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FARMER PREFERENCES AND DRIVERS OF DECISION-MAKING RELATED TO WATER QUALITY ACTIONS AND LAND USE CHANGE IN TUKITUKI

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Introduction

Water quality preservation and improvement in New Zealand is important for ecological integrity, economic sustainability and environmental resilience. The agricultural sector has been subject to improved management practices and regulations for some time, however little research into farmer decision-making and preferences for water quality actions (mitigations) has been undertaken.

Understanding the preferences and decision-making factors of farmers concerning water quality initiatives is critical in driving effective behavioural change for enhanced water quality outcomes. As part of the Our Land and Water National Science Challenge, Perrin Ag Consultants Limited (Perrin Ag) was engaged in a comprehensive study across three distinct catchments, including the Tukituki catchment in the Hawkes Bay. The research seeks to estimate (through a complex GIS model) the scope of land practice and land use change over a 20-year time horizon that might be required to achieve the required water quality outcomes for those catchments.

The research uses social science methods to assess and account for farmer preferences for adopting certain mitigations or land use changes on their farms. The outcomes will inform the order of mitigation costs curves rather than the modelling solely reflecting the assumed financial drivers.

While the economics of water quality actions are an important part of farmer preferences and decision-making for whole farm systems, environmental benefit and personal preference are also primary motivations for farmers implementing water quality measures.

Method of research

A sound ethics process was developed by the research team prior to the project initiation. This ethics process was followed meticulously to ensure integrity of the research results. The farmer survey involved a two-step process. The first step was a phone interview. Interested interviewees across the three catchments received an initial email with an information sheet and farmer consent form. A unique identifier and a range of interview time options were provided to the farmer to confirm a time for interviewing. All phone participants were also invited to take part in the online survey, the second step of the research process. All participants received a koha of $150 for participating in the phone interview. Participants willing to partake in the follow up online survey received an additional $100 koha on receipt of the submitted survey.

The phone interview and online survey sought to gain insights into farmer preferences towards adopting specific actions or altering land use practices on their farms, all with the aim of advancing water quality outcomes within their catchment. Participants were presented with a series of questions relating to current actions, their willingness to adopt future actions that affect water quality and their willingness to adopt or expand alternative land uses to current farming operations in future. Farmers were asked whether there are perceived or known barriers and/or challenges with land use change for farmers in their catchment, and what they consider the biggest drivers of land use change in the catchment will be in future.

A master water quality mitigation library was compiled from literature. A total of 33 possible mitigation actions (e.g., reduced stocking rate, partial land retirement and effluent system changes) were identified, though not all were applicable to every typology (land use) across all the catchment. These comprised five farm system ("FS") mitigations, nineteen general ("G") mitigations, seven edge of field mitigation ("EOF") and two [partial] land use change ("LUC") mitigations.

The online survey was conducted via SurveyMonkey® and the data extracted into a MS Excel format to be compatible with the phone interview data recorded from each respondent. The survey data sought to complement and expand on the data collected from the phone interview. Raw data from the mixed-methods research was analysed through the process of triangulation to integrative the quantitative and qualitative data (Olsen et al., 2004; Webb, 2009). Key themes were identified and ranked based on occurrence.

The data collected in the farmer survey was used to inform an alternative preference to the application of mitigations than what a least-cost or cost-efficacy ordering approach would suggest.

Drivers of mitigation adoption

Of the 46 farmers in the Tukituki catchment who took part in the phone interview and the 37 who also completed the online survey, drivers for water quality action were broadly categorised into environmental benefit, regulatory compliance, capital/funding, diversification of income or personal preference. These motivators were not considered in isolation, and in most cases, it was a combination of environmental benefit, regulatory compliance and personal preference that led to the implementation and/or preference of water quality actions.

