zealand at the catchment level due to differing environmental and social contexts.

7.4. Opportunity of mitigation for dairy farming

This research looks into what possible mitigation approaches are available to dairy farmers to reduce contaminant loss from dairy farming.

There are many on farm practices that reduce contaminant loss from farming systems that are now considered common practise. These are established mitigations, such as effective nutrient management, effluent management or stream fencing that are accepted as having a beneficial impact on farm production and mitigating nutrient loss from the farm. Research shows that implementation of established mitigations between 1995 and 2015 reduced phosphorus losses to water by an estimated 20%-25% (Monaghan et al., 2021).

Implementation of established mitigations measures have not been enough to offset the effects of an expanding and intensifying dairy herd, however, they have been important for constraining rates of N losses from pastoral land (Monaghan et al., 2021).

More recently there has been a shift towards implementing both accepted and emerging mitigations. Emerging mitigations are less common and the science to determine their impact on contaminant loss reduction is still being fully quantified. Examples of emerging mitigations are edge-of-field mitigations, in-stream sorbents, controlled drainage, management of critical source areas, and retention dams or bunds (McDowell et al., 2021). Research has found that if all accepted and emerging mitigation actions were implemented by 2035 the national load of nitrogen, phosphorus and sediment from pastoral land could be decreased 34, 39 and 66%, respectively from 2015 levels. A greater proportion of reduction could come from land in dairy farming due to the higher per hectare yield and the number of mitigation actions available (McDowell et al., 2021).

The research covered by Monaghan et, al. (2021) and McDowell et, al. (2021), did not cover all possible emerging mitigations. Considerable research is occurring on Low N mitigations for dairy farming including the use of forage crops for reduced nitrate leaching (including plantain, fodder beet and catch crops) or advances in animal breeding (low milk urea cows) (Kok & Bryant, 2023). Another element for consideration regarding mitigations is the impact of stacked mitigations to improve efficiency of mitigations when implemented together. Combinations of mitigations that target multiple parts of the N cycle can have a greater impact on reducing N loss than singular approaches (Chikazhe et al., 2023, submitted). Further research has also been done to quantify the impact of edge-of-field mitigations such as constructed wetlands (NIWA, 2021) or woodchip denitrification bioreactors in waterways (Burbery & Abraham, 2022).

The above research shows that there is a considerable amount of science and investment going into developing and implementing mitigations to reduce contaminant loss from dairy farms. This approach has achieved great reductions and even more can be achieved with implementation over time. However, some of the freshwater regulations will be difficult to achieve with mitigations alone. For example, the bottom lines for dissolved inorganic nitrogen (DIN) and dissolved reactive phosphorus (DRP) introduced through the NPS-2020 are unlikely to be met through mitigating nitrogen or phosphorous loss from existing farm systems. McDowell et al., 2020, found that the proportion of catchments exceeding these bottom lines if all known mitigations were implemented was predicted to be 4% for DIN and 9% for DRP. This could lead to the requirement of land use change or deintensification to meet national bottom lines. Regional Councils will play a key role in determining where land use change is required to meet freshwater objectives. Land use change is a difficult transition for individual farm business owners and considerable effort will need to go into ensuring the required changes are seen as 'just' by land users and the public (Knickel et al., 2011).

8. Method

This research project consisted of semi-structured interviews with dairy farmers, a regulatory scan of current freshwater regulations under development, a thematic analysis of interview responses and a policy assessment of options against chosen criteria analysis to investigate how freshwater regulations can be drafted to provide certainty for farmers to innovate.

8.1. Data collection

8.1.1. Semi-structured interviews

Eight semi-structured interviews were carried out with farmers who were identified as possible early adopters of freshwater mitigation strategies. The interviewees were selected through snowball sampling after conferring with colleagues in the dairy farming industry. The interview participants were farm owners or share milkers on dairy farms in the Waikato, Lower North Island, Canterbury, and Southland. Two of the interview participants were speaking on behalf of a collective of farms.

The questions were designed to understand the freshwater challenges farmers faced, whether those challenges were linked to regulatory changes and how these regulatory changes had influenced farmers decision-making. The interviews aimed to explore what impact changing regulation has had on farmers adopting innovative freshwater management practices on farm.

The semi-structured interviews consisted of six structured questions allowing for plenty of space to discuss each issue, and any additional challenges raised by the interviewees. The purpose of the first three questions was to gain an understanding of the interviewee's farm's freshwater context and were designed to be straight forward to answer, to set the scene for the interview. The last three questions were aimed at gaining a deeper understanding of the regulatory context of the farm and what the farmers' experience was with regulations and freshwater quality. The last two questions required more reflection from the farmers on how their previous experiences might impact their approach going forward. In most cases, the conversation led on to further discussion on the regulation development process, emerging technologies, catchment groups or farm planning.

The following questions were used in the semi-structured interviews:

1. What are the freshwater quality challenges facing your farm?
2. How have you approached these challenges?
3. Did you include innovative practices in your approach? i.e., new technology, new tool, new practice?
4. Were the freshwater challenges regulated in anyway by central or local government?
5. How did regulations change the way you farmed or approached the freshwater challenges?
6. In the future how will you approach new or other freshwater challenges, especially ones that might be regulated?

8.1.2. Regulatory scan of current freshwater regulations under development

An assessment of freshwater regulations in New Zealand was undertaken. Relevant documents from regulators such as the Ministry for the Environment or the Ministry for Primary Industries were assessed. The NPS-FM 2020 was investigated in more detail as it was found as the most relevant freshwater regulation that was still in the implementation phase. This regulation was considered alongside the analysis and recommendations to ensure the outcomes of this research were practical and applicable to the rural sector at the moment.

8.2. Data analysis

8.2.1. Thematic analysis of interview responses

A thematic analysis was undertaken on the interview data to investigate the relationship between innovation and regulation. Interview responses were coded to find themes (Braun & Clarke, 2006). The responses provided insight into what freshwater challenges faced farmers, what the regulatory context they were operating in was and how this had influenced farmers' decision making. The responses highlighted the complex relationship between adopting innovative freshwater mitigations on farm in the face of a changing regulatory landscape.

8.2.2. Policy assessment of options against chosen criteria

A policy assessment of regulatory options was undertaken informed by a framework used in government Regulatory Impact Assessments that has been adapted to respond to the aims of this research. This framework was chosen because it had attributes that allow for an analysis of options against a set of relevant criteria.

Three policy options for mitigating freshwater quality issues were selected from the regulatory scan and literature review. These options were chosen because they are common regulatory approaches or captured alternatives highlighted in the literature review.

The policy options were then assessed against four criteria that were chosen to represent the findings of the literature review, farmer interviews and regulatory scan. The criteria that were chosen to represent the broad set of themes that has come through from the research were flexible, enforceable, practical and ambitious.

The assessment of policy options against the criteria influenced the recommendations provided at the end of this research project.

9. Analysis and Findings

9.1. Thematic analysis of Semi Structured Interviews

A thematic analysis of the eight farmer interview responses was undertaken. Interview responses were coded to find themes (Braun & Clarke, 2006). The responses provided insight into what freshwater challenges faced farmers, what their

regulatory context was and how this had influenced their decision making. The responses highlighted the complex relationship between innovation and regulation.

9.1.1. Key themes from interviews

Figure 1 outlines a thematic map that indicates the key themes that came through in the farmers responses. Words in bold are points that came up in three or more interviews.

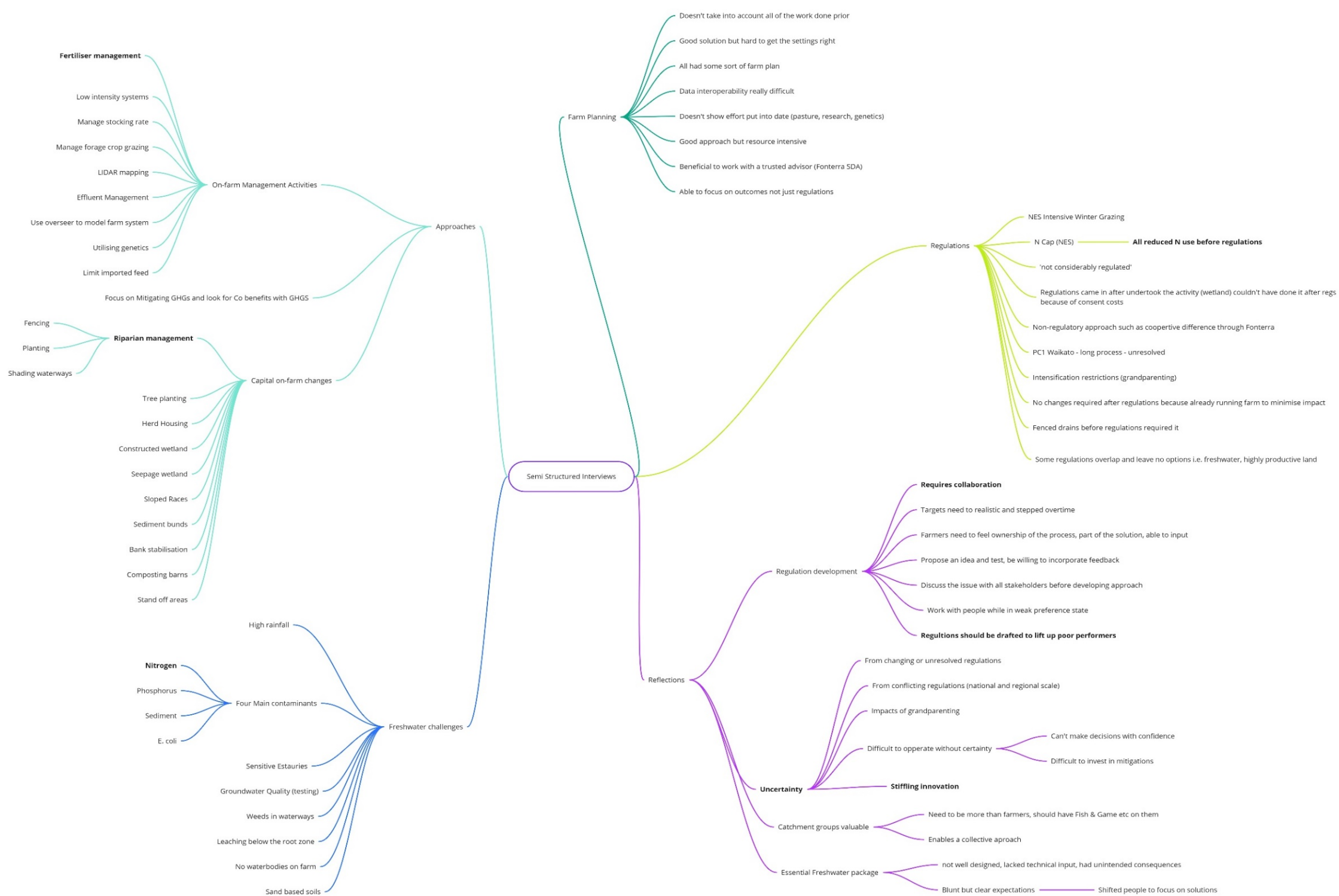


Figure 1: Mind map representing interview responses as themes. Miro (2022). *Miro online whiteboard*. www.miro.com.

9.1.1.1. Freshwater challenges

All of the farmers interviewed mentioned one or more of the four key contaminants to freshwater (Nitrogen, Phosphorus, Sediment or E. coli) in their response to the first question. Most farmers emphasised nitrogen loss was a challenge for the farm which is not uncommon in dairy farming systems. The farmers responses showed that they were well aware of how the biophysical features of their farms (rainfall, soil, waterways etc.) raised or lowered the risk of contaminant loss to freshwater. This shows the variation between farm system can be considerable and on farm knowledge is important to understanding freshwater risks.

9.1.1.2. Approaches to freshwater challenges

All of the farmers interviewed had put considerable effort into mitigating the impact of their farm on freshwater quality. In almost all cases these mitigations had been put into place prior to regulation requiring them and due to a desire from the farmer to make improvements to the farm system. This is likely a reflection of the cohort of farmers identified for these interviews through industry recommendation, as a consistent trend was the proactiveness of the farmers actions.

The mitigations implemented fell into two main categories 1) on-farm management activities – these are changes to the day-to-day management on farm and can be made without physical changes to the farm system and 2) capital on-farm changes – physical changes on-farm that require capital investment into infrastructure and installation. For both the on-farm management activities and the capital on-farm changes a considerable amount of investment of time, money, and resources such as land had gone into the mitigations. For example, fertiliser management with Overseer files is a costly approach that can involve paying for a consultant, an Overseer licence, and carrying out more frequent fertiliser applications (costing time and equipment use). Another example of a costly mitigation implemented by one of the farmers interviewed was the construction of a wetland on the farm, as this involved consultant advice, contracting earthworks, retirement of land and ongoing maintenance costs. These mitigations were implemented voluntarily, and whilst scientific evidence indicates they are effective at mitigating contaminant loss to water quality it is very difficult to quantify the actual reductions from the mitigations. Modelling can provide some insights, but these are estimates not actual figures. This adds to the complexity of utilising innovative practices in a regulatory context.

Many of the farmers interviewed mentioned that mitigating their methane emissions on farm was their first concern when it came to on-farm changes and that they prioritised actions with co-benefits to water quality. This highlights that farmers are working in a regulatory context much wider than just freshwater. Farmers look at changes required on farm from a practical viewpoint that considered freshwater, methane emissions, animal welfare and profitability as just some of the key considerations. This shows that farmers don't work in silos in quite the same way that experts, scientists, or regulators do, and it is important to ensure that work to progress freshwater quality improvements do not lead to 'pollution swapping' or are at least efficient in a wider farm system to ensure they can be implemented on farm.

9.1.1.3. Regulatory context

In most cases the farmers interviewed did not need to make changes due to regulations (either national or local) because their farms were already well above compliance (especially the stock exclusion and Nitrogen Cap rules that came in as part of the Essential Freshwater package). Those interviewed who represented larger farming collectives highlighted that the Intensive Winter Grazing regulations as part of the Essential Freshwater package did require practice change on some farms. Despite the farmers interviewed being well ahead of the requirements from regulation there was a general sentiment that the regulations were not well drafted as they were difficult to interpret, monitor and enforce and they were not outcomes focused. One farmer described how the mitigation they implemented that has had the greatest impact (a constructed wetland) would not be possible to do implement now because the regulations have added a significant compliance burden and a costly resource consent (equivalent to around half of the construction costs). This is an example of the tension of regulating for environmental protection whilst stifling innovation that could achieve considerable contaminant mitigation.

Two farmers raised examples where they were considering implementing an innovative mitigation but no longer feel confident to implement them because of regulatory uncertainty. One farmer was considering constructing a woodchip bioreactor on farm which is an emerging mitigation showing promising results for the reduction of nitrogen from a farm system. However, the consent process was almost more expensive than the costs of construction and so it became prohibitive. In this case the farmer had a strong relationship with the council and was a farming leader and demonstration farm in the region, therefore was disappointed that there was not a trust model that could avoid such a restrictive consenting process. Another example was a farmer who was considering installing a wintering barn on farm which is a relatively expensive mitigation to implement. Currently, there is no regulatory certainty about freshwater limits or activity rules in the area due to a pending review of the regional plan, and it is likely that to afford to implement the mitigation, on-farm production would need to increase to offset the costs which may not be possible under new rules. A second-hand story was shared where it had been heard that farmers were interested in incorporating plantain into their crops to reduce nitrogen loss but were waiting until freshwater limits were set by the regional council in case they were asked to reduce nitrogen loss from a baseline that included already utilising plantain. These three examples emphasize that the uncertainty from frequent regulatory changes in the freshwater context is stifling innovation.

Another theme that came up was the role of non-regulatory, processor led initiatives to drive practice change. A few of the farmers mentioned that they have made changes on farm not necessarily due to regulatory requirements but to meet processor supply requirements or to achieve premiums. Fonterra's Cooperative Difference (Fonterra, 2023) and Synlait's Lead with Pride (Synlait, 2023) initiatives both offered a premium milk solid price to those who carried out activity on-farm that meet higher standards across a range of areas (not just freshwater). These initiatives seem to be implemented in a way that work well to lift the bar above what regulatory requirements are (i.e., the bottom line). These initiatives offer a good

opportunity of rewarding early adopters of practice change without the need for a regulatory mechanism.

9.1.1.4. Farmer reflections

Uncertainty

Uncertainty was a key theme that came through the responses from the farmers interviewed. Some were awaiting regulations to be finalised (those in the Waikato PC1 catchments), while others were unsure how regulations announced like the NPS-FM were going to be implemented in their catchment. A farmer in the Canterbury region had been through a lengthy process with the catchment and regional council to figure out how to implement the required Dissolved Inorganic Nitrogen (DIN) bottom line of 6.9 mg/L and then the NPS-FM 2020 introduced a Nitrate toxicity bottom line of 2.4 mg NO₃ – N/L (milligrams nitrate-nitrogen per litre) – a comparable measure. This meant that farmers in the catchment were left uncertain on how the new bottom line would impact the way they could farm especially as all prior farm decision making had been based on the earlier target. This example highlights the context of regulatory change that farmers are having to navigate.

A key impact of the uncertainty that farmers are facing is that they are not able to make investment decisions on implementing mitigations that go over and beyond regulations to improve water quality. Investment decisions require certainty that the mitigation will be effective, that the land use will be able to remain as intended for the mitigation to be effective (i.e., no land use change or densification requirements), and that the mitigation will not need to be modified or redesigned to meet new regulations that may be introduced. There is an increased risk that investment into mitigations could lead to stranded capital if regulations come into effect that drive land use change, a theoretical example to illustrate this issue would be investment into a herd home to reduce nitrogen and sediment loss from a dairy farm. If freshwater limits were introduced in the catchment requiring deintensification or land use change into non livestock uses the herd home would be stranded capital and the investment lost if it could not be used at the intended stocking rate. Because farmers are in a time of uncertainty due to regulatory change, they are unlikely to invest in and implement mitigations. Implementing mitigations early could make a greater impact on improving water quality because they can mitigate contaminant loss earlier reducing the long-term contaminant load of the waterbody compared to mitigations implemented later down the line.

Development of regulations

Another key theme from the farmers responses was their feedback on the regulation development process. A term that is emerging is 'consultation fatigue' implying that there have been many consultation processes over the last few years that have required farmer input and the farmers have lost interest in contributing to consultations. The farmers interviewed highlighted that consultation is important for regulators to understand the true implications and get an understanding of how the regulations can be implemented. The farmers responses emphasized that those impacted (farmers) need to feel like they are part of the process, part of the solution and able to input to have the greatest chance at successful implementation of a

regulation. Interestingly there was some conflicting ideas on how this could be achieved with one interviewee suggesting that regulators should meet with stakeholders early to discuss the issue and firm up solutions before the regulators then draft them into regulations. This approach is intended to get all stakeholders working towards a solution whilst in a weak preference state (i.e., preconceived decisions). This approach can be very effective but requires more time and resources from all parties. Alternatively, one interviewee suggested that regulators test a drafted proposal with all the required information included with farmers but need to be willing to take on feedback and alter the proposal as needed. Regardless of the contrasting approaches, it is clear that consultation with stakeholders is a vital step in developing regulations. As the RMA requires community consultation on regional planning decisions it will be important for regional councils to get community consultation needed for the required updates to regional plans right.

Catchment groups

Many of the farmers interviewed mentioned catchment groups as great conduits for collaboration. Catchment groups are popular among farmers to share learnings and progress made mostly regarding freshwater but also a wider set of topics. A key point that multiple interviewees mentioned was that catchment groups should have a wider membership than just farmers, and that other stakeholders like Fish & Game representatives, council representatives, wider community members and sector groups should also join to allow the conversations that are had to contain the full scope of the issue and any solutions developed meet the needs of the whole community.

Farm planning

Although it was not in scope of the interview questions the concept of farm planning came up a lot in the semi-structured interviews, all of the interviews had some form of plan and thought they were a useful resource to focus on the outcomes of the farm system. Farm planning and Freshwater Farm Plans were discussed as an option of capturing the effort required and impact that implementing mitigations have on-farm. The farmer responses suggested that farm plans are usually future focused and do not capture the prior work gone into the farm system over prior decades (for example keeping stocking rate low or genetics) to reduce the farms impact. This could be one option to recognise early adopters for the practice change or capital investment. There were a few limitations of farm planning highlighted such as the intensive resource requirements to develop them, the resources required to keep them up to date and difficulty of data-interoperability between platforms.

Conclusion

In conclusion the farmer interviews compounded some of the trends seen in the literature review, in particular, the pace of regulatory change over the last few years has led to uncertainty, there are considerable opportunities to reduce farming impacts on water quality through implementing both accepted and emerging mitigations and that collaboration is vital for successful implementation of regulations.

9.2. Diffusion of innovation model

The purpose of this research topic is to investigate how freshwater regulation can provide certainty to farmers adopting innovative practices. In this context innovators are farmers implementing or trialling emerging mitigations on-farm and early adopters are farmers who implement accepted mitigations voluntarily well before regulation requires.

In 1962, Rogers first developed the theory of Diffusion of Innovations. The theory describes the spread of each category of adopter throughout a general population and describes the boundary between early adopters and the early majority as the tipping point of behaviour change (Rogers, 1995). This implies that innovators and early adopters play a crucial role in achieving behaviour change within a community through non-regulatory levers. If innovators and early adopters are penalised through unintended consequences of regulations (re-work, added costs or consent requirements) they are less likely to lead their communities through behaviour change. This would mean the loss of a peer-to-peer approach to achieve desired outcomes such as freshwater quality improvements.

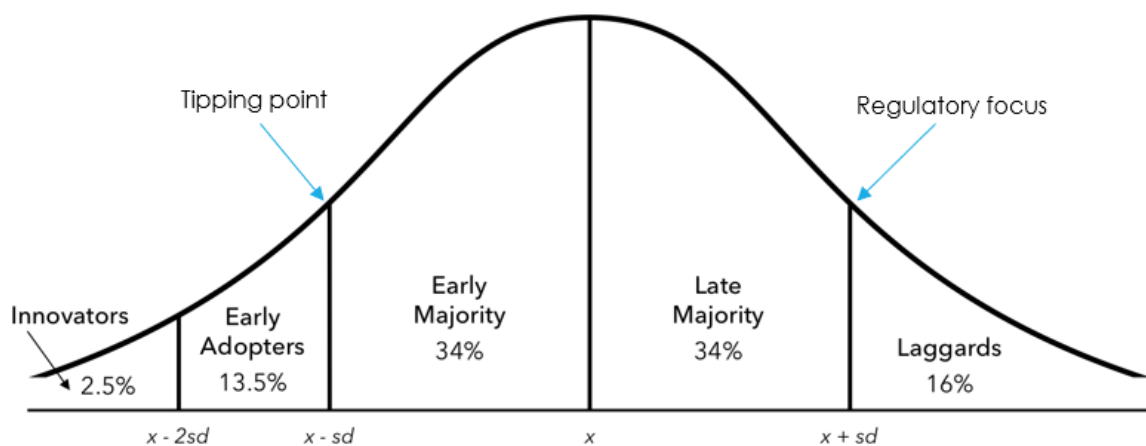


Figure 2: Modified version of the adoption curve showing where the different categories of adopters sit (Rogers, Diffusions of Innovations, 5th edition, 2003).

Overall, this model illustrates that within dairy farming, like most communities, there is a large variation in the attitude and aptitude of farmers regarding behaviour change. Research has shown that the average time to peak adoption of a new land use practice or mitigation action is about 15–20 years (McDowell et al., 2021).

Farmer feedback from the semi-structured interviews emphasized that regulations should focus on lifting the performance of laggards to ensure that poor practice could not continue. A balance could be struck if freshwater regulations could be drafted well to successfully target the behaviour of laggards, and overall sector performance improved due to a tipping point of influence from innovators and early adopters.

9.3. Freshwater Regulatory requirements

The purpose of this research topic is to investigate how freshwater regulation can provide certainty to farmers adopting innovative practices. Of the recently introduced freshwater regulation including the NPS-FMs, the NES-F, regional planning processes and stock exclusion requirements. The NPS-FM 2020 is the only finalised piece of regulation that is still in the implementation phase as it directs regional council to draft and notify regional plans that give effect to its requirements at a regional scale by the end of 2024. Therefore, this analysis will look at how regulations drafted by regional councils to implement the NPS-FM 2020 can provide certainty for farmers to apply innovative practices on farm (or be early adopters).

As depicted in the infographic below each regional council is required to ensure that the regional policy statement (RPS) and regional plan;

- a) identify Freshwater Management Units (FMUs) in the region
- b) identify values for each FMU
- c) set environmental outcomes for each value and include them as objectives in regional plans
- d) identify attributes for each value and identify baseline states for those attributes
- e) set target attribute states, environmental flows and levels, and other criteria to support the achievement of environmental outcomes
- f) set limits as rules and prepare action plans (as appropriate) to achieve environmental outcomes

The National Objectives Framework also requires that regional councils:

- (a) monitor water bodies and freshwater ecosystems
- (b) take action if degradation is detected.

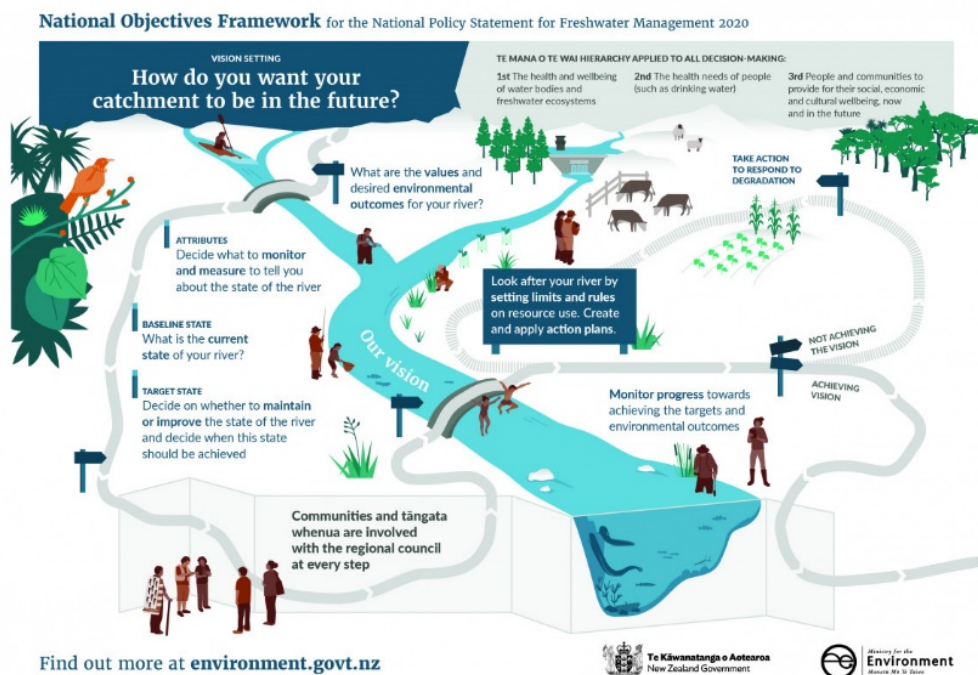


Figure 3. Graphic depicting the National Objectives Framework for the NPS-FM 2020

When regional councils develop the long-term visions for FMUs with their communities they must set goals that are ambitious but reasonable (that is, difficult to achieve but not impossible) and identify a timeframe to achieve those goals that is both ambitious and reasonable (for example, 30 years after the commencement date).

The long-term visions for each FMU must be developed in consultation with tangata whenua and the community. This is an important stage of the process for farmers to be involved as they themselves are members of the community. This stage of the process is an important time to build consensus within the community so adequate consultation is needed from the regional council, as heard in the farmer interviews.

Policy 11 of the NPS-FM also states that freshwater must be allocated and used efficiently, all existing over-allocation is phased out, and future over-allocation is avoided.

The direction given for setting limits on resource use states that limits may:

- (a) apply to any activity or land use; and*
- (b) apply at any scale (such as to all or any part of an FMU, or to a specific water body or individual property);*
- (c) be expressed as any of the following:*
 - (i) a land-use control (such as a control on the extent of an activity)*
 - (ii) an input control (such as an amount of fertiliser that may be applied)*
 - (iii) an output control (such as a volume or rate of discharge); and*
- (d) describe the circumstances in which the limit applies.*

This provides some context around how regulations must be drafted to meet the requirements of the NPS-FM 2020.

9.4. Policy assessment of regulatory options

9.4.1. Criteria for effective regulation drafting

From the interviews with farmers some key themes came through which could represent criteria for successful regulation development. These are certainty, flexibility, consultation, and a stepped approach. From the literature review it was apparent that there are key considerations that need to be strengthened in the regulation development process. These are implementation, responding to perception and incorporating emerging science. From a review of the NPS-FM 2020 regional councils are looking for regulations that are ambitious but reasonable, avoid or reverse overallocation and are enforceable. To carry out the following analysis options will be assessed against four criteria outlined in table 1, which captures the majority of ideas raised by farmers, literature and regulators.

Table 1. Criteria and descriptions for successful regulation development

Criteria	Description
Flexible	Provides options to achieve desired outcomes, takes into account emerging science on mitigations
Enforceable	Sets clear expectations for all stakeholders, easy to define compliance
Practical	Can be incorporated into farm management, has achievable timeframes
Ambitious	Meets the expectations of the community/public, has ambitious timeframes for implementation

9.4.2. Assessment of regulatory options

Based off of the literature review, interviews with farmers and scan of freshwater regulations there are three main pathways for drafting regulation that could be considered by regional councils. These include an input-based approach, a risk-based approach, or a collective catchment approach. These three options will be assessed against the criteria and the wider benefits, limitations and implications will be discussed.

Input-based approach

An Input-based approach to freshwater management would be one based on input controls, land use controls or activity controls. This would restrict the amount of input, for example fertiliser or stocking rate on the land to reduce the impact on water quality. This approach was seen in the NES-F 2020, in the Nitrogen Cap and Intensive Winter Grazing regulations.

An input-based approach was assessed against the criteria and received an overall rating of moderate based off two low ranking criteria and two high ranking criteria.

Table 2. Assessment against criteria of an Input-based approach

Criteria	High	Moderate	Low
Flexible			✗
Enforceable	✓		
Practical			✗
Ambitious	✓		

Discussion

The above assessment ratings for each criteria were assigned to an input-based approach based on the following assessment;

Flexible – this approach does not provide options on how to meet the desired income, instead restricts certain activities on land. Instead of farmers being able to innovate to try technologies to reach a desired outcome, prescriptive rules are applied to the farm.

Enforceable – this approach sets a very clear direction of what is expected of the farm, and it is often a simple process to determine whether or not compliance is being met, by both the farmer and the council. This removes ambiguity and makes implementation more straight forward for all parties.

Practical – this approach uses blunt tools that can be disruptive to the farm system. If set at levels to target solely the laggards they can be easy to meet for most farmers but this approach risks both creating a low limit of acceptable practice, and high compliance burden for a regulation that won't achieve much change.

Ambitious – this approach can be set at any level to target certain behaviour change e.g., the Nitrogen Cap policy in the NES-F 2020 which set a 190kg/N/ha control. This targeted high fertiliser users on pastoral farming systems. An input control can be set to be very ambitious and drive considerable behaviour change quickly, however if timeframes for compliance were short, implementation would be difficult to achieve as considerable extension and compliance would be necessary.

Risk-based approach

A risk-based approach looks at what impact the farm is having on freshwater quality and focuses regulations on the outputs or the risks of contaminant loss from the farm system. Output controls look like a limit on the total loss of a contaminant like sediment or nitrogen from the farm. A risk-based approach could also look like a farm planning approach where the biophysical and management factors of a farm are considered to assess the risk of contaminant loss from the farm. Mitigations can then be carried out to address the highest risks, the actions are recorded and verified through audit. This approach can be seen in Environment Canterbury's Land and Water Plan which require audited Farm Environment Plans or through central government's Freshwater Farm Plans approach.

A risk-based approach was assessed against the criteria and received an overall rating of high, based off two moderate ranking criteria and two high ranking criteria.

Table 3. Assessment against criteria of a risk-based approach

Criteria	High	Moderate	Low
Flexible	✓		
Enforceable		—	
Practical	✓		
Ambitious		—	

Discussion

The above assessment ratings for each principle were assigned to a risk-based approach based on the following assessment;

Flexible – this approach identifies risks and assigns actions to mitigate them. There is flexibility around what actions can be taken as long as there is evidence that it will achieve the desired effect, meaning farmers can combine a choice of accepted or emerging mitigations on farm. Whilst this approach is flexible it also provides credibility to the actions undertaken on farm (including those that are innovative or adopted early), because actions are recorded and verified through audit.

Enforceable – this approach can be difficult to get consistent application of during implementation. Because the approach is tailored specifically to the farm there is considerable time and resource put in to plan development and audit, and there can be variation in the application of professional judgement. This can be addressed with guidance and worked examples. It is also difficult to gather evidence to prove that some actions have been undertaken, for example some actions that are worked into the day-to-day management on farm like feed composition or temporary fencing of critical source areas cannot be assessed at an individual audit therefore it is difficult to balance the flexibility of farm planning with the evidence required for audit.

Practical – this approach is practical to implement because it is tailored specifically to the farm system. The highest risks are mitigated which reduces contaminant loss and improves freshwater outcomes and there is no wasted effort on carrying out activities to comply with a regulation that targets a low-risk area of the farm. It also works in the ability to account for stacked mitigations to further reduce risks.

Ambitious – this approach can be ambitious but in practice takes an approach of continuous improvement that means that actions and changes are made over time with new iterations of a plan. This can mean that change is slow to be seen as each farm is taking a different approach which is stepped over time.

Collective Catchment approach

A collective catchment approach is a voluntary approach that convenes representatives of a community to set the direction of water quality outcomes in a catchment.

A collective catchment approach was assessed against the criteria and received an overall moderate rating based off two low ranking criteria, one moderate ranking criteria and one high ranking criteria.

Table 4. Assessment against criteria of an Input-based approach

Criteria	High	Moderate	Low
Flexible	✓		
Enforceable			✗
Practical			✗
Ambitious		—	

Discussion

The above assessment ratings for each principle were assigned to a collective catchment approach based on the following assessment;

Flexible – this approach would provide an outcome that is based on community objectives and would build in the needs and ideals of all of those represented in the community. Because it is a voluntary approach there is no specific regulatory form the outcomes of the group need to take so it provides for full flexibility.

Enforceable – this approach would be difficult to enforce by any regulatory body including a regional council because the approach is completely voluntary.

Practical – this approach requires considerable consensus to get agreement on the desired freshwater outcomes for the water body in the catchment, which could be difficult especially when the financial interests of some of the representatives are at stake.

Ambitious – this approach could be ambitious in terms of vision and objectives of the community but is unlikely to be accompanied by ambitious rules or limits because of the implication for individuals within the community.

9.4.3. Summary of drafting approaches

In summary it is clear from this analysis of drafting options against a set of criteria that there is no perfect way to draft regulations to provide certainty for farmers to innovate. Getting regulatory setting right to achieve multiple outcomes is a difficult

task but one that must continue to play out to implement the NPS-FM 2020 and improve ecosystem health of Aotearoa's waterways.

A risk-based approach that utilises farm planning (such as Freshwater Farm Plans) is the best way to regulate for freshwater management whilst providing certainty for farmers to innovate because farmers can have confidence that mitigations undertaken on farm are recorded and acknowledged. A risk-based approach could shift the way farming activities are regulated and support the uptake of innovative practices. A risk-based approach allows for targeted effort on farm to reduce risks of contaminant loss and can incorporate the effort that farmers put in to go over and above regulations. This would allow for better alignment with actions to mitigate methane emissions from farms as well. A farm planning approach could also help build trust with the public and contribute to a 'licence to operate' as it involved third party certification that the right practices are undertaken on farm.

Regulated farm plans such as Freshwater Farm Plans offer an opportunity to capture the effort put in by farmers when they are early adopters of innovation. Recording actions undertaken on farm and having them verified through audit should ensure they are recognised if further regulations come into effect such as resource limits or input controls. This should provide some certainty to farmers to implement innovations on farm.

It is likely that the three regulatory approaches combined could provide a robust approach that balances flexibility, enforceability, practicality, and ambition.

A catchment collective approach could be used to consult with the community, set clear goals and visions for each Freshwater Management Unit and to test concepts with, throughout the drafting process. Multi-Criteria Decision Analysis (MCDA) could be carried out to determine priorities within the community for the implementation of the attributes in the NPS-FM (Simone et. al., 2018).

Finally, input-based controls could be utilised to set clear expectations in over-allocated catchments and to reverse any degradation. However, input controls would need to be well drafted to avoid unintended consequences and to achieve the desired results.

10. Conclusion

In conclusion, the considerable amount of regulatory change in the freshwater space over the last 15 years has been difficult to implement for both farmers and regulators.

As different versions of regulations have been introduced consecutively there has been an increased level of uncertainty for farmers wishing to implement mitigations on farm. This has seen some stifling of innovation occur at the farm level. However, the available science on innovative mitigations is continuing to expand and the opportunity to mitigate contaminant loss on farm is increasing.

Responses in farmer interviews compounded some of these trends, in particular, the pace of regulatory change over the last few years has led to uncertainty, there are considerable opportunities to reduce farming impacts on water quality through implementing both accepted and emerging mitigations and that collaboration is vital for successful implementation of regulations.

Regulations for freshwater management are required particularly to implement the NPS-FM 2020 within regional plans. Therefore, an approach to freshwater management that is flexible, enforceable, practical, and ambitious will provide certainty for farmers to adopt innovation on farm.

A risk-based approach which regulates through a farm planning regime like Freshwater Farm Plans is the most effective way to regulate for freshwater management whilst providing flexibility for innovation. A mixed approach including input-based regulations and catchment collectivism is likely to be needed to meet all objectives of the NPS-FM, however the risk-based methods should be heavily relied upon to provide certainty for farmers.

All parts of the sector contribute to how the relationship between regulation and innovation plays out on farm not just regulators. Therefore, regulators including local and central government and political parties as well as farmers and the dairy sector should all act to ensure freshwater regulations provide certainty for innovation whilst improving freshwater quality of Aotearoa's waterways.

11. Recommendations

The following recommendations were made in response to the research questions; How might freshwater regulations provide certainty for farmers to innovate?

11.1. Recommendations to regional councils

- Regional councils should utilise a risk-based approach to regulations including the Freshwater Farm Plan scheme when implementing the NPS-FM 2020 in regional plans.
- Regional councils should utilise the Freshwater Farm Plan scheme to acknowledge early adopters of innovative practice.

11.2. Recommendations for central government

- Central government, in particular the Ministry for the Environment and the Ministry for Primary Industries should ensure that regional councils are adequately supported to implement Freshwater Farm Plans within their regions.
- Central government should support the implementation of Freshwater Farm Plans in a way that ensures they are flexible, enforceable, practical and ambitious.

11.3. Recommendations for political parties

- Political parties should avoid using freshwater regulation as campaigning tool, instead a non-partisan approach should be taken with any further regulation required (relating to freshwater) developed effectively outside of three-year political cycle.

11.4. Recommendations for farmers

- Farmers should utilise Freshwater Farm Plans to capture evidence of all mitigations implemented on farm, including those that were innovative or early-adoption.
- Farmers should utilise their Freshwater Farm Plan to demonstrate to the community, how mitigating on farm risks reduces their farms impact on freshwater quality.

11.5. Recommendations for the dairy sector

- Processors (dairy companies) should continue to develop and integrate recognition programmes for good practice and where possible provide a premium as a way to encourage and acknowledge early adopters of innovative practice.

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