Rural Freshwater Quality

What's Perception? What's Reality?

Kellogg Rural Leadership Programme

Course 43 2021

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Contents

Executive Summary

It feels in recent times public perception has been increasingly negative towards the primary Industries as a result of the water quality "showdown" between farmers, government and the general public. The urban rural divide has been perceived to be greater than ever, and social media has presented a new arena for robust debate about water quality. However, this project discovered that:

- Even though four out of five Kiwis rate water quality as their number 1 environmental concern 60% still feel positive about the primary industries.
- Water quality is giving way to other key issues growing in concern for New Zealanders like climate change, greenhouse gases, recycling, ocean pollution and more.
- New Zealanders perception on whether they feel positive or negative farming has been eroding since 2008. However, since 2017 has been improving and post Covid 19 that trend has been galvanised.
- Negative perception towards the primary industries is still largely based around Dairy's impact on water quality.
- The dominate land use within a catchment has the biggest influence on water and ecosystem health.
- Lag time between land use or system changes made now and impacts on water quality can be upwards of 50 years depending on the natural makeup of the land scape.
- Water quality has been stable nationally over the last 10 years.
- Northland has high Dissolved reactive phosphorus in the ground and river/stream water but low nitrogen levels.
- Waikato has huge variances across the catchment but has pockets with high nitrogen and phosphorus levels.

As a result of these findings, I believe:

- Farmers need to continue forming catchment groups which involve the urban community especially in highly sensitive catchments. Forming catchment management plans with all key stakeholders will improve water quality and public perceptions.
- Industry groups need to unite as one and have one voice when lobbying central government to ensure regulation is pragmatic and has timeframes which allow for the environmental work already done on farm to take effect in water quality results.
- The industry as a whole need to continue their environmental improvements and tell their story louder and wider to ensure those not involved in the sector can understand the sacrifices and changes being made.
- Northland farmers need to focus on containment lost through overland flow to reduce phosphorus and sediment reaching water ways.
- Waikato farmers need to continue improving their nutrient efficiencies to ensure any nutrients brought into the system is required and utilised at the correct time to minimise nitrogen and phosphorus lost to the environment.

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

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This report is a product of the learning journey taken by participants during the Kellogg Rural Leadership Programme, with the purpose of incorporating and developing tools and skills around research, critical analysis, network generation, synthesis and applying recommendations to a topic of their choice. The report also provides the background for a presentation made to colleagues and industry on the topic in the final phase of the Programme.

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Introduction

If you research the statement 'Public perception on rural freshwater quality' you will come across articles titled "**Freshwater quality Kiwis' biggest environmental concern"** and "**Four out of five New Zealanders are concerned about freshwater quality".** This narrative does not go unnoticed in the rural sector with farmers and growers recognising they are increasingly being targeted and judged on their environmental footprints.

But what is the true picture behind this social shift from relative "acceptance/complacency" towards water quality to "overwhelming concern"? Is the quality of our freshwater resource really something to be concerned about? Are the headlines inflating perceptions towards an issue that is in fact not an issue at all? Just because four out of 5 New Zealanders are concerned, does that mean they believe farmers are responsible?

This report will analyse this complex issue addressing the question **'How have public perceptions changed on the impact of farming on rural freshwater quality, compared to freshwater quality trends on farms.'**

With extensive data on freshwater quality across New Zealand, trends can be analysed within regions. This report will focus on the Northland and Waikato Regions and their freshwater quality over the past 10 years in their rural catchments. Analysing this historical data will provide insight to current trends to the state of rural freshwater quality. Nitrogen and phosphorus concentrations in groundwater and streams/rivers are used as the basis measure on quality trends.

Several Industry Bodies and Government Ministries collect and track perception data regularly. This data can be used to determine if the "Four out of Five" New Zealanders concerned about New Zealand's freshwater quality believe the farming sector is doing a poor job to manage freshwater quality; or if in fact the concern doesn't directly correlate to negative perception towards farming as an industry?

This topic is interwoven into others like the perceived urban rural divide, and Farmer's Social Licence to Operate. Are these perceptions driven by the media? Facts are not always fully reported and 'opinion pieces' can manipulate data and surveys to favour the Authors conscious or unconscious bias.

Aims and Objective

To answer my research questions of '**How have public perceptions changed on the impact of farming on rural freshwater quality, compared to freshwater quality trends on farms.'** I aim to understand:

- The drivers, influences and trends behind public perceptions over the last 10 years.
- How the primary industry can continue to influence perceptions positively.
- How freshwater quality has changed over the last decade in New Zealandand the key catchment attributes which contribute to this.How freshwater quality is trending in Northland and Waikato andpotential drivers behind this.

My objective is to compare the results of perception data with water quality data, and to understand the linkages and disparities between the two. I shall then determine the strength of this relationship and what external factors have thebiggest influence.

Literature Review

New Zealand's natural environment and its health indicators are very well researched, monitored and recorded. A range of indicators are used to track freshwater quality within New Zealand, however for this literature review I focused on two key measures; Nitrogen and Phosphorus. These nutrients, along with sediment and E. coli., are commonly identified as the two main pollutants from farming operations.

Nitrogen generally leaches from farm systems into ground water which then flows into the freshwater streams and rivers. It can also be directly excreted from stock roaming through freshwater environments. Phosphorus, E. coli and sediment follow the same over-land path caused from surface runoff. Phosphorus, E. coli and sediment are co-related. Phosphorus binds to soil particles through anion retention. As a result, both are lost to the receiving freshwater environment together through erosion or runoff during rainfall events. E. coli can be lost through the same process or alternatively through direct deposition as stock roam freshwater environments.

Nitrogen is more strongly linked to dairy farming. Due to more intensive systems with high stocking rates, nitrogen fertiliser use, protein diets, and irrigated farms, dairy farms contribute to higher nitrogen loss than sheep and beef farms. Conversely, due to the nature of sheep and beef farming, high amounts of sediment and E. coli is lost from steeper, erosion prone farms and unfenced upland waterways. This does not represent all dairy or dry stock farming operations but is the basis of what is reported on and generally accepted within the two industries.

Public perception data towards rural freshwater quality by comparison is scarce. Industry bodies collect perception data, in addition to Lincoln University and other Government sources. When reviewing perception data, it is critical to understand the exact question being asked, and the context of the answer. Perception data has been interpreted differently by organisations in the past based on the same set of data. Differing interpretations can lead to both positive and negative reflection towards the primary industries.

Freshwater quality in rural areas is an emotive topic which draws national attention and scrutiny. Surprisingly, we rarely see it reported on simultaneously with public perceptions, and correlations between the two factors are rarely drawn. This literature review shall investigate the two topics and aim to establish any correlations. A Thematic analysis will follow, with the themes Delphi tested through interviews with the findings discussed in the body of this report.

Within the literature review the research shall be divided into two work streams:

- Public perception data towards the primary sector nationally, with a focus on freshwater. National data was analysed due to lack of regional data.
- Water quality trends in Northland and the Waikato Regions, focused on freshwater in rural catchments.

N.B. Utilised data ranges from 2008-2021.

Literature review

Public Perceptions on the Primary Industries

Beef and Lamb New Zealand

Rural water quality remains an important issue in 2021, yet this has been overtaken by climate change as the biggest concern to New Zealanders. The consensus is action needs to be taken to improve water quality; however, what that action looks like causes division within New Zealand. Data shows that perception is heavily influenced by what Central Government is saying and enacting. Heightened public interest and discussion occurred leading up to the 2020 Election as big issues facing New Zealand were debated. Policy released by Central Government gave voice to industry groups both for and against the freshwater reform. Conflicting debates occurred regarding accountability; i.e. rural vs urban. This highlights the complexity of the issue that is "rural freshwater quality".

Negative perception by association is common with rural freshwater quality. As issues like synthetic fertiliser use or poor stock effluent management gain media attention, water quality perceptions are negatively impacted.

Over the past 12 months conversation sentiment towards water quality has been split as follows (approx.):

- 13% Positive
- 58% Neutral
- 29% Negative

Environmental/ Ethical factor conversations were analysed from the last 12 months. A shift has occurred with animal welfare and emissions becoming the dominant focus, overtaking water quality.

New Zealander's responses when asked in November 2020 "How satisfied are you with the performance of the New Zealand Sheep and beef sector on water use and environmental impact?"

- 6% very satisfied
- 26% satisfied
- 39% neutral
- 21% dissatisfied
- 8% very dissatisfied

These figures have remained relatively stable since November 2018.

New Zealander's responses when asked in November 2020 "How well is this attribute demonstrated by theindustry? Behaves in a responsible and caring way towards the environment"

Table 1: Respondents answers to environmental question

	Sheep	Beef
Agree	51%	44%
Neutral	24%	24%
Disagree	14%	24%
Don't Know	12%	8%

Summary of key themes identified within this data set:

- Central Government decision making, and the subsequent media coverage have an impact on public perceptions towards environmental issues.
- New Zealanders are concerned about water quality however this doesn't directly correlate to negative perceptions towards the primary industries.
- As water quality is affected by all land management decisions it is often negatively perceived due to association with other issues (synthetic fertiliser, effluent etc).
- The sheep and beef sectors are perceived positively in regard to the environment because of the ways it cares for and is responsible for the stewardship of it.

Summary of data obtained DairyNZ

Public perception data gathered annually (Q1 2021) shows that concerns over the environmental impact of farming is currently the leading contributor of negativeperceptions towards the dairy sector and dairy farmers.

The public recognise that change has started with environmental improvements, and they want to continue seeing more of this.

- The key thing that the public would like to see from farmers is that they are reducing their environmental impact.
- Those who currently feel negative towards the sector say it's due to the environmental impact of farming.

Summary of key themes identified within this data set:

- Water quality is one of the top themes/aspect for 'environmental impact' of the primary industries. It's not the only aspect; concerns over climate change/GHG and other impacts also come through which shows growing concern for these environmental aspects also.
- Public perception towards dairy farmer's commitment to protecting the environment and water quality has been improving since 2017.

Dairy NZ and 'THE VISION IS CLEAR'.

Dairy NZ started 'The Vision is Clear' programme in 2018. This movement aims to improve water quality by inspiring all New Zealanders to look at theactions they can take to improve rivers, streams, lakes and beaches. The programme publishes the stories and videos showing what the sector is doing to improve their effect on the water quality in New Zealand.

This programme is the first of its type and aims to bridge the large (perceived) gap between perceptions (urban and rural) towards how the Primary Industries are managing the environment. As well as encouraging more collaboration between all New Zealanders to acknowledge what is a huge issue (water quality) it advocates for change and accountability across the country.

Since starting in 2018, this programme may be playing an important part in improving public perceptionstowards the dairy sector, and counteracting what feels like disproportionate negative media coverage.

Dairy NZ recently published in its December/January 2021 'Inside Dairy' publication a story on public perceptions, titled 'More Kiwis rate dairying highly'. Below is an info graphic from the story which summarises recent survey results done on public perceptions.

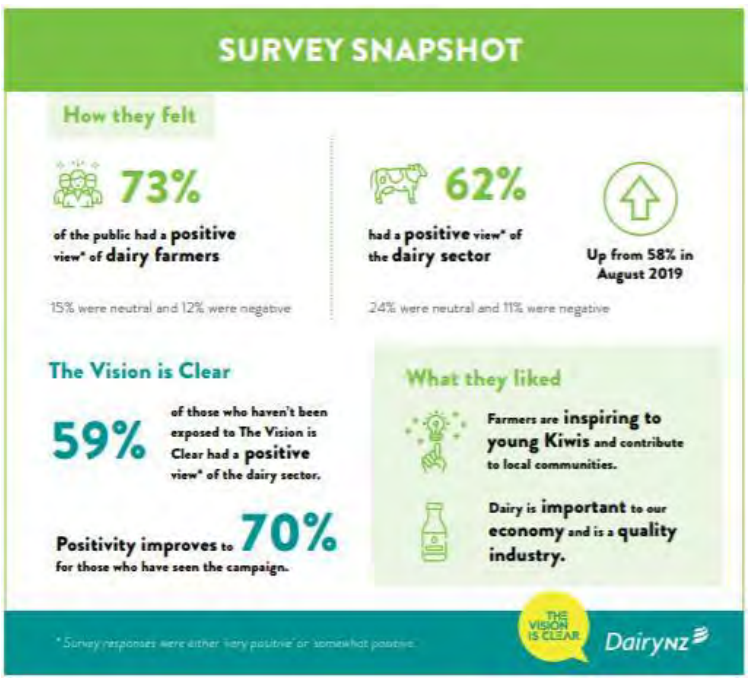


Figure 1: Survey Snapshot from DairyNZ's Inside Dairy' Publication (adapted from DairyNZ, 2021)

The first line of the article reads "*Dairy farmers have told us that public perception is one of the biggest issues facing the dairy sector".* It goes on to outline why 'The Vision is clear' started and how highlighting farmers recent actions will improve public perceptions towards Dairying and its impact on freshwater quality. Participants were surveyed who had seen 'The Vision is Clear' and 50% felt more positive about the industry

- 70% felt positive towards the dairy sector
- 43% said they had more understanding of the dairy sector

This flows onto media coverage becoming increasingly more positive; in September 2020 more then 1100 stories mentioning dairy were published. Of these 50% were positive, 46% were neutral and 4% were negative (DairyNZ, 2021). This demonstrates change compared to the previousyear, where 31% were positive,16% were negative and the balance neutral (DairyNZ, 2021). This data showed a real shift in public sentiment and perception change towards a more positive outlook. This is a significant upwards trend for positive public perception and raises the question: what is the big driver(s) behind this? Covid 19 saw the primary industries in 2020 generating the majority of tax revenue through exports for the country, at a time when proximately ¾ of the countries wages were being paid by Central Government subsidy. Is the public noticing the ever-increasing dedication from farmers and the sector to minimise environmental impact through improvement and promotion of farm management practices? Is it the positive media coverage, or a combination of the two?

Summary of key themes identified within this data set:

- Public perception campaign the "Vision is Clear" is working to improve public perception.
- Public perceptions are improving towards dairying as well as improved media coverage.
- The question remains: What are the core drivers behind the changes? covid? Hard work form dairy farmers? Improved media coverage?

Fish and game New Zealand

A poll conducted by Fish and Game annually since 2016 asked new Zealanders "To what extent are you concerned, or not concerned about the following issues in New Zealand? The results for the last 4 years are shown below:

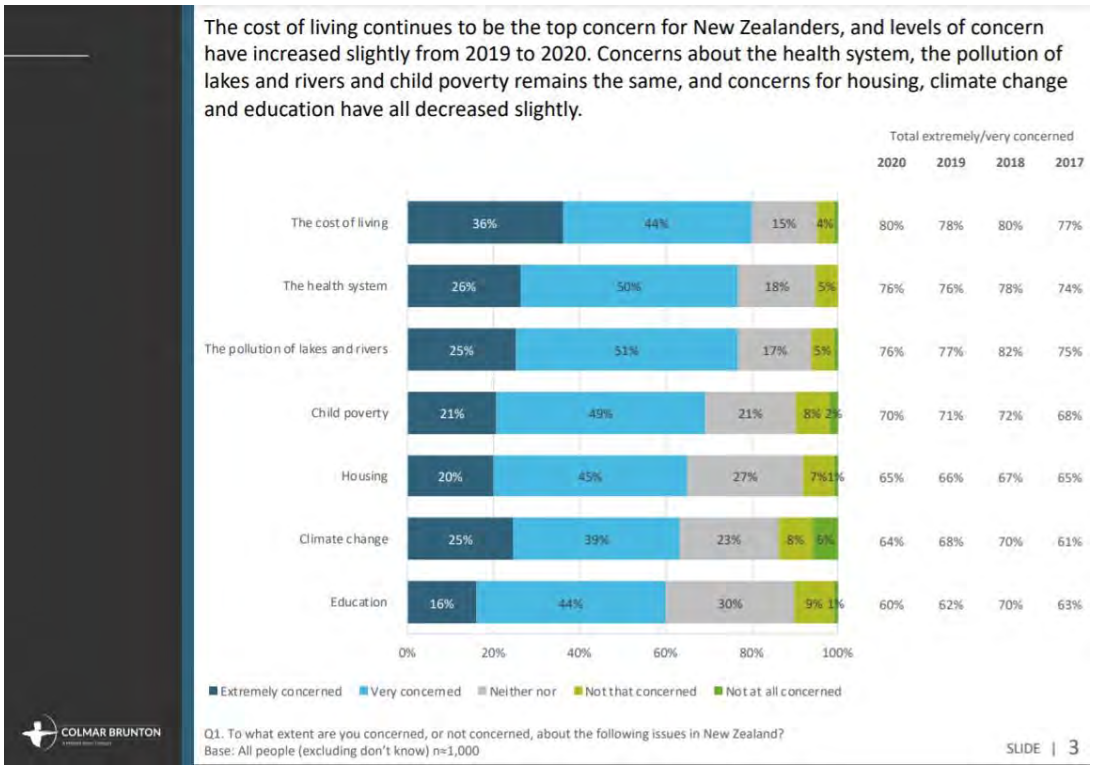


Figure 2: Survey showing the main concerns for New Zealanders with the trend from 2017 -2020. (adapted from Colmar Brunton, 2020)

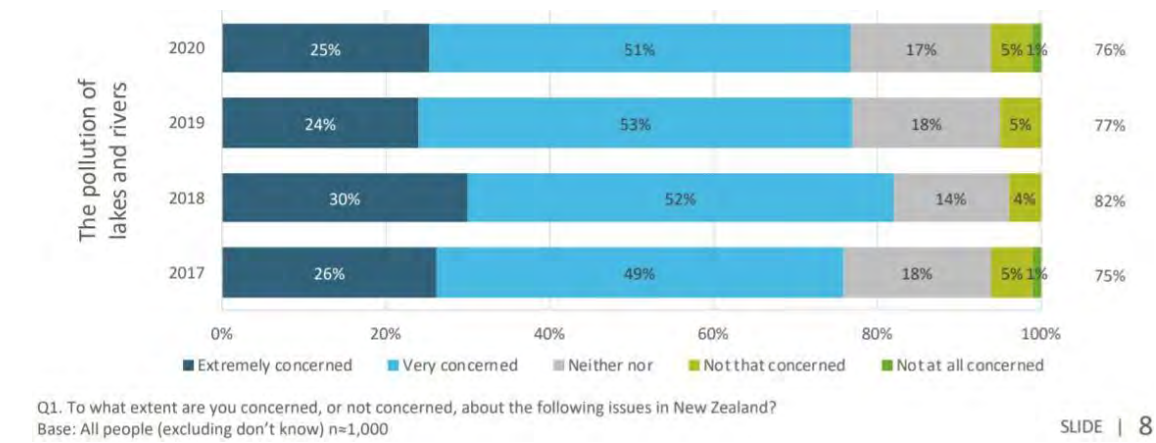


Figure 3: Changes in New Zealanders Concern towards the pollution of lakes and rivers (adapted from Colmar Brunton, 2020)

The annual surveys show the majority of New Zealanders are 'Very to Extremely Concerned'about pollution of lakes and rivers in New Zealand. However, it gives no indication on their perceptions towards rural freshwater quality and if they believe farmers are doing a good job or not.

Summary of key themes identified within this data set:

-This survey has similar results to others, highlighting the environmental concerns of New Zealanders as being freshwater quality. These concerns appear to have remained consistent for the last 5 years.

UMR for Ministry of Primary industries

A survey carried out in 2017 by UMR for the Ministry for Primary industries looks at New Zealanders views of the primary sector. It was a substantial piece of research which covered the main issues facing the primary sector and looked at public opinions on this.

The quantitative results showed that many New Zealanders (both urban and rural) held positive views overall towards the primary sector, however positivity had declined over the previous 10 years from its high in 2008. Since then, the sector has grown significantly; in particular the Dairy sector, which may have contributed to this declining result. The qualitative research suggests that the main driver behind positive views was largely because of the critical role the primarysector played in the economy.

Urban and rural views towards the pastoral farming industries were 'mildly positive'; this has slipped from 'very positive' in 2008. The question in 2008 was combined, asking about farming in general. In 2017 this was split into two questions; one about sheep and beef, and the other about dairy. In 2017, 67% of rural respondents and 59% of urban respondents held positive views towards sheep and beef farming. In comparison, 50% of rural respondents, and 47% of urban respondents held positive views towards dairy farming(UMR, 2017).

Data results demonstrated positive views towards the dairy sector are still more common than negative ones, with corresponding negative ratings for the dairy sector being 21% (rural respondents) and 25% (urban respondents).

As mentioned previously, this decline could be down to the intensification of the primary industries; in particular dairy in the decade following 2008. It is likely the cause will be more complex than just one driver.

When asked about the main environmental issues facing the primary sector, both urban and rural respondents were united with their response. Water pollution and quality was voted the most significant environmental issue facing primary industries in New Zealand by urban (52%) and rural (58%) respondents. This response demonstrated the most significant change since 2008, when asked about all issues not just environmental facing the primary industries. It doubled in the percentage for both urban (from 23% to 47%) and rural (from 26% to 53%) respondents. They now see water pollution and quality as the most significant environmental issue facing New Zealand.

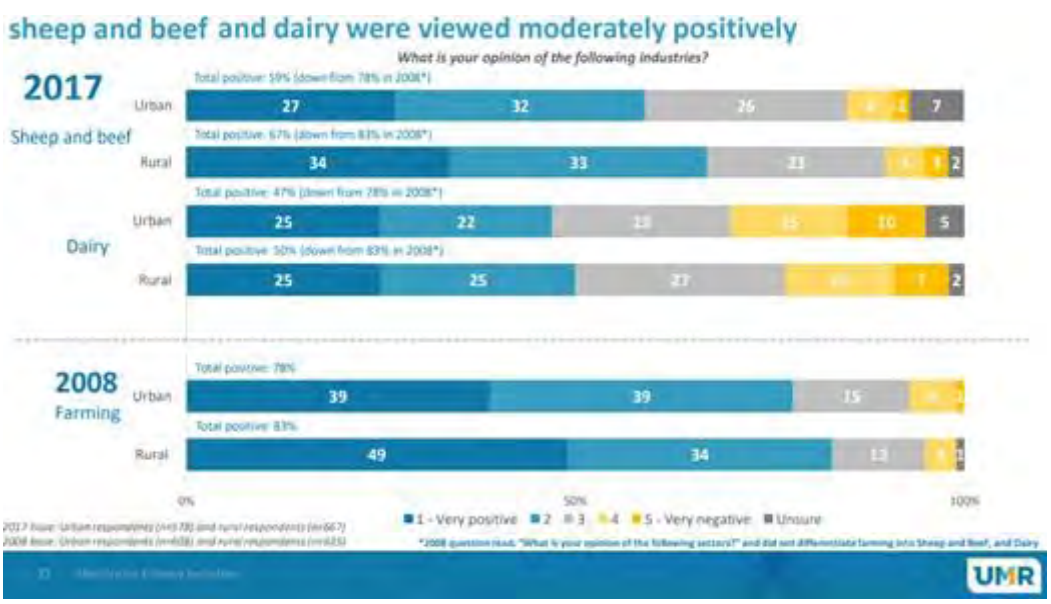
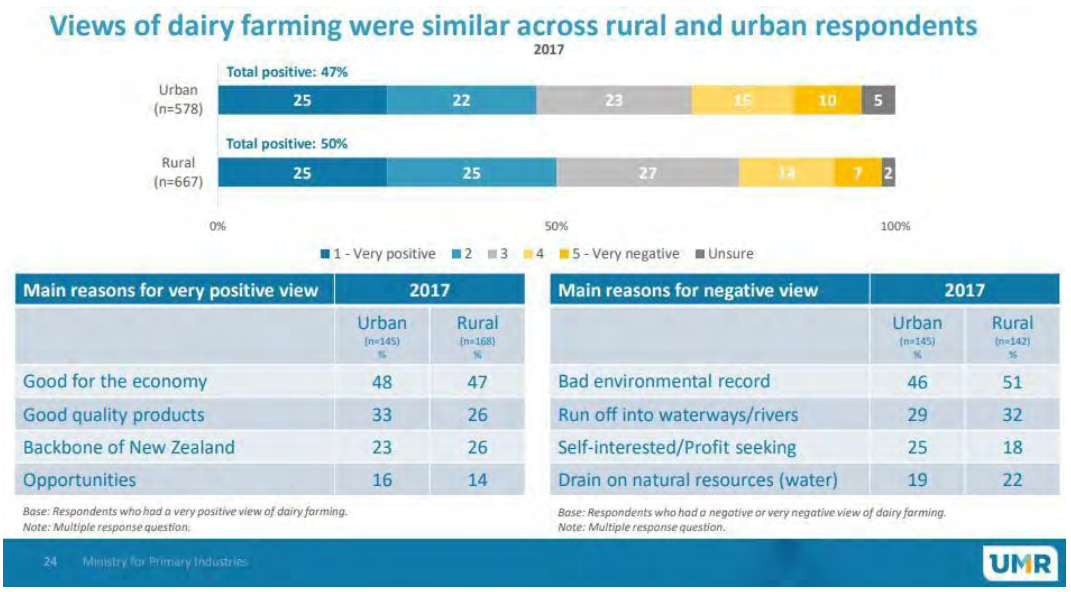


Figure 4: Comparison of 2017 vs 2008 views of the pastoral sector (adapted from UMR, 2017)



Main reasons for very positive view	2017	
	Urban (n=145) %	Rural (n=168) %
Good for the economy	48	47
Good quality products	33	26
Backbone of New Zealand	23	26
Opportunities	16	14

Base: Respondents who had a very positive view of dairy farming.
Note: Multiple response question.

Main reasons for negative view	2017	
	Urban (n=145) %	Rural (n=142) %
Bad environmental record	46	51
Run off into waterways/rivers	29	32
Self-interested/Profit seeking	25	18
Drain on natural resources (water)	19	22

Base: Respondents who had a negative or very negative view of dairy farming.
Note: Multiple response question.

Figure 5: Reasons behind the positive and negative views of dairy (adapted from UMR, 2017)

Figure 5 highlights the key reasons behind the positive and negative views towards the dairy sector. A range of factors influence both views, including economic and environmental factors. Positive views are generally due to economic benefits, while 3 of the top 4 negative reasons are related to environmental impact. The ongoing change towards finding the balance between profitability and sustainability is crucial for the pastoral sector to both remain viable and to improve public perception.

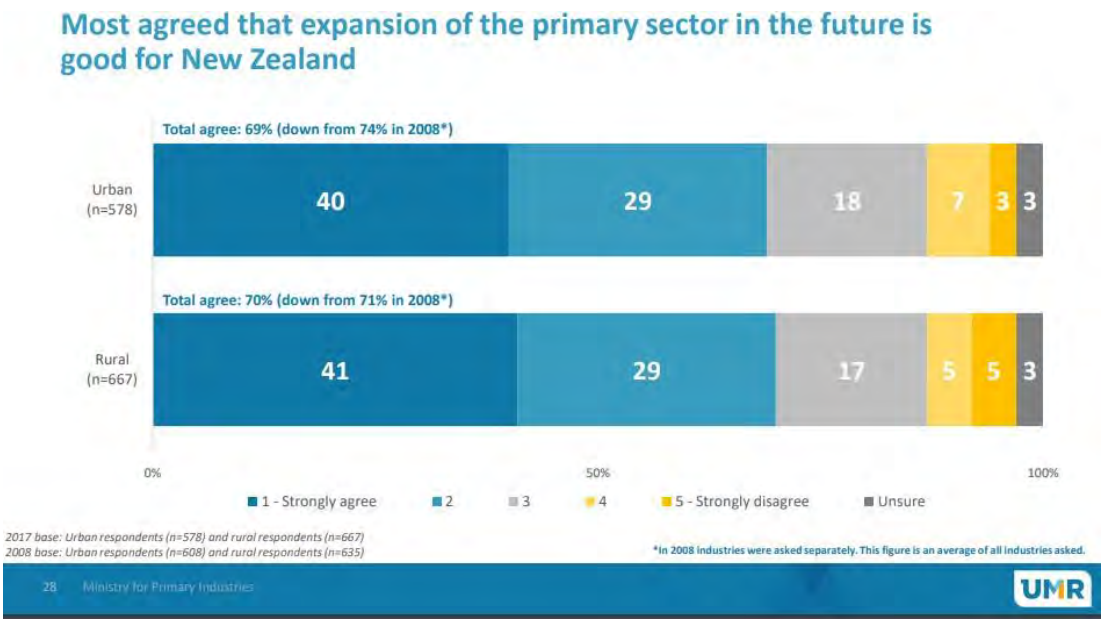


Figure 6: Consensus amongst kiwis that expansion of primary sector good for New Zealand (adapted from UMR, 2017)

Figure 6 demonstrates respondents agree the expansion of the primary sector is good for the future of New Zealand. This matches the governments 'Fit for a Better World' strategy for the primary industries.

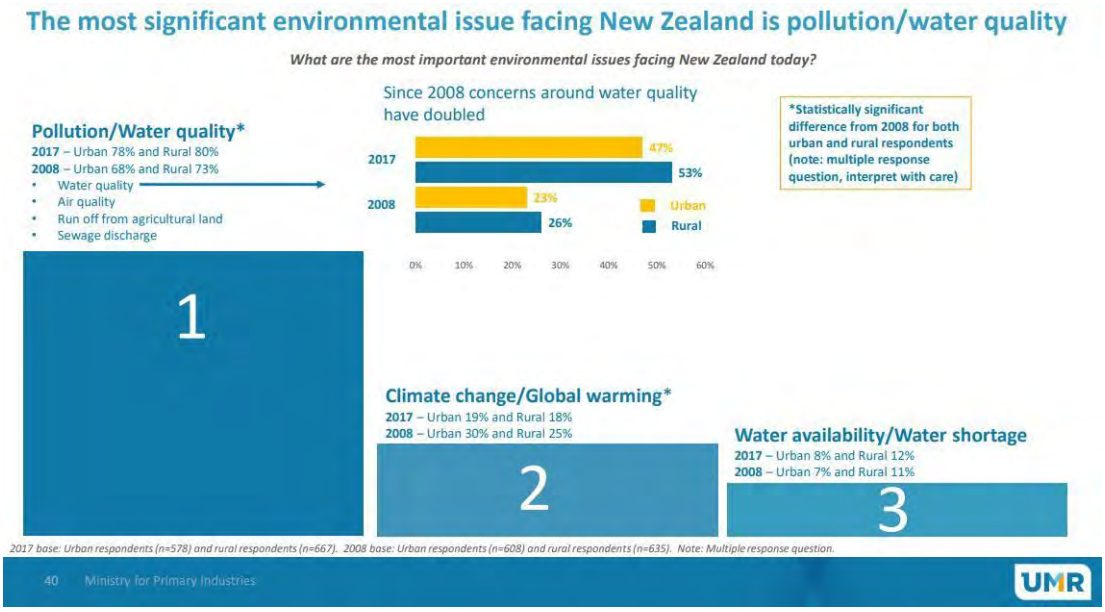


Figure 7: Top 3 environmental issue facing New Zealand according to the respondents. (adapted from UMR, 2017)

Figure 7 shows the extent at which participants were concerned about increasing levels of pollution in waterways. Grouped in with pollution, three quarters of respondents placed it as the most significant environmental issue facing New Zealand. Some respondents believed waterways were becoming unusable and this would impact on public use. The dairy industry was seen to be the main source of concern and Canterbury the main region impacted. Participants expressed concern about the rate of land use change, the types of land being converted and intensification of the farming system. However, there was also credit given to pastoral farming (dairy, sheep and beef) for working to fix issues via fencing off waterways and planting stream banks Respondents acknowledged change is occurring in the right direction, however more needs to be done to further improve perceptions.

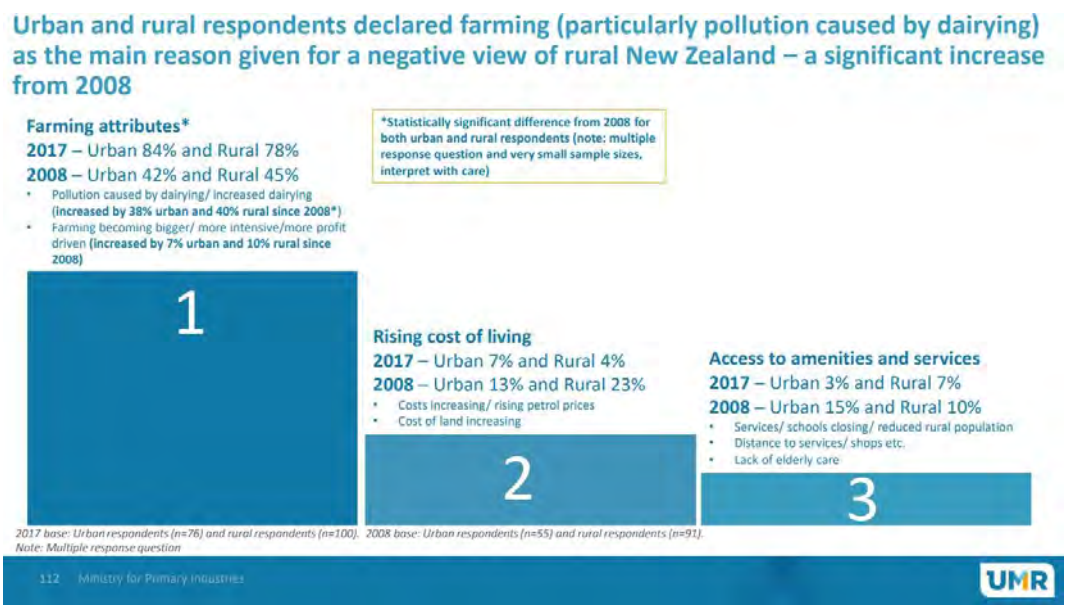


Figure 8: Main reason respondents had a negative view of rural New Zealand. (adapted from UMR, 2017)

Figure 8 highlights the concerns respondents hold towards certain farming attributes (pollution and intensification) which drive any negative perception they have on rural New Zealand. Results were from both urban and rural respondents, which demonstrated consistency across demographics.

Summary of key themes identified within this data set:

While these findings indicate there is definitely concern about the environmental impacts of the primary industries,in particular the impact of dairy farmers on water quality, it also shows that respondents (both urban and rural) were still more likelyto hold a positive view of all primary industries than a negative view. This is contrast to what is talked about in the media and the alleged urban/rural divide. In many cases, respondents recognised farmer stewardship acknowledging the fencing and planting happening in the countryside. This shows that if farmers continue down this path, positive perceptions should theoretically continue to increase.

Participants expressed concerns that over the last decade or so the primary sector growth and intensification has put strain on New Zealand's environment. Farming changes need to continue to happen to continue minimising the impacts of intensive farming and ensure a sustainable relationship between profitability and environmental impact. Participants understood the need for a primary sector to both feed New Zealanders and drive the economy through revenue creation. This left them torn between protecting the environment and the realities of economic survival. This survey was completed in 2017 and current perceptions are likely amplified more than ever in a post Covid economy. Respondents indicated they wanted to see a more sustainable sector, but not by imposing unrealistic changes onto landowners making it unfeasible to continue farming

The urban/rural divide has been discussed regularly in the media and the industry and data has highlighted a higher percentage of New Zealanders (86%) now live in urban locations. However, this is only 6% higher than was the case in the 1970s (Statistics New Zealand 2017)

To conclude, this research challenges the urban/rural divide and suggests if such a divide exists, it may not be as great as generally perceived. Results suggest the urban rural/divide and the polarisation of urban/rural people on certainissues may only relate to certain issues rather than being widespread.

Since 2008, more urban and rural respondents attribute 'Pollution caused by dairying' as a cause for their increased negative views of rural New Zealand. Water pollution and its use were identified as the main environmental issues for New Zealand and the primary sector specifically. This data set has indicated the importance of ongoing action by famers to minimise contaminant loss. Additionally, the industry must continue to tell the good story of all that is being done and future successes.

Key themes

- Water quality is the biggest environmental concern for most New Zealanders.
- Sheep/Beef and Dairy is perceived positively by twice as many kiwis than those whoperceive it negatively.
- The urban/rural divide is not as prominent as the media and industry portray.
- Dairy farming affecting water quality is the key driver around negative perceptions of the primary industry
- Most New Zealanders understand the economic importance of the primary sectorand realize the primary sector is a key component for a prosperous future.

2020 UMR Findings

The UMR has since carried out a number of smaller surveys focusing on perceptions as a whole towards the primary industries. Most recently, a survey was carried out in April 2020 whileCovid 19 was at its peak in New Zealand. The results are outlined below.

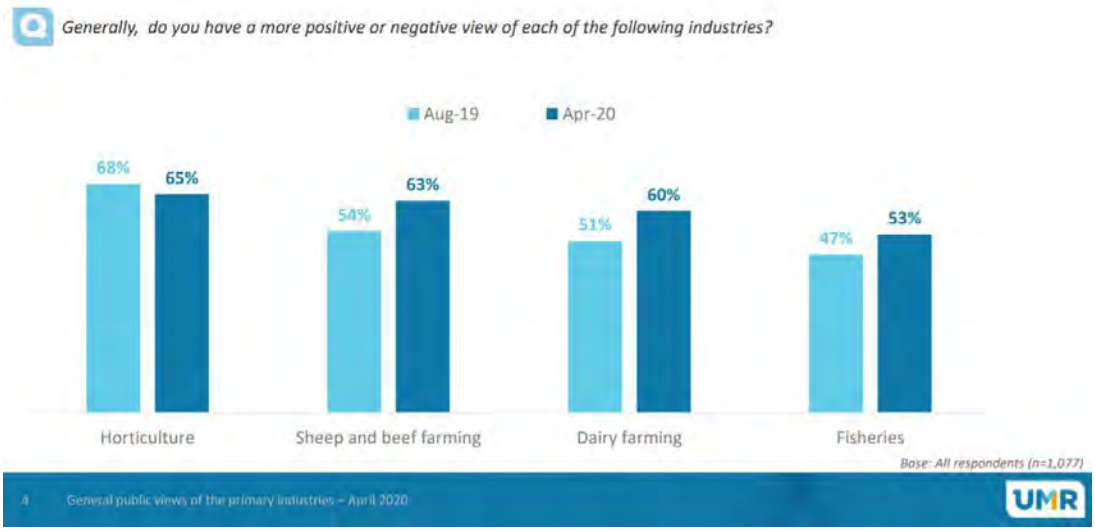


Figure 9: Changes in the percentage of respondents who felt positive about each sector. (adapted from UMR 2020)

Figure 9 demonstrates improvement in perceptions towards both pastoral based farming sectors over a 12 month period from August 2019 to August 2020. Both sectors have seen a positiveincrease of 9%. The report statedthat older respondents and male respondents were more positive than the younger and female respondents. Auckland was generally slightly less positive towards the primary industries than other regions. Data demonstrates the gap between dairy and sheep/ beef in terms of positive perception is very small, and the pastoral sector is seen almost as positively as the horticultural sector.

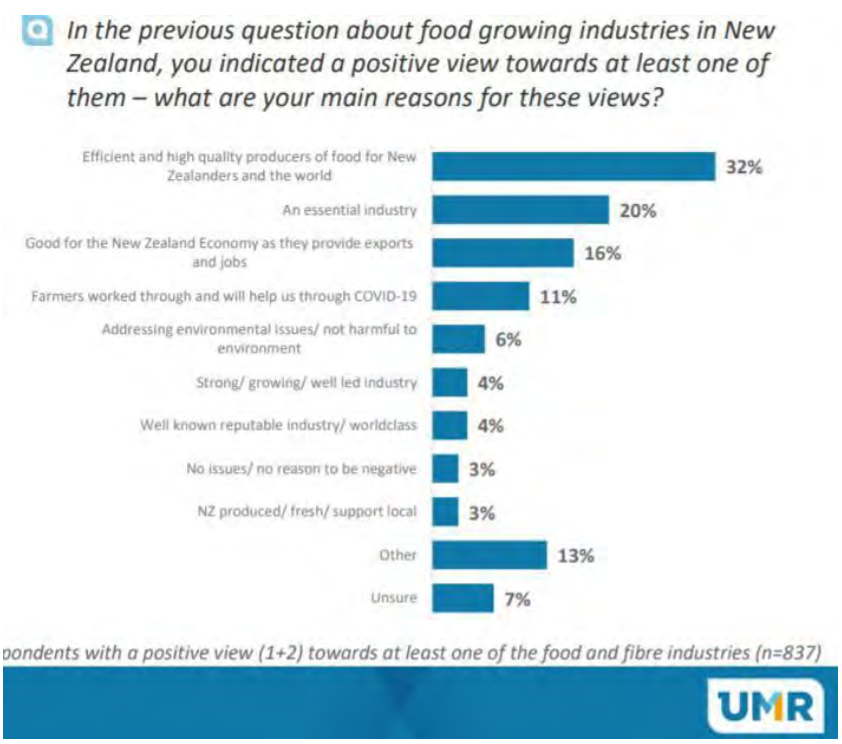


Figure 10: Main reasons for respondents to have positive views towards the primary industries. (adapted from UMR 2020)

Figure 10 outlines the main reasons for the positive perceptions towards the primary industries. The top reason was producing high quality food at an essential time when the world went back to basics. The next three can be grouped as economic benefits as an essential service that worked through COVID19 providing exports to New Zealand and being a large employer. These results indicate the current narrative towards the primary industries is likely having a positive influence on public perceptions.

Summary of key themes identified within this data set:

- Positive perception is growing for both dry-stock and dairy
- Covid proved beneficial by highlighting to New Zealanders the importance of the industry.
- The younger demographic is more likely to feel negative towards the primary industries

Ministry for Primary Industries - Colmar Brunton

With a shift in the engagement between the Ministry for the Environment and New Zealanders, the Ministry approached Colmar Brunton to undertake research in 2018. This research was designed to gain a baseline of the attitudes and perceptions New Zealanders currently have towards the environment.These results would help guide the Ministry with future allocations of time and resources, and eventually enable real change with the people of New Zealand. Below is a summary of the key points identified which relate to freshwater.

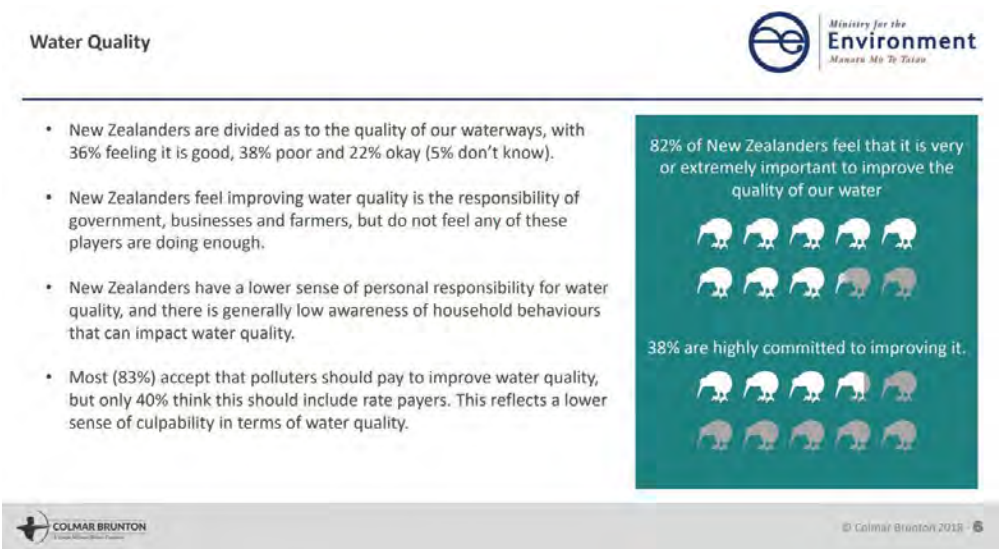


Figure 11: What Kiwis thought about Water Quality in 2018 (Adapted from Colmar Brunton 2018)

New Zealanders were equally split on their opinions towards waterway quality (good versus bad) ,with a smaller percentage answering ok. Without a greater understanding of the respondents, it is difficult to make judgement on which regions of New Zealand respondents believe the water is good quality and poor quality. However, this data does highlight that although 82% of Kiwis believe it is important to improve water quality, a huge percentage of New Zealanders do not believe the water quality is bad. Another very interesting statistic is that 83% of people believe polluters should pay to improve water quality, however only 40% think this should include rate payers. This indicates a low sense of personal responsibility amongst a number of New Zealanders towards water quality. This may provide some validation for the primary industry who feel the urban population do not appreciate how the urban contribution to water quality issues.

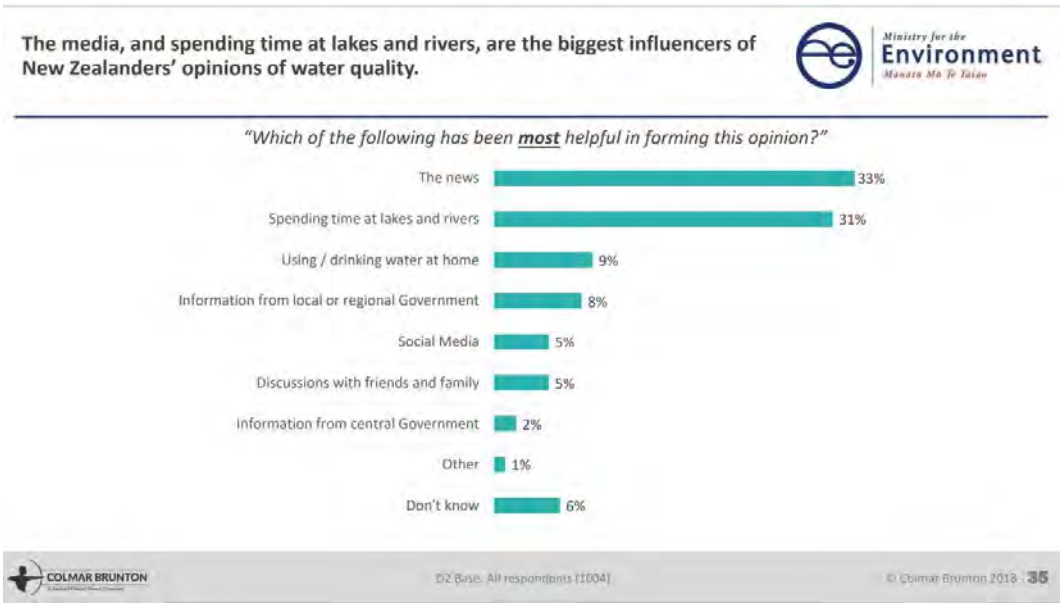


Figure 12: Key drivers behind public perception on water quality (Adapted from Colmar Brunton 2018)

Figure 12 indicated 'The news' is the biggest driver behind people's perceptions. Combined with social media, these two outlets make up 38% of information impacting on people's opinions. This highlights theimportance of how stories and statistics are portrayed in the media, as they influence over a third of New Zealanders opinions towards water quality. A further third of kiwis are influenced by what they see and feel when they are spending time at lakes and rivers. Figure 13 further breaks down how theses influences flow onto perceptions.

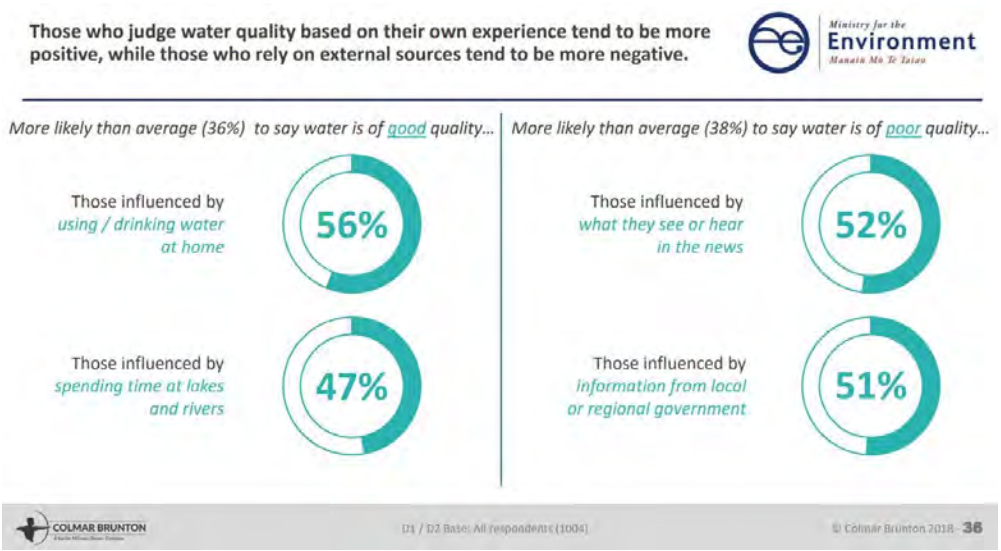


Figure 13: How external sources influence perceptions differently to own experiences. (Adapted from Colmar Brunton 2018)

Figure 13 provides interesting insight into how the average survey respondents determine water quality. Respondents who rate water quality based on their own experiences are 20% more likely to say water quality is good in New Zealand. Respondents who base water quality on external information i.e. what they see or hear in thenews are 14% more likely to say water quality is poor in New Zealand. These statistics speaks volumes about how information sources can disproportionately affect individuals, especially those who may not be well educated on a topic. This further highlights why effective and accurate public relations is critical for the primary industries in the environmental debate.

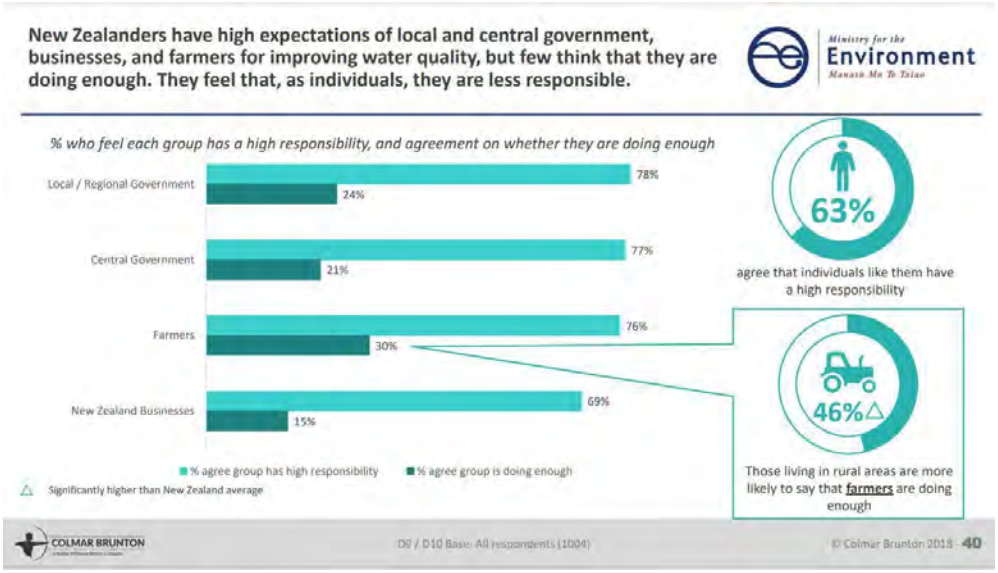


Figure 14: Public perception on who is responsible for improving water quality and if they are currently doing enough. (Adapted from Colmar Brunton 2018)

Figure 14 indicates New Zealanders believe Regional Government, Central government and farmers are all equally responsible for improving our water quality. However, only a third believe these groups are currently doing enough in this space. This reaffirms the previous point identified in Figure 11; identifying some New Zealanders take very little personal responsibility themselves for water quality.

Summary of key themes identified within this data set:

- Water quality is an important environmental issue according to over 80% of people. However, on 38% of people perceive it to be poor.
- Only 40% of New Zealanders believe they need to take responsibility themselves when it comes to water quality
- Many New Zealander's opinions are highly influenced by the news and these individuals are morelikely to have a negative opinion of water quality.
- The majority of New Zealanders believe it is collectively up to Regional Government, Central Government and farmers to improve water quality, and believe these groups are currently not doing enough.

Lincoln University Triennial Perceptions Survey

Lincoln University conducts a survey every three years investigating public perceptions towards New Zealand's environment. This is one of the most robust data sets related to the topic, dating from2000 with10 surveys being completed since. Below are some of the key resultsfrom 2019 and trends over the last 20 years.

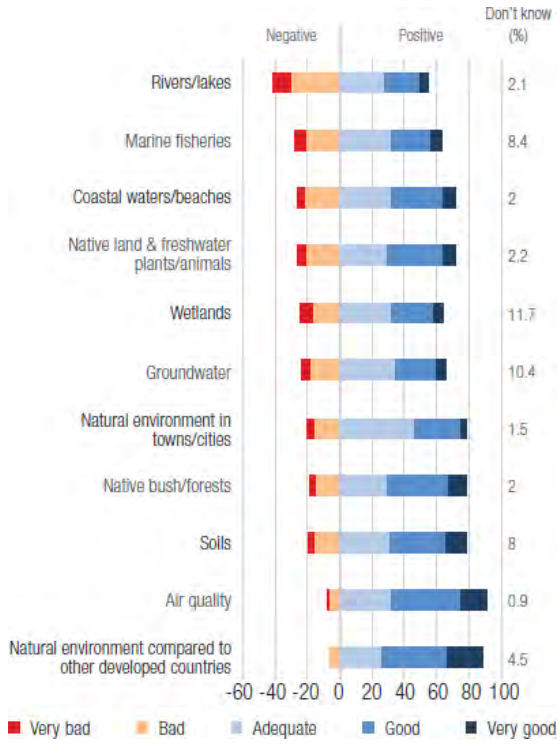


Figure 15: Perceived state of the environment (adapted from Hughey et al., 2019)

River and lake quality are again perceived as the poorest natural environment within New Zealand. Over 40% of respondents believed the quality of rivers and lakes were either 'bad' or 'very bad'. This was followed by marine fisheries, coastal waters and beaches.

Table 2: Perceived main causes of damage to the environment. The fill colours (■ ■ ■) indicate in order the three most-frequently- cited causes. (adapted from Hughey et al., 2019)

Perceived Cause of Damage	Air	Native Land & Freshwater Plants & Animals	Native Forests and Bush	Soil	Beaches & Coastal Waters	Marine Fisheries	Marine Reserves	Fresh Waters	National Parks	Wetlands
Motor Vehicles/ Transport	77.3%	4.7%	5.0%	3.1%	4.1%	1.8%	1.9%	2.5%	8.1%	3.6%
Household Waste/Emissions	25.0%	13.7%	4.9%	14.4%	22.8%	9.8%	8.9%	18.5%	6.4%	9.4%
Industrial Activities	64.1%	25.8%	16.3%	28.5%	19.4%	15.3%	11.7%	25.9%	9.2%	16.3%
Pests/Weeds	4.9%	38.6%	51.3%	16.6%	5.9%	4.9%	7.2%	14.7%	41.5%	31.4%
Farming	16.6%	42.1%	23.5%	39.7%	11.9%	6.8%	6.2%	43.0%	11.0%	32.7%
Forestry	3.5%	19.5%	42.5%	14.7%	4.1%	3.1%	2.5%	10.7%	21.3%	12.8%
Urban Development	19.9%	26.0%	30.4%	19.8%	21.3%	6.0%	6.8%	16.7%	18.2%	28.8%
Mining	4.0%	9.5%	14.7%	13.8%	2.3%	4.1%	3.4%	5.2%	12.7%	5.6%
Sewage/Stormwater	5.5%	24.0%	5.6%	18.9%	58.6%	35.0%	27.6%	43.6%	5.9%	28.0%
Tourism	4.9%	9.6%	19.6%	3.2%	19.7%	6.8%	12.7%	8.6%	44.9%	9.1%
Commercial Fishing	1.6%	5.7%	1.3%	1.7%	21.7%	69.0%	39.0%	6.9%	2.3%	2.0%
Recreational Fishing	0.4%	3.1%	1.1%	1.2%	7.5%	25.8%	23.8%	6.1%	1.3%	3.3%
Dumping of Solid Waste	9.4%	20.3%	13.8%	35.5%	26.9%	17.4%	15.1%	21.2%	14.5%	17.5%
Hazardous Chemicals	20.0%	16.7%	10.2%	35.6%	16.3%	16.4%	13.8%	20.8%	8.1%	14.2%
Other	2.4%	3.1%	4.5%	5.0%	5.3%	6.0%	7.1%	4.4%	7.1%	9.9%

Note: Percentages in each column do not add to 100% because respondents identified up to three causes for each environmental component.

Table 2 demonstrates the perceived main causes of damage to different environments around New Zealand. For freshwaters, respondents voted sewage/stormwater as the main cause for damage. This indicates a sense of understanding and ownership not previously seen in perception surveys. Farming was identified as a close second cause for environmental damage, with almost the same percentage of respondents (43% vs 43.6%). Industrial activities was ranked third, again indicating a good understanding and responsibility related to the urban population and its impact on freshwater resources.

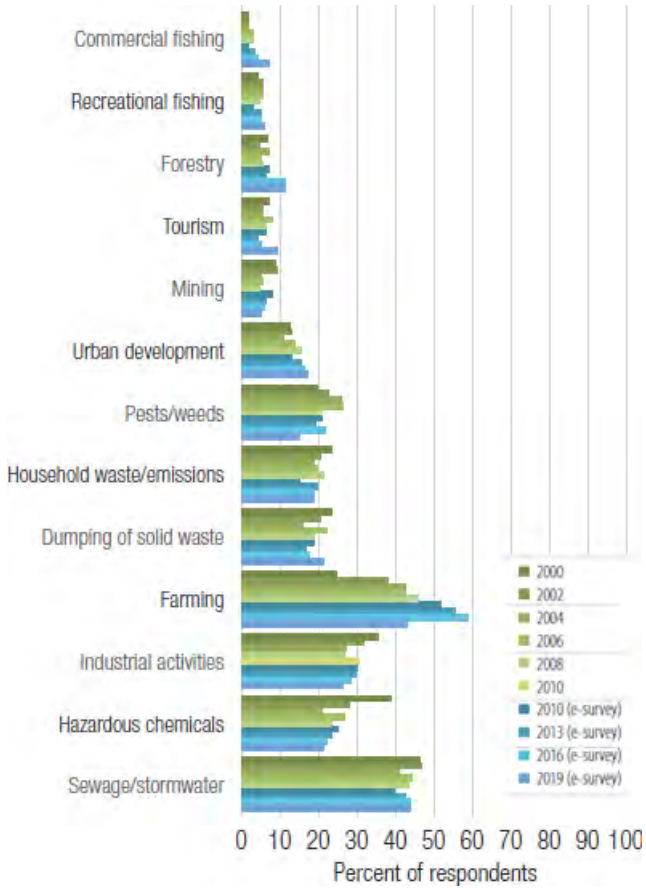


Figure 16: Perceived main cause of damage to water quality (adapted from Hughey et al., 2019)

Figure 16 indicates how the general public have perceived an increased impact on water quality by farming around New Zealand over the past 19 years
These results increased by over 2% per survey year, indicating a greater proportion of the population perceiving farming to have a negative impact on the environment year on year. However, this dropped around 16% in the 2019 survey back to 2008 levels. This was the first drop in over 10 years. This indicates a huge paradigm shift in perceptions in the space of 3 years. It is hard to draw conclusions on what could be driving this change during this pre COVID19 time.

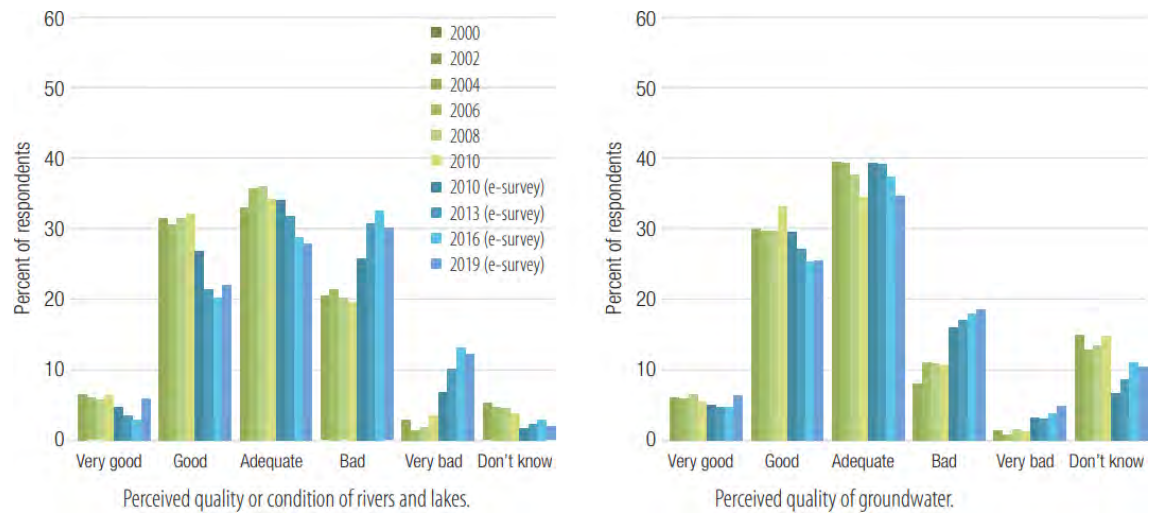


Figure 17: Perceived Quality of rivers, lakes and groundwater (adapted from Hughey et al., 2019)

Summary of key themes identified within this data set:

- Since 2008, public perception towards farmers impact on freshwater had beensteadily declining
- 2019 saw a16% reduction in respondents who percieved farmingas the main cause of poor water quality in New Zealand.
- The perceived quality of freshwater improved in 2019

Literature Review

Freshwater Quality

The Ministry for Environment has an environmental reporting series which has been running since 2015. It reports on air, atmosphere and climate, freshwater, land and marine. The latest report on freshwater was completed in 2020.

Freshwater is affected by both natural (geology, climate, and landforms) and unnatural (land use, land management) factors as it travels through a catchment. Not all water moves quickly through a catchment; it may take decades for rainwater to move throughsoil into aquifers, streams and rivers to finally leave a catchment (Ministry for the Environment & Stats NZ 2020). This is the **first and very key point** when discussing freshwater. Water quality today will be the result of cumulated farming practices over the past 10, 20, 50 or even more years. Therefore, some farmers are currently attempting to turn around legacies of past activities within their catchments through restoration and improved practices Unfortunately, the full extent of the results of these beneficial changes may not be apparent for decades.

Freshwater is multifactorial and factors which affect water quality are cumulative (Ministry for the Environment & Stats NZ 2020). Predicting water quality trends, or even determining the single biggest influencing factor is extremely complex. Individual Water takes don't have a big effect, but many water takes close together can have a larger impact. Likewise, water quality canbe affected by sediment, excess nutrients, temperature and flows. They all have an impact individually, however when occurring simultaneously these factors are compounding e.g. sedimentation is stronger when water flows are low.

Catchment management is being achieved across the country through the formation of catchment groups. These have proved successful in implementing positive change, not only on the farm but by promoting community and encouraging people to connect by providing opportunities for people to connect around a common goal.

Half of New Zealand's river length is located in catchments within pastoral land cover (Ministry for the Environment & Stats NZ 2020). River water quality in these areas varies by season, with higher nutrient concentrations and turbidityin winter. The Australian and New Zealand Guidelines for Fresh and Marine Water Quality define default guidelines values (DGVs) as the concentrations of water quality variables that are estimated to occur in natural conditions. These DGVs focus on ecosystem health and are in absence of human influence. These DGVs are not standardswhich need to be meet but are guidelines to understand how freshwater quality has changed from its natural state.

Figure 18 outlines despite what the land use cover is, water quality in New Zealand is affected beyond is natural state. Urban catchments have the greatest impact on water quality, followed by pastoral base land use. This aligns with what was discussedin the Lincoln University perceptions survey of 2019. This survey indicated the quality of water in New Zealand's lakes, rivers, streams and aquifers is variable and depends mainly on the dominate land use **(**Hughey et al., 2019).

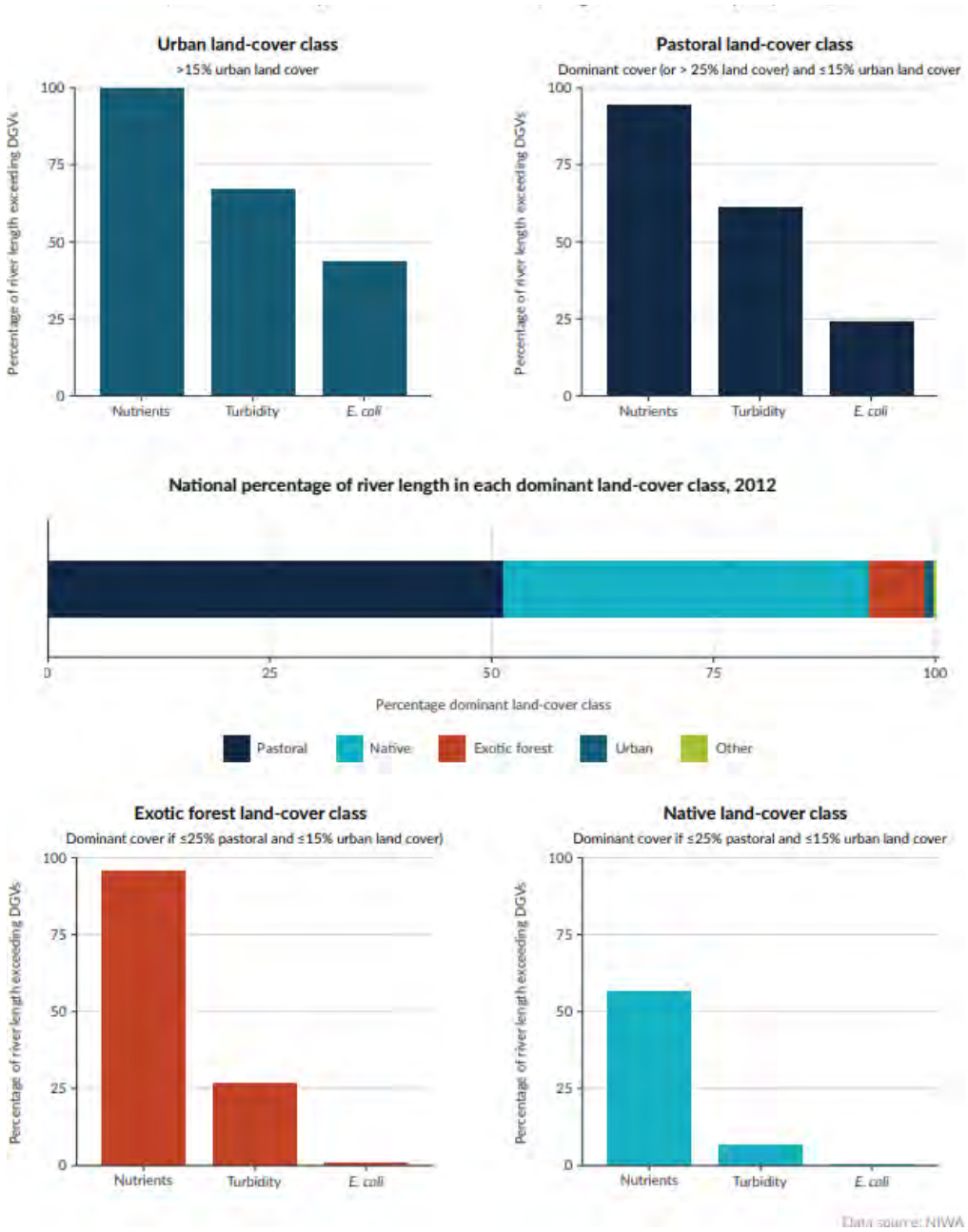


Figure 18: The percentage of waterways within different land-cover classes that exceeds expected natural conditions (DVGs) (adapted from Ministry for the Environment & Stats NZ 2020)

While assessing overall trends for nutrients, E.coli and turbidity the results are mixed, with slightly more sites improving than worsening from 2008-2017. Pastoralland cover has seen 67% of sites demonstrate improved trends for ammoniacal nitrogen.

Below is a summary of the trend data from 2008 – 2017 for Northland and the Waikato.

(Ministry for the Environment & Stats NZ 2020)

Nitrate – Nitrogen

- Many sites identified with worsening trends in the Waikato
- Many sites identified with improving trends in Northland

Dissolved reactive phosphorus

- Many sites identified with worsening trends in both the Waikato and northland.

E. coli

- Many identified sites with improving trends in both the Waikato and northland.

Turbidity

- Many identified sites with worsening trends in the Waikato
- Many identified sites with improving trends in Northland

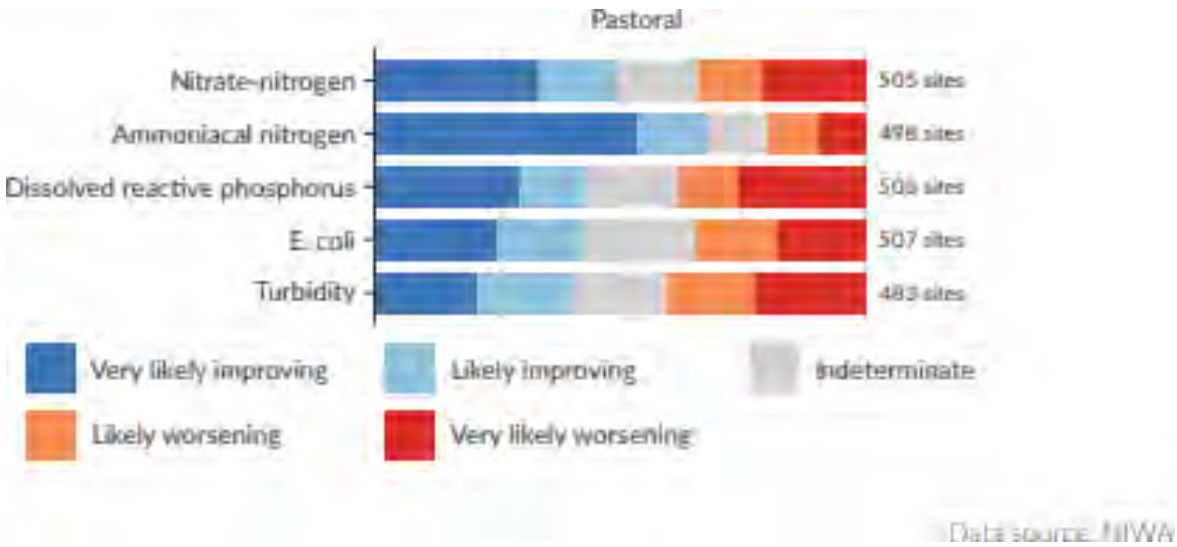


Figure 19: Water quality trends for river monitoring sites 2008-2017 ((adapted from Ministry for the Environment & Stats NZ 2020)

Figure 19 outlines the water quality trends of pastoral sites from 2008-2017 across New Zealand. These results show that across each quality indicator all but turbidity have more sites improving than worsening. Turbidity (how cloudy or opaque the water is) appears to be at a deadlock. The two nitrogen indicators are showing the most improvement, followed by Phosphorus and E. coli at about the same level. This suggests that management changes on farm andland use changes across the country are turning the tide on nitrogen, however containment loss through overland flow are not being dealt with as well.

Key themes identified within this data set:

- Northland is improving in most key containments apart from phosphorus
- Waikato E. coli levels are improving however the other containments still havemore sites worsening then improving
- Land use cover is the key driver behind water and ecosystem health in a catchment.
- Indicators of nutrients lost through drainage through the soil profile are improving
- Indicators of contaminants lost through overland flow are barely improving or stagnant.
- Lag times can be up to 50years+ for management decision made on the farm now to impact water quality

LAWA (Land, Air Water Aotearoa)

LAWA is a partnership between New Zealand's 16 regional Councils and unitary authorities as wells as MFE, DOC, Stats NZ, Cawthorn Institute, Tindal Foundation and Massey university. It connects the people of New Zealand with their environment through sharing scientific data. It holds a huge amount of water quality data and shows trends in time. LAWA, similar to other study's, state that lands use is the key driver of water quality and ecosystem health. There is a consistent pattern amongst land cover categories for all four indicators. The highest proportion of better scoring streams were within native vegetation, followed by exotic forest, pasture and lastly urban streams. Table 3 below outlines how each land cover category makes up catchments within New Zealand.

Table 3: River and Stream catchment classifications across New Zealand (Adapted from LAWAriver quality 2021)

Classification	Percentage of NZ river and stream catchments
Native Forest	48%
Pasture	45%
Exotic forest	5%
Urban	1%

The new Nation Policy Statement for Freshwater Management (NPS FM) was implemented it 2020 and 'gives effect' to Te Mana O te Wai. Te Mana o te Wai is a concept that refers to the fundamental importance of water. Te Mana o te Wai recognises that protecting the health of freshwater allows protection the health and well-being of the wider environment. It protects the mauri of the wai. Te Mana o te Wai is about restoring and preserving the balance between the water, the wider environment, and the community (New Zealand Government, 2020). The National objectives framework (NOF) in the NPS FM requires regional councils to set objectives, policies and rules to manage the freshwater resource in their regions. A component of the NOF is the requirement to 'define attribute states or bands'; these are similar to other water quality indicators discussed earlier. These states or bands range from A (best quality) to D(in some case E). Water quality data can be evaluated against these bands and then displayed accordingly. Councils, alongside their communities, set the 'target attribute states' for sites intheir region with the NPS FW identifying a national bottom for the attributes. The council must aim for the bottom line or better and must also set time frames to achieve these targets. (Cawthorne Institue 2020).

NOF Band

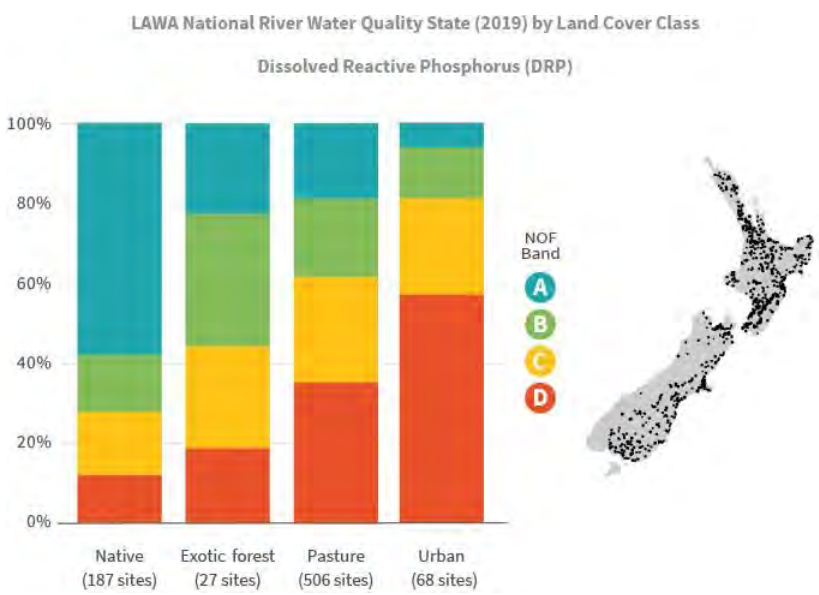


Figure 20: Comparison of NOF bands for dissolved reactive phosphorus across the 4 different land cover classes. The bands are calculated form trend data from 2015-2019 (Adapted from LAWA river quality 2021)

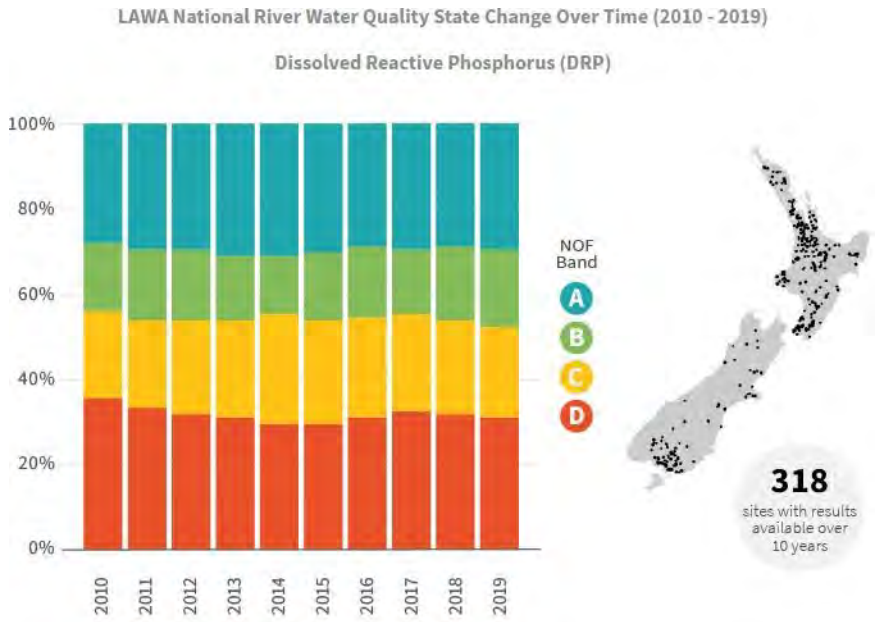


Figure 21: Changes in NOF band for dissolved reactive phosphorus from 2010-2019. (Adapted from LAWA river quality 2021)

Dissolved reactive phosphorus is an important nutrient in freshwater ecosystems as it contributes to the growth of algae and other aquatic plants. However elevated levels can contribute to unwanted algae blooms as this form of phosphorus is most readily available for aquatic plant uptake. Figure 20 and 21 outline trends in DRP levels across land cover classes and across a decade of all sites in New Zealand. It has remained relatively stable with a small reduction in the D band over the last 3 years; this may suggest the start of a trend.

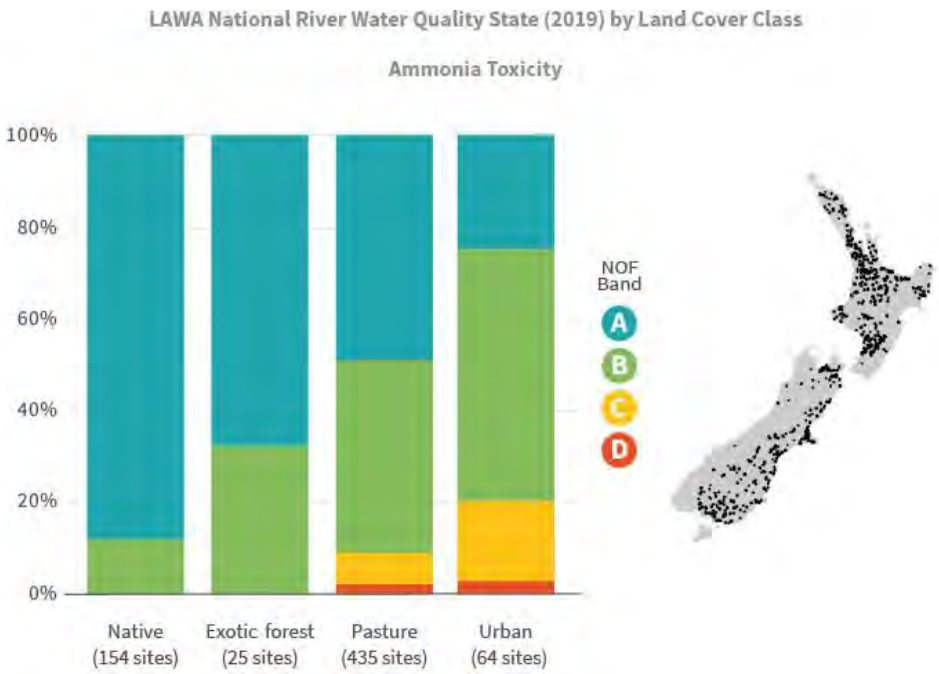


Figure 22: Comparison of NOF bands for ammonia toxicity across the 4 different land cover classes. The bands are calculated form trend data from 2015-2019. (Adapted from LAWA river quality 2021)

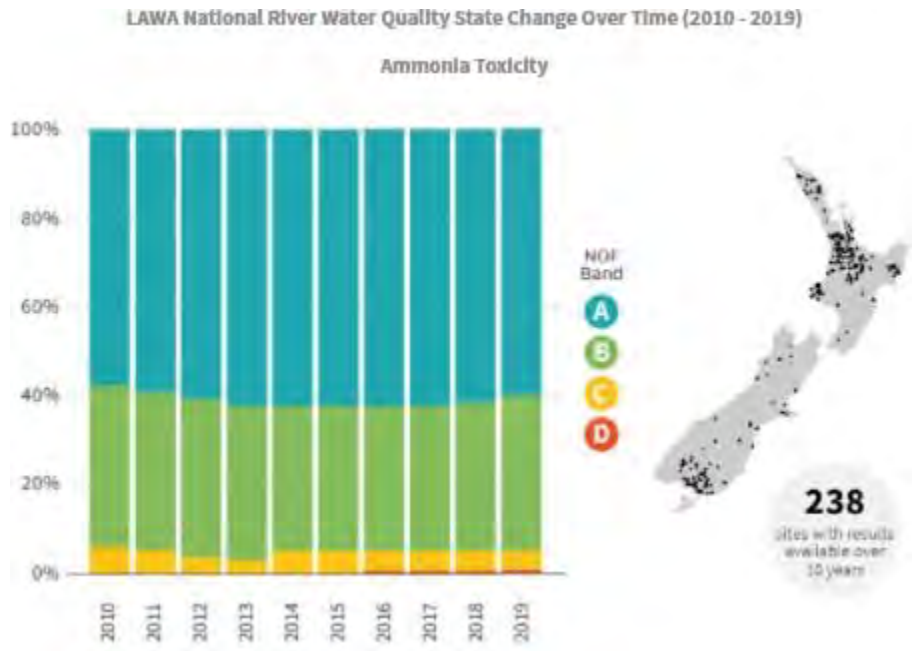


Figure 23: Changes in NOF band for ammonia toxicity from 2010-2019. (Adapted from LAWA river quality 2021)

Ammoniacal nitrogen can present a problem in fresh water as it has the potential to reach toxic levels for instream fauna and can contribute to algae blooms. However, levelsmust be quite high for it to result in poor ammonia toxicity grades. Therefore, sites withA and B bands can still have levels that may contribute to excessive algae growth. This trend appears consistent over the last 10 years (Figure 23)

Northland River and ground water quality

(below is a summary of figures 24-27)

Northland river and ground water quality is a tale of two halves, as demonstrated in Figures24-27. Overall in Northland, nitrogen levels in river and ground water are of good quality. There are pockets of land, such as west of Whangarei, with high levels of nitrate nitrogen within ground waters and total nitrogen in rivers and stream water. However, generally levels are low with nitrate nitrogen levels trending downwards apart from Ruawai and Kerikeri.

Levels of nitrogen and phosphorus in river and groundwater are determined by a number of factors and have natural variances across the year. However, land use within each catchment and management decisions made within that land use determine the amount of unnaturally occurring nitrogen reaching the freshwater resource. Changes in farming practices and de- intensification may be contributing to the improving trend on nitrogen levels within Northland catchments.

Meanwhile, phosphorus levels are contrastingly high in both rivers and ground water. Trends appear to be worsening, suggesting large amounts of sediment are reaching waterways with phosphorus bound to those soil particles. This can be a result of Northlands naturallandscape which is steep in parts with highly erodible poorer draining soil. This results inrunoff during weather events, regardless off the land use. Additionally, underlying geology of unstable mud and limestone (Northland Regional Council 2015) in parts of Northland may also naturally be contributing to the phosphorus concentrations. Considering these factors, land useand management around watercourses and efforts to minimise topsoil loss is critical to turn the tide on these trends.

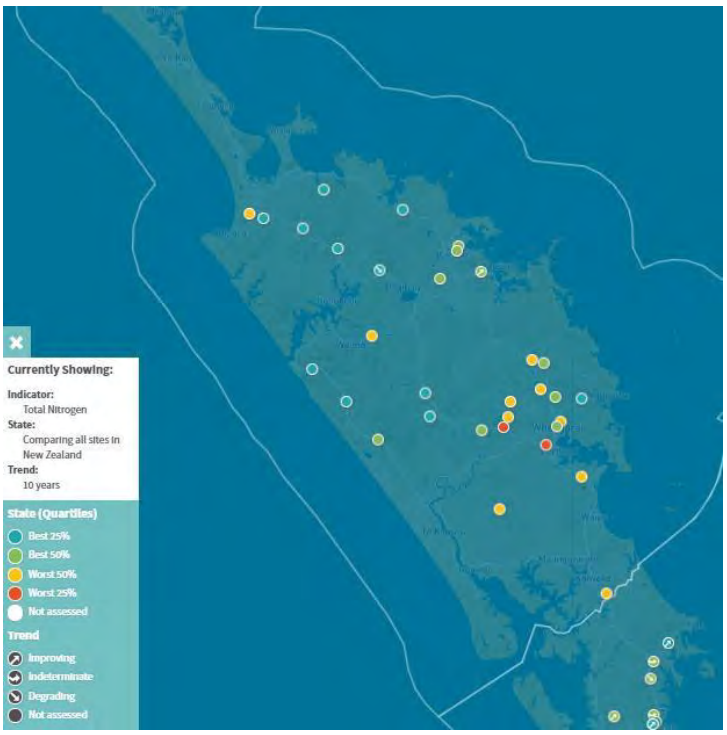


Figure 24: Total Nitrogen state and trends for river water quality in Northland for the last 10 years. (Adapted from LAWA river quality 2021)

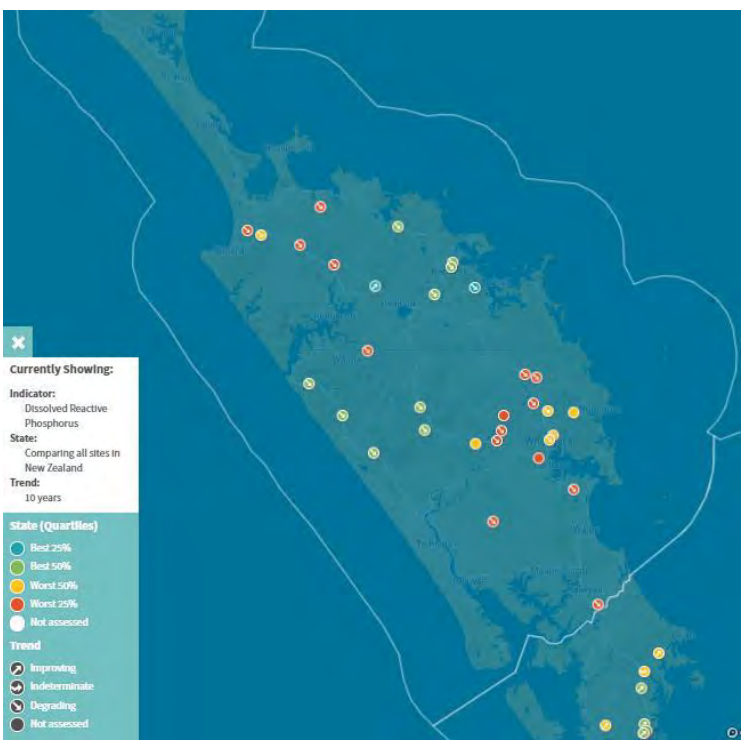


Figure 25: DRP state and trends for river water quality in Northland for the last 10 years. (Adapted from LAWA river quality 2021)

Figure 26: Nitrate Nitrogen state and trends for ground water quality in Northland for the last 10 years. (adapted from LAWA ground water quality 2021)

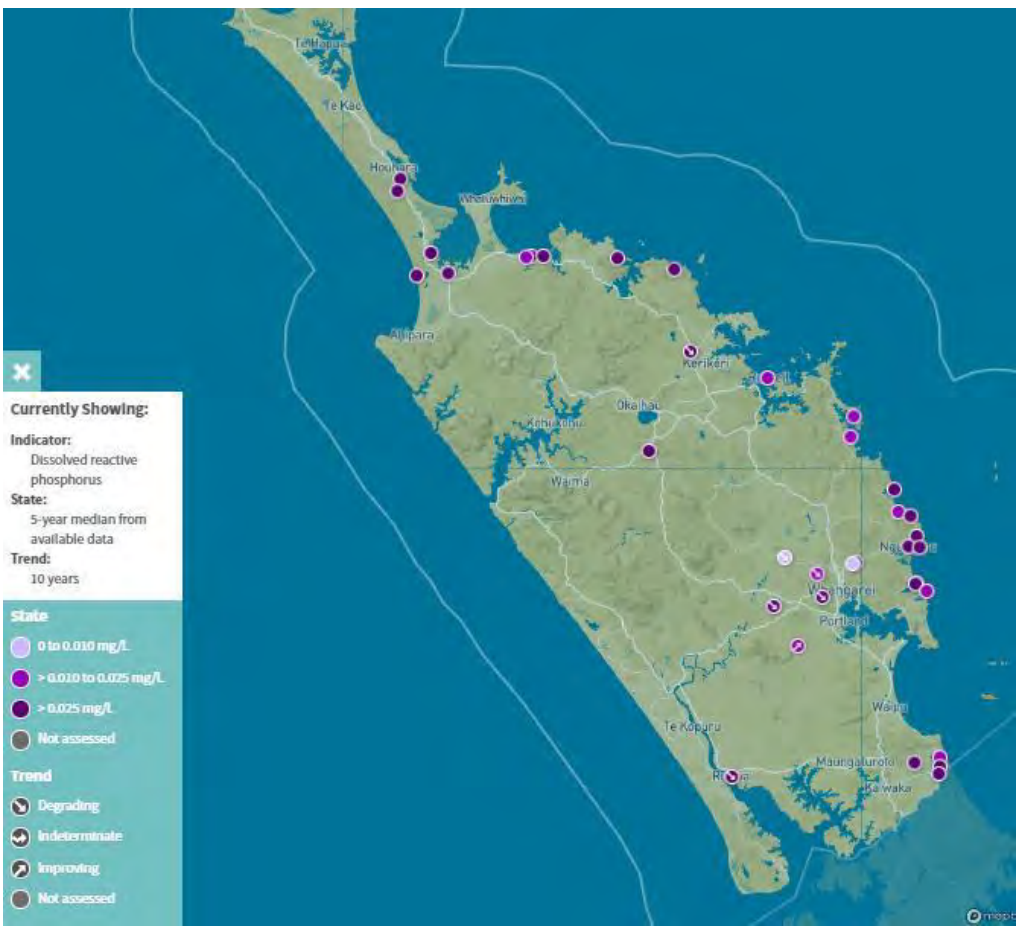


Figure 27: DRP state and trends for ground water quality in Northland for the last 10 years. (adapted from LAWA ground water quality 2021)

Waikato River and ground water quality

(below is a summary of figures 28-31)

The Waikato catchment is extremely variable when it comes to ground and river/stream water quality. Nitrate nitrogen levels in ground water are high in pockets (between Morrisville, Matamata and the Bombay's on the border with Auckland). Overall, a number of sites sit below the 5.65mg/l level and well below the recommend levels for groundwater of 11.3mg/l set by the ministry of health (figure 28). However, the total nitrogen concentrations in river and stream water demonstrate huge variability and irregular trends across the catchment (Figure 30). Over half are in the 50% or worst state in relation to New Zealand levels, with some improving and some worsening. Several the tributaries to the Waikato River are poorerquality along with the East Waikato catchment.

The phosphorus picture is very similar to the nitrogen with the south-east part of the Waikato around Matamata and Taupo having high DRP in ground water. The majority of the Eastern side ofthe Waikato have high DRP in rivers and streams.

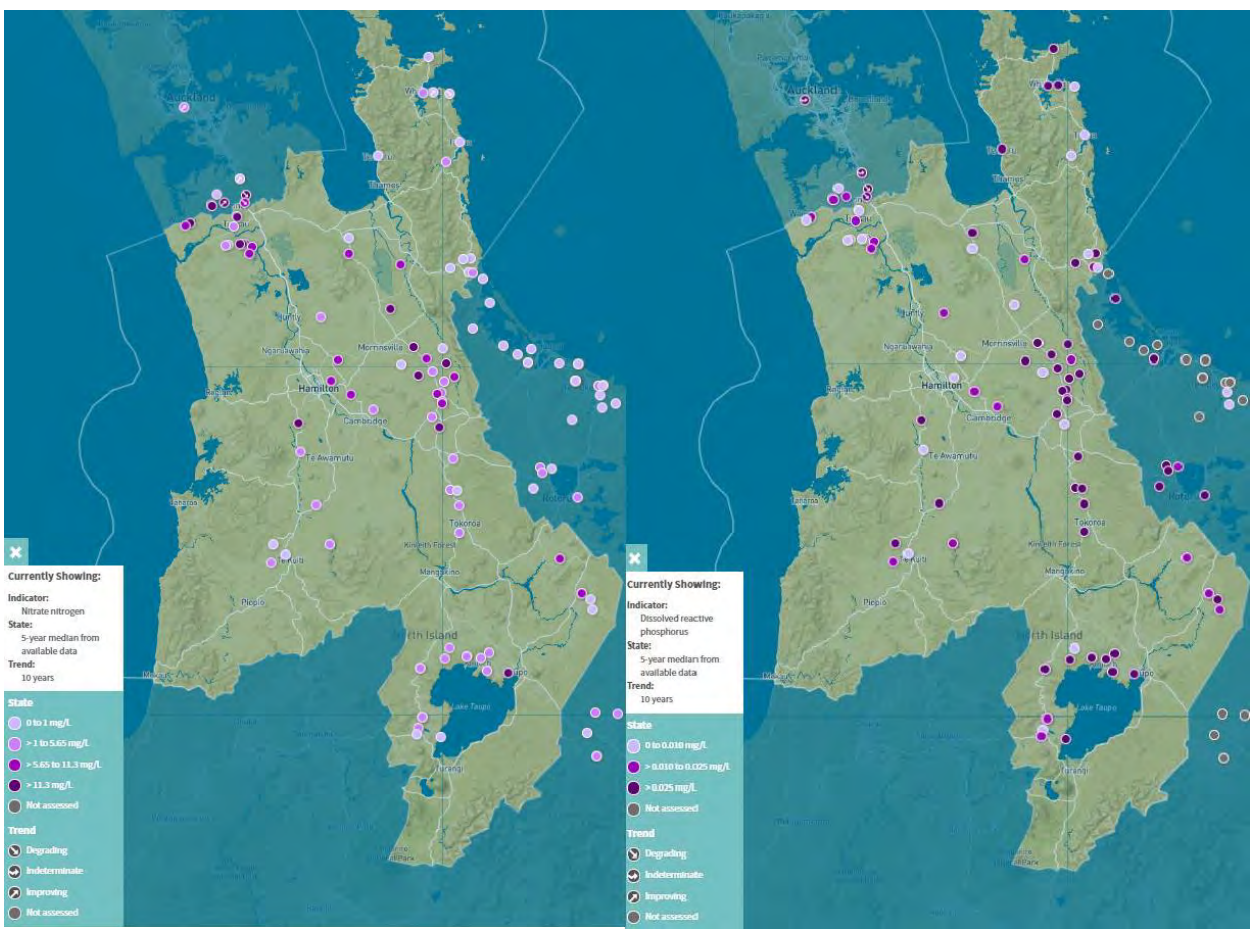


Figure 29: Nitrate Nitrogen state and trends for ground water
quality in Waikato for the last 10 years. (adapted from LAWA ground water quality 2021)

Figure 28: DRP state and trends for ground water quality in Waikato for the last 10 years. (adapted from LAWA ground water quality 2021)

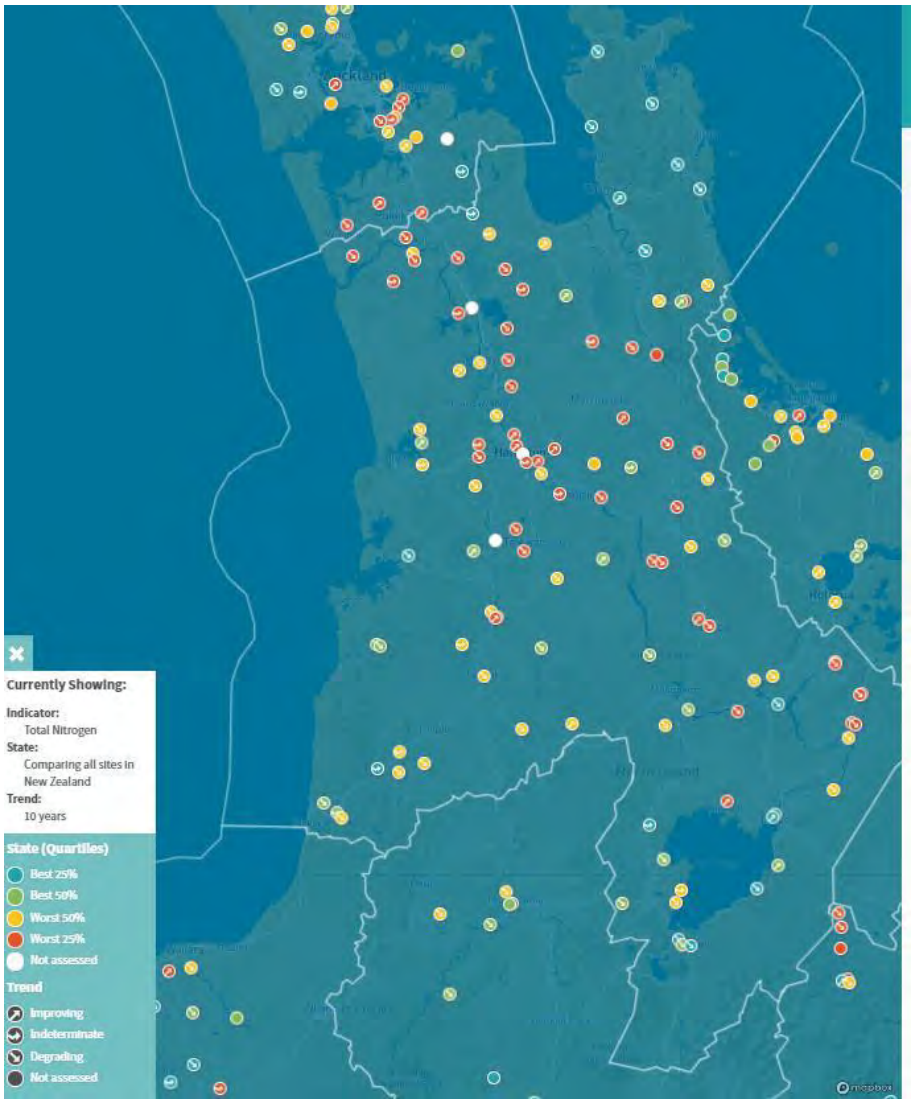


Figure 30: Total Nitrogen state and trends for river water quality in Waikato for the last 10 years. (Adapted from LAWA river quality 2021)

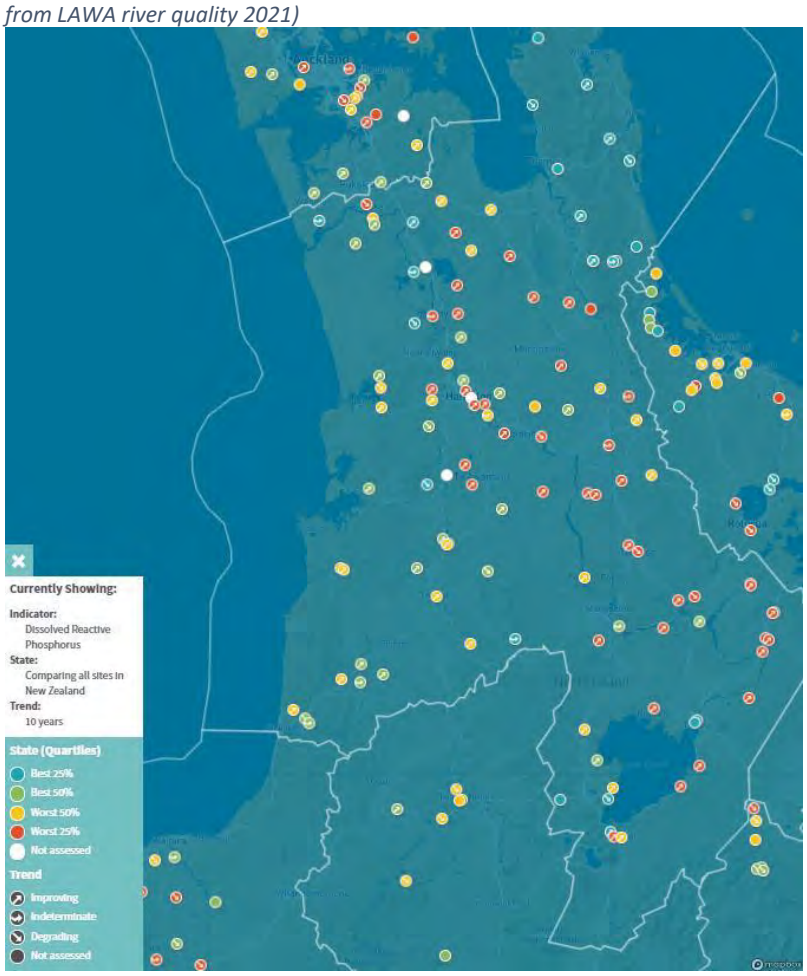


Figure 31: DRP state and trends for river water quality in Waikato for the last 10 years. (Adapted from LAWA river quality 2021)

Method

This project involved four key processes to answer the question **'How have public perceptions changed on the impact of farming on rural freshwater quality, compared with freshwater quality trends on farm.".** Firstly, a literature review was carried out on existing data and studies done over the last decade. The literature review was split into two topics, public perception trends and water quality trends. Perception data is only available on a national scale and was analysed focusing on perceptions and attitude towards freshwater and the role primary industries plays in the management and consequential quality of this freshwater resource. Water quality trends in Northland and Waikato were reviewed to offer two data sets to compare and contrast and help understand what the drivers are behind differences and similarities between results. Throughout the literature review the key messages from each resource and data set was identified and grouped into theme(s).

Following the literature review a thematic analysis was implemented. This qualitative tool analyses all the themes identified and groups the overall key themes. These are thencrossed checked with the data set and the study question to ensure they work to answer the questions and are backed by literature. These key themes are then refined, compared and contrasted with each other to identify complex associations or interactions between the themes.

To further check the key themes refined through the thematic analysis of the literature review, semi structured interviews were conducted with farmers and the general public as part of the Delphi Method. This method is a communication technique that interviews experts, in this case the general public are the experts on public perceptions and farmers are the experts on water quality on farm. The questions were shaped to cover topics, opinions and data that made up the key themes identified through the thematic analysis. This eliminates having to do multiple rounds of interviews to get to a consensus on topics and simply uses the answers of the experts to cross examine the themes Once a representative number of interviews were carried out the data is grouped. This data is analysed for common responses, themes and opinions to understand each group of expert's relative similarities or contrasts to the key themes. It can also be use do forecast where the trends in opinions, perceptions and themes may head in the future. However, this project focused on the here and now and didn't do any forecast except when commenting on where current trends could potentially lead.

The last process was to answer the question 'so what?' in relation to these themes derived from thematic analysis of the literature review and crossed checked through the delphi method. The delphi method checks the themes drawn out from the literature review by interviewing a panel of experts, in this case farmers and the public. Common opinions from the interviews are compared with the themes of the literature review to check the validity of these themes. The 'so what' is essentially the recommendations or call to arms for certain parts of the sector.

Key Themes and Interviews

To answer the question **'How have public perceptions changed on the impact of farming on rural freshwater quality, compared with freshwater quality trends on farm.'** the key themes from the literature review and interviews need to be summarised to identify trends in both perception and water quality. The key themes which will answer the report question are outlined below:

Public Perceptions

Through the literature review of public perception towards the Primary industries two key themes stood out which encompasses most of the sub themes of the literature.

- Central Government decision making, and media coverage have an impact on public perceptions towards Primary Industries

This theme relates to how different sources of information and influences on opinion and can predetermine some people's perceptions. It looks at the complex and self-fulfilling relationship of Government decision making, media coverage, public pressure and public perceptions on the population who have no links to rural New Zealand.

- New Zealanders environmental concern doesn't directly correlate to negative perceptions towards the primary industries, but water quality does.

This theme covers the analysis of the last 10 years of data on peceptions of the primary industries. It looks at perceptions relating both positiveley and negativeley towards the industry and how conerns about issues don't necessarily correalte to negative perceptions on the industry.

Water quality

Through the literature review of water quality trends across NZ and specifically Northland and Waikato two key themes stood out which encompasses most of the sub themes of the literature.

- Land use cover is the key driver behind water and ecosystem health in a catchment. However, lag times can be up to 50years+ for management decisions made on farm now to impact water quality.

Throughout the literature review on water quality it was regularly stated that land use cover is the key driver behind water and ecosystem health. This helps describe water quality trends but lag time between changes made to land use type or management now means catchments can take up to 50 years to notice water quality improves.

- Water quality Results are extremely variable across the Waikato and Northland.

Analysing water quality results for Northland and Waikato focusing on Nitrogen and Phosphorus showed trends and current states are variable and it is hard to draw simple conclusions to where it is heading.

Interviews

Following the literature review and thematic analysis interviews were carried out with the general public and farmers to test the key themes identified. Five people from the general public and five farmers were interviewed and a summary of the main results are as follows.

General Public (two females and three males ranging from 28 – 57 years old)
Question: How do you feel about the primary industries?

Respondent	Very Happy	Happy	Neutral	Unhappy	Very Unhappy
1	✓				
2	✓				
3		✓			
4			✓		
5	✓				

Question: Rate the quality of the water in countryside in your area now and 10 years ago (1 being the worst, 10 being the best)

Respondent	Now	10 years ago,
1	7	5
2	7	6
3	-	–
4	5	5
5	8	6

Question: What percentage of farmers do you believe are reducing their impact on water quality?

Respondent	Percentage of Farmers
1	50- 60
2	60
3	50
4	80
5	90

Question: what are you top 3 biggest environmental concerns right now?

Respondent	1	2	3
1	Recycling	Waste in Oceans	Overfishing
2	Overfishing	Pollution of water	Recycling
3	Overfishing	Waste in Landfill	Too much single use plastic
4	Overfishing	Single use plastics	Car emissions
5	Urban sprawl		

Farmers (five males ranging from 27 – 62 years old)

Question: Top three biggest concern on farm right

now?

Respondent	1	2	3
1	Regulation	Climate change	staffing
2	Climate change	Regulation	Losing control of on farm decisions
3	Profitability	Long term viability	Staffing
4	staffing	regulation	Public perception
5	Regulation	Staffing	Productivity

Thematically analysing the themes from the literature review then Delphi testing them through targeted interviews with farmers and the general public resulted in four key themes. These will be discussed further in the discussion.

Discussion

Form the thematic analysis four key themes were identified which will address the question **'How have public perceptions changed on the impact of farming on rural freshwater quality, compared with freshwater quality trends on farm.'**

Theme 1: Central Government decision making, and media coverage have an impact on public perceptions towards Primary Industries

Since the controversial 'Dirty Dairying' campaign released by Fish and Game in 2002, we have seen a large proportion of the population basing their opinions and perceptions purely on what they hear and see from different media outlets. This in turn mounts public pressure not only on the industry itself, but the Government. Successive Government's then implement policy changes which in turn perpetuate further media coverage further driving public perceptions. This self-fulfilling process (Figure 32) has driven change (for better and worse).

The 'Dirty Dairying' story released in 2002 set a new rhetoric for media when covering environmental shortfalls in the dairy industry. The phrase 'dirty dairying' has been used in excess of 1000 times across various media outlets. It has almost made it a metaphor for New Zealanders who relate it to of poor management and environmental impacts on the farm. This isn't to say the 'Dirty Dairying' campaign was fabricated purely to impact public perception. It was based on a report by NIWA outlining the worsening water quality in lowland catchments with a high proportion of dairying. The intention by Fish and Game was to rally public support to improve waterways; however, the paradigm shift in public perception that followed in New Zealand was staggering. For many in the primary industries it felt a polarising process which fuelled the perceived urban rural divide. Until then dairy farmers felt they 'could walk down Queen Street with their head held high' (*Dairy Farmer, 62*), but since have at times felt vilified in their country built primarily on their industries endeavours.

The resulting policy changes have been many; 2003 Dairying Clean Streams Accord, 2013 Sustainable Dairy: water accord, National Policy statement for Freshwater management 2011, 2014, 2017, 2020, National Environmental Standards 2020 to name a few. With the increased policy implementation from Central and Local government and the corresponding increased media coverage, perceptions have been negatively impacted (Colmar Brunton 2018). More than a third of New Zealanders base their opinions onwater quality on the news or social media, especially of young people, and are more likely influenced to hold a negative perception (Colmar Brunton 2018). Sensationalised media releases with confronting images receive the most exposure, even if they represent a small minority within the industry.

UMR perception data showed the younger demographic and those living in Auckland hold a more negative view of the primary industries. It can be assumed that this age and geographic demographic obtains most of their information from the media or social media.

In discussion on the next theme, I outline how the growing urban rural divide farmers felt since 2002 may not be as widespread as they perceive and acquiring accord may already be underway.

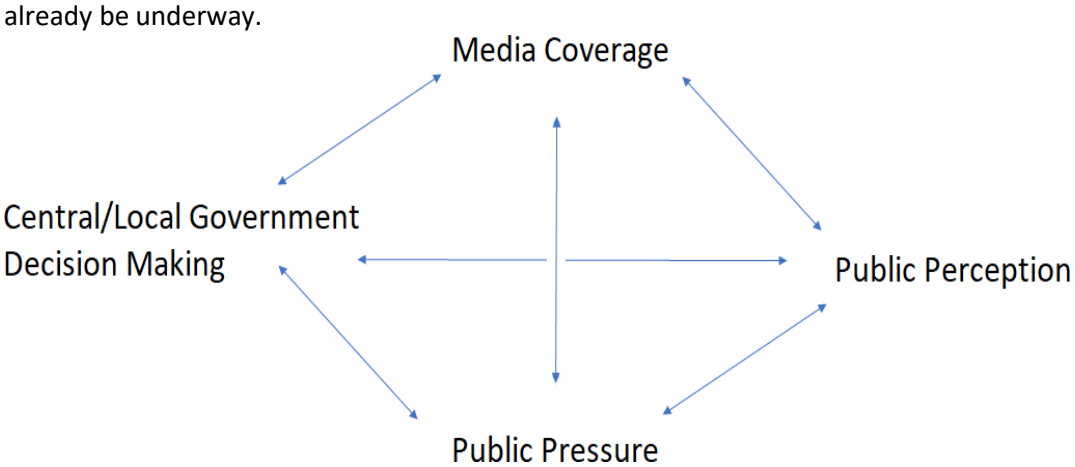


Figure 32: Relationships influencing public perceptions on Primary Industries for people with no connection to the rural industry.

Theme 2: New Zealanders environmental concern doesn't directly correlate to negative perceptions towards the primary industries, but water quality does.

The urban rural divide and social licence to operate are regularly discussed as perception issues in the primary industries.

The majority of perception studies undertaken in the last decade show that on average four out of five New Zealanders rate water quality as their biggest environmental concern(UMR).

This statistic has been used as a headline by many environmental lobbyists and media over the past decade and on the surface looks to give credibility to the growing urban rural divide theory. When you delve deeper into the surveys and break down perceptions towards the drivers behind this the headline, the story reads more positively for the primary sector than people may initially suspect.

Two surveys completed in the last 2 years (Inside Dairy, UMR) found 60% of respondents felt positive about the dairy industry and only approximately 20% negative - with the balance either neutral or unsure. This compares to only 50% feeling positive in 2017. Notably however, the 2008 research figure was 78% positive when asked how to do you fell about farming. This indicates that there is still some way to go to reach the highs of the early 2000's levels of positive perception. It shows that of the 80% of New Zealanders concerned about the environment only 20% felt negatively towards farming.

When looking into why people felt negative about farming, 'water quality' was the leading reason stated. Historically since 2000, when focusing solely on water quality, public perception on the causes of damage to freshwater quality in New Zealand had increasingly blamed farming. The percentage of negativity increasing from 25% (2000) to 59% (2016). The most significant increase occurred between 2000 and 2002 the period when the 'Dirty Dairying' campaign was released.

Figure 33: shows the relationship between public perception of farming and perception on causes of damage to water quality. It reflects positive movement of both indicators, suggesting the measures being undertaken are on track to improve perceptions of the industry.

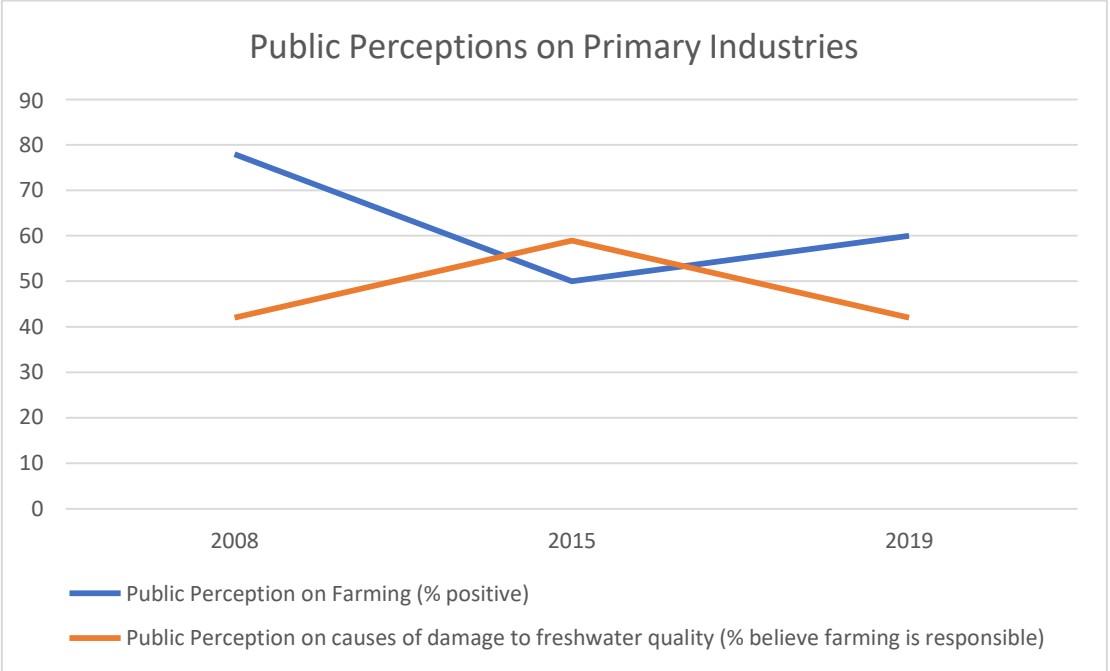


Figure 33: Relationship between perception of farming and perception on causes of damage to freshwater quality. (table made from data from Hughey et al., 2019 and UMR 2017)

Theme 3: Land use cover is the key driver behind water and ecosystem health in a catchment. However, lag times can be up to 50years+ for management decisions made on farm now to impact water quality.

Water quality is an extremely complex issue influenced by both natural and unnatural attributes of a catchment. Overwhelmingly the common message that came through from the literature reviews is the dominant land use in a catchment is a key driver behind water and ecosystem health.

A clear example of this is the expansion of the dairy sector since the early 2000's. Figure 34 highlights this. Dairy cattle numbers increased exponentially as beef cattle numbers dropped up until 2015.

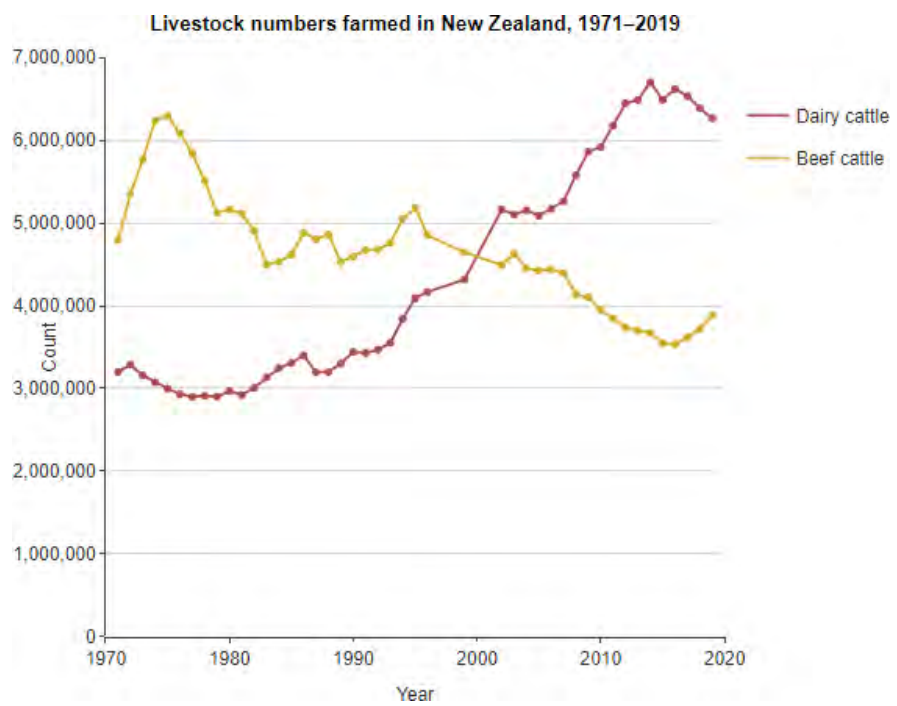


Figure 34: Livestock Numbers farmed in New Zealand (adapted from stats 2021)

Between 1990 and 2019 the national dairy herd increased 82% with Canterbury seeing a 973% increase and southland a 1584% increase (stats 2021).

Figure 35 outlines how this impacted on nutrient loss in these areas and to the receiving freshwater environment. Nitrate-nitrogen leached in Canterbury and Southland increased approximately 120% and 60% respectively (stats 2019) This change of land use has put pressure on the receiving environment and resulted in regulatory change in this catchment. When analysing Northland and Waikato regions there are contrasting results. Northland's leaching reduced during the period 1994 to 2017 showing an improvement in nitrogen water quality. Waikato's leaching levels have been slowing increasing, with their water quality being variable with pockets of poor quality.

As lag time for containments lost into the receiving environment (especially through leaching into groundwater) can be anywhere from 10-50+ years (MFE 2020), some of the current results we are seeing now may still be being impacted by the intensive land use some years ago. Measures being implemented by Farmers may not be noticeable in the river,stream and groundwater quality for another 10-50 years.

Regulatory change in the regions aimed and curbing this nitrogen loss trend have set lofty goals around time frames for implementation. Expectations need to be managed carefully by the primary industries to ensure that the science behind perceived slow progress in results is clearly understood by both the key stakeholders and the general public, to ensure draconian measures are not brought in before the full results of current land management changes are seen.

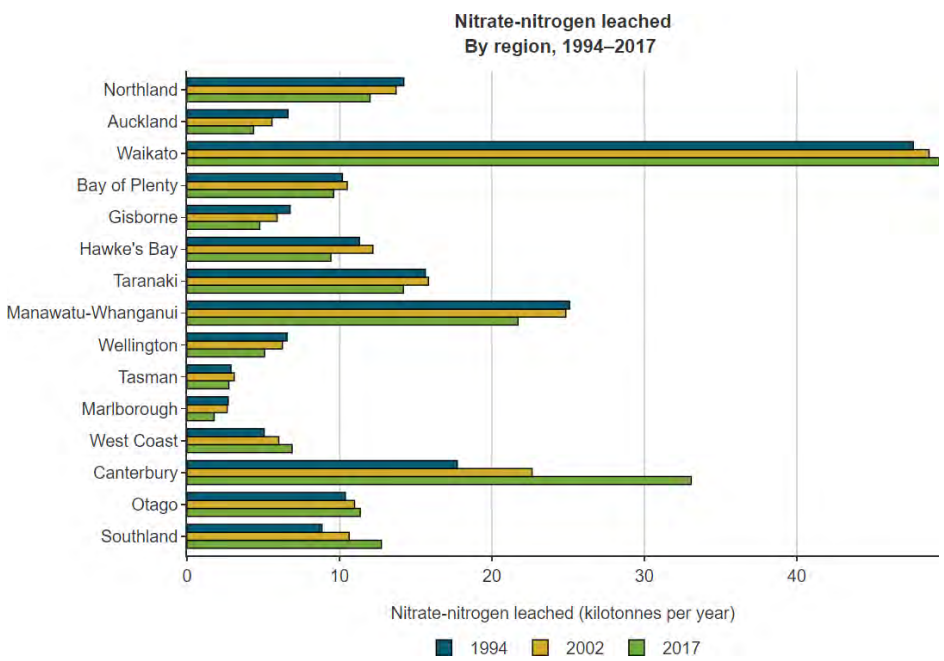


Figure 35: Kilotonnes of Nitrate - nitrogen leached each year. (adapted from Stats NZ 2019 Nitrate leaching From livestock)

Theme 4: Water quality Results are extremely variable across the Waikato and Northland.

As Councils, Industry groups, farmers, growers and the public have come to realise - water quality is a complex issue. It is influenced by a raft of natural and unnatural factors, seasonal variances, and is slow to responded to land management changes.

More data is collected annually from additional sites around the country than ever before. On a national scale, water quality results over the last 10 years have been relatively stable when looking at dissolved reactive phosphorus and ammonia toxicity levels in our rivers and streams.

When studying the two focus regions of Northland and the Waikato the results are variable.

Northland nitrogen levels are low or tracking downwards across most of the region. The exception being a small pocket around the West of Whangarei where there is a number of horticultural and dairy farm systems on free draining volcanic soil. Northland has been un intensifying over the last few years with a number of dairy farms being decommissioned annually. Investment in effluent infrastructure and management changes have also contributed to lower Nitrogen loses.

Phosphorus levels are high in groundwater and across several areas in the catchment. As previously outlined, Northlands steep countryside and eroding soils contribute. Northland has a number of unfenced waterways and wetlands that allows sediment and phosphorus into water ways through overland flow. Due to Northlands climate and geographical features flooding occurs regularly, which can result in large pulses of sediment and phosphorus losses during certain times of the year.

Contrastingly, the Waikato region has a large proportion of its catchment in intensive land use. The resulting nitrate nitrogen leaching is above average in areas and is impacting freshwater. (figure 36) Groundwater quality impact is not as widespread, with most areas well below recommended levels. There are pockets in the far north of the catchment around Mercer and between Matamata and Morrinsville. These areas have a mix of dairy, drystock and horticulture land usage.

Total Nitrogen levels in rivers and streams across the Waikato region are higher and improvement trends are variable, with some improving and some worsening. Waikato farmers have invested heavily in infrastructure and management changes on farm to mitigate environmental impact. It is my personal belief that we are seeing an example of the lag time issue between changes on farm being reflected in results in water ways. As the groundwater levels are good optimistically in 20 years' time river and streamwater quality should be much improved.

Dissolved reactive phosphorus continue to be a real concern across both the ground water and river water quality. It is difficult to determine what is causing this trend as Waikato landowners have completed much of the required infrastructure improvements i.e. fencing waterways. Notably fertility levels are generally high across thecatchment. This suggests an above agronomical required level meaning there is excess phosphorus at risk of being lost to the environment. Another possible influencing factor isthe number of townships having an impact on water quality, an impact that is difficult to quantify.

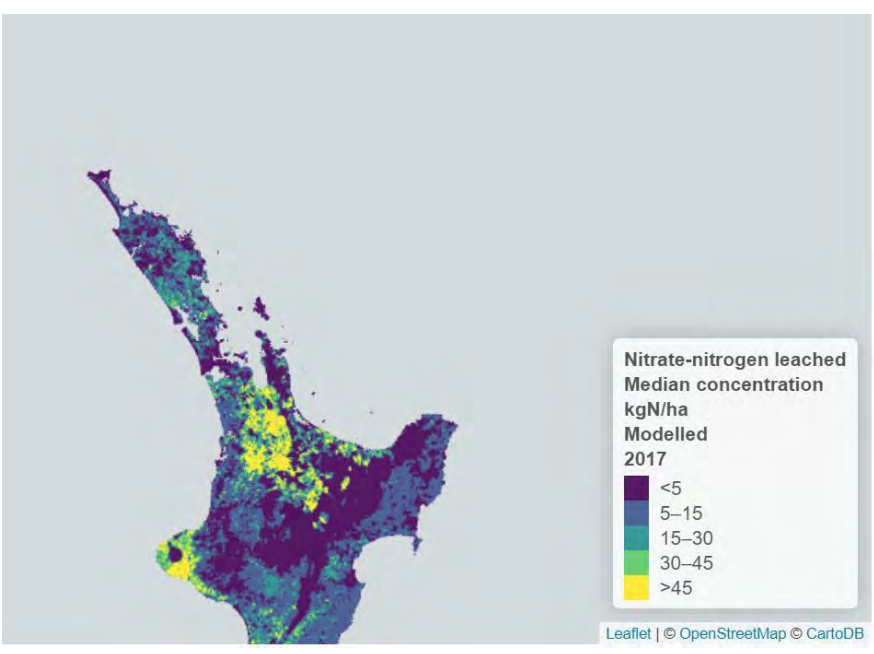


Figure 36: Modelled Median Nitrate-Nitrogen leached in the North Island (adapted from Stats NZ 2019 Nitrate leaching From livestock)

Conclusions

Public perceptions are influenced by a range of factors. The most prominent influencers are now the media, and more recently social media. One third of New Zealanders now gain their information from these sources, using this to form their opinions on issues concerning primary industries. In recent years as a result, this segment of the population is more likely to have a negative perception. A higher percentage of the younger demographic are included in this segment.

New Zealanders are concerned about the environment and in particular freshwater quality. This however does not directly correlate into negative perceptions, towards the Farming Industry. In fact, the results are quite to the contrary. Over two thirds of New Zealand's feel positive towards farming as an industry. There is a lack of understanding of the responsibility taken on by farmers to improve freshwater quality. The Urban Rural divide which at times feels like it is growing, is in fact shrinking. Positive perceptions are increasing towards the previous highs of the early 2000's as the influence of the 'Dirty Dairying' campaign recedes. Infrastructure work and improved farming practices undertaken by farmers, coupled with promotion of this to the wider community by the industry, is paying dividends with more positive perceptions.

This momentum needs to continue and grow as 45% of rivers and streams flow through pastoral catchments and only 1% flows through urban catchments. Urban catchments are the most polluted however are a very small percentage of New Zealand's freshwater resource. Any negative perception from the public is directed towards the impact of farming on water quality. Farmers are still identified as one of the main stakeholders that need to improve it. The lag time between management changes on farms and improvements in water quality means there is an ongoing battle to keep the mounting regulation practical, reasonable and manageable. The environmental story must be told louder to a wider audience and be more transparent and science based than ever before.

Water quality across the Waikato and Northland Catchment is variable and we still see catchments where water quality is heavily impacted from intensive land use. Northland needs to continue to fence and plant to minimise sediment loss and the phosphorus bound to it. Waikato needs to manage its nutrients more efficiently. Applying what is required, when it is required and where it is required. Trends are improving, and the management changes made now will continue to be reflected in these trends.

Farmers need to hold their heads up high and desensitise themselves from the extreme opinion-based stories that get the most airtime in the media. Farmers must appreciate that most stories are either positive or neutral about farming in the media and the small percentage are written with questionable bias.

Finally, how have public perceptions changed on the impact of farming on rural freshwater quality, compared with freshwater quality trends on farm? Public perceptions between 2000-2017 became increasingly negative towards farming as an industry. However, in the last three years perception towards farming as an industry and its effect on the environment have improved and are on track to return to pre 2000's levels if this trend continues.
Water quality has plateaued over the last decade with national phosphorus and nitrogen quality trends neither improving nor worsening. There is a variance in water quality and trends across the upper north Island. Overall more sites are now seeing improving water quality then the number worsening. The slight similarities between perception trends over the last 10-20 years and water quality suggests there is a weak relationship between the two. However other external factors (media, age, geographic location) play a part in the publics perception towards the primary industry.

Recommendations

- **More farmer led community catchment groups**
  Farmers need to continue working collectively; forming more catchments groups which will help improve water quality but also help keep farmers connected. They need to engage with the wider community and share their stories and the process. These groups are the most effective strategy to improve the understanding of the public on environmental impact.

- **Unified industry lobbying**
  Industry Bodies need to unite as one to continue supporting the Industry by lobbying with one voice on their behalf to Central Government to ensure regulation is kept at a practical level.

- **Louder environmental story**
  Industry groups, processors and farmers need to continue telling their environmental story by having more open days and promoting their efforts far and wide. Social media means the sector is no longer hamstrung by the pre internet media of TV radio and newspapers and can now tell their own story.

- **Northlanders target sediment**
  Northland farmers and growers need to continue focusing on minimising contaminant loss through over land flow by fencing and planting streams, wetland and rivers in lowland catchments. Highly erodible land on sloping areasneeds to be managed carefully and retired if possible.

- **Nutrient efficiency in Waikato**
  Waikato Farmers need to focus on nutrient management. Precision agriculture will be critical going forward to ensure all nutrients applied are maximised. Also, certain catchments where water quality is low will need to band together and come up with catchment management plans with all the stakeholders involved to ensure the health of the catchments going forward.

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Appendices

Questionnaire on Public perceptions for farmers

1. What is the farming operation you are involved in?
2. How long have you been farming for?
3. Have you always been in the primary industries? If not what were you doing prior?
4. What does ‘good water quality’ mean to you?
5. How would you describe environmental best practice?
6. What ‘environmental practices’ have you undertaken in the past or are currently doing on farm?
7. What was your motivation behind doing these?
8. Did you have any financial support to undertake these?
9. What practices would you like to implement in the future?
10. Are there things limiting the timeframe on implementing these practices?
11. Do you have a farm environment plan or nutrient management plan? How did you find this process, and do you regularly refer to it and update it?
12. Have you sought or received any advice from consultants or anyone else in the industry to assist you on implementing good management practices?
13. What would you consider to be the main driving forces behind farmers having to improve the environmental impact of their farming systems?
14. What do you think is a realistic time frame for most farmers to adopt environmental practices?
15. What balance do you think there should be between a rules approach (from Central and/or Local Government) and a voluntary framework?
16. Do you think any regulatory approach should be led by Central Government or Local Government? Or by an industry body?
17. What’s your top three biggest concerns on farm right now?
18. How do you feel public perceptions towards farming have changed in the last decade?
19. Do you see changes in both public and farmers perceptions towards environmental sustainability?
20. Do you have any other comments to add regarding farming, the environment or Public perceptions ?

Questionnaire on Public perceptions for general public

1. Do you have any connection to the rural/farming sector?

   1.(b) If so how?

2. How do you feel about farming as a sector, just in general ?

   - Very happy, happy, Neutral, unhappy, Very unhappy.

   2.(b) Why

3. What does ‘good freshwater water quality’ mean to you?
4. How do you rate the quality of freshwater in the countryside (not in towns)? 1 being the worst and 10 the best. Why did you rate it that number?
5. If I asked you to rate the quality of freshwater in the countryside 10 years ago would you answer the same?
6. Do you feel farmers are actively reducing their impact on freshwater and the environment?
7. What could farmers be doing more of to protect the environment?
8. What could they be doing less of?
9. What is your top three biggest environmental concerns in New Zealand?
10. What does sustainable farming look like to you?
11. If you were in government what regulation would you bring in to improve the environmental impact of farming?
12. How important do you believe farming is for New Zealand’s economy? Why do you believe that?
13. Do you have any other comments about Farming impact on in New Zealand?