On most farms, actions have been taken that farmers did not think of as actions to improve water quality. These actions may have occurred for another reason but they do also have a water quality benefit. The phone interview was designed to assess farmers' understanding of water quality actions. A key finding from the interview process was a general gap in the understanding of the breadth of actions that contribute to water quality improvements. Generally, the surveyed farmers identified fencing and riparian planting as the only tangible actions that contribute to this. It became clear in the online survey that more actions were being undertaken that contribute to water quality improvement in the catchment than the farmers were aware of. The following implementation graphs indicate farmer preferences toward the most 'applicable' water quality actions, however it should be noted that these are only some of the 33 potential actions used in the research.

Farmers that contributed to the online survey were predominantly sheep and beef breeding and finishing (24) and arable (13) farmers. Sheep and beef finishing farms only were excluded from this analysis as it was assumed that a finishing farm system was significantly different to a breeding and finishing farm. Across the sheep and beef breeding farmers (many of whom had some crops), typically 50% or more have already implemented a range of water quality actions as indicated in Figure 1 below. Of the farmers that hadn't implemented some of these water quality actions yet, most indicated they were willing to implement or already planning to implement them.

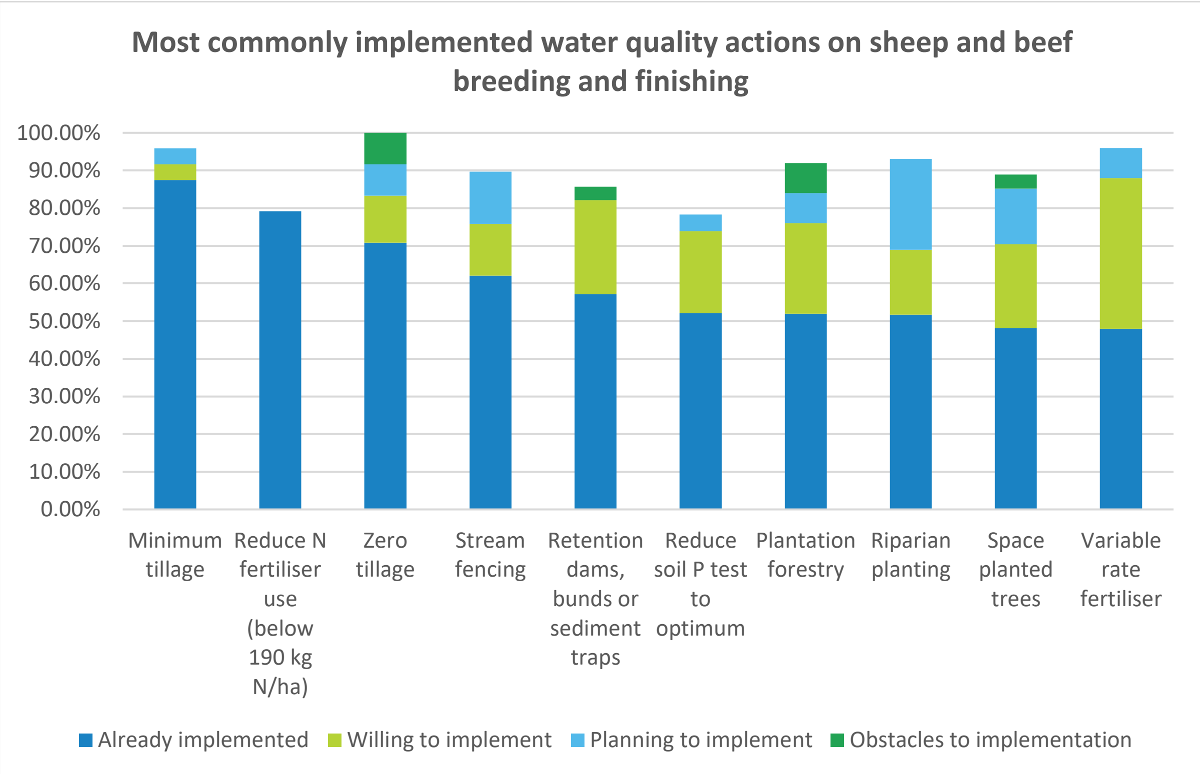

Figure 1: Farmer implementation and willingness for implementation of water quality actions on sheep and beef breeding and finishing land in the Tukituki catchment

While we often assess typical systems and associated costs and benefits for mitigations in farm systems modelling, it is important to consider the farmers' perspective, as they may have more accurate cost estimates for their specific situation that may be higher than standardised calculations. Additionally, farmers may perceive costs as barriers without having conducted a thorough assessment of their actual impact, including any potential positive effects.

Across the arable farmers, typically 30% had already implemented a range of water quality actions. A number of farmers indicated their willingness or intention to adopt actions where they perhaps had not yet, though a higher number of obstacles were also indicated.

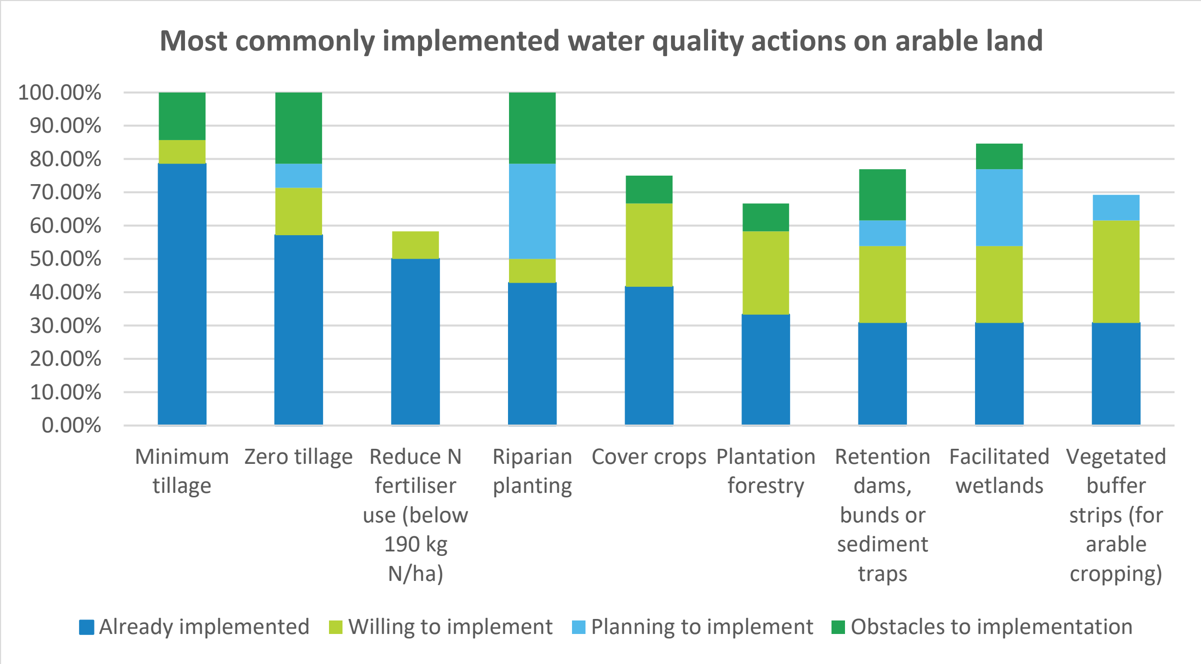

Figure 2: Farmer implementation and willingness for implementation of water quality actions on arable land in the Tukituki catchment

Obstacles to implementing water quality actions were grouped across all land uses and categorised based on qualitative responses to the online survey question.

Across all the arable farms, it was clear that there are some more pertinent obstacles to implementing water quality actions, with cost and farm being the largest obstacle according to 77% of respondents.

Figure 3 below highlights where obstacle categories may have been common across water quality action groups of FS, G, EOF and LUC. Two key barriers for system change actions across the catchment appears to be farm system suitability and financial barriers. Farmers are likely to be hesitant to adopt new practices if they require significant upfront investment where the return is dependent on other variables (e.g., a barn may be beneficial if the milk price is high but drop of at lower milk prices etc.).

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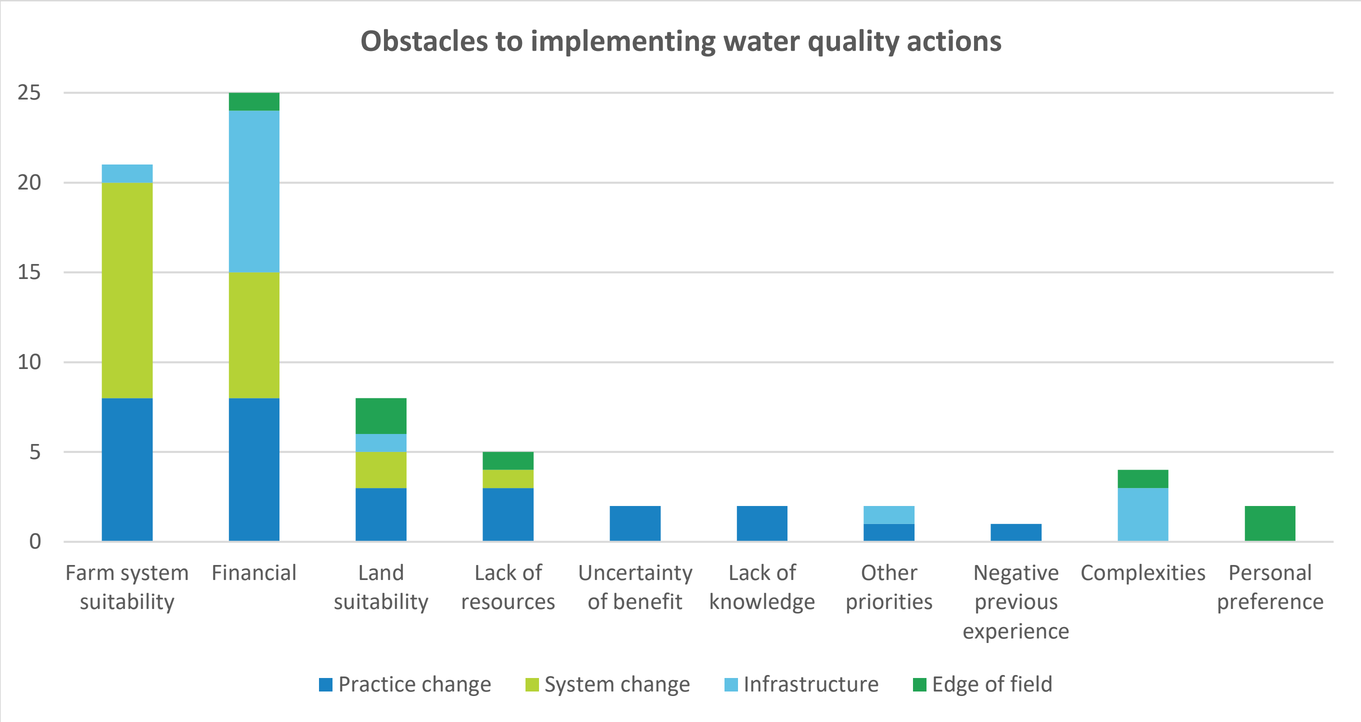

Figure 3: Obstacles to implementing water quality actions in the Tukituki catchment

Economic efficiency rankings

There are multiple water quality actions that can reduce contaminants, however, they typically have an associated cost. In this research contaminant reduction across typologies considered nitrogen, phosphorus, sediment and E. coli. In the Tukituki catchment, nitrogen was identified as the priority contaminant and phosphorus as the secondary contaminant. Economic efficiency rankings for the suite of applicable mitigations were based on these two contaminants.

On sheep and beef finishing breeding and finishing farms in the Tukituki catchment, of the water quality actions that are the most economically efficient, farmers generally have a higher preference for adopting these actions (Figure 4). Most arable farmers expressed that their decisions regarding water quality actions are primarily influenced by the economic impact on the overall farm system. It appears that farmers in the Tukituki have tended to prioritise the implementation of more affordable actions as initial measures.

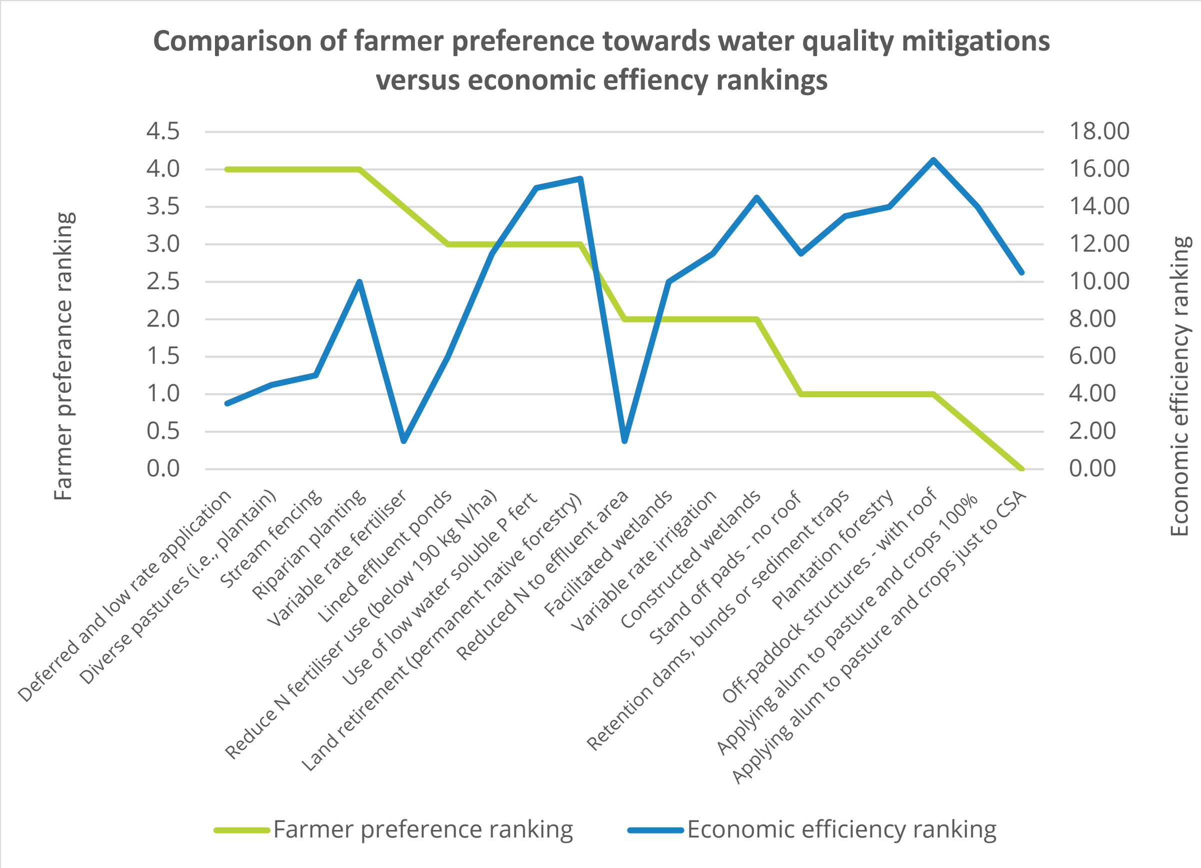

Figure 4: Comparison of farmer preference toward water quality mitigations versus economic efficiency rankings on sheep and beef breeding and finishing land uses in the Tukituki catchment

To understand the water quality actions that have been implemented on farmers' own accord, the reduction of nitrogen fertiliser (below 190 kg N/ha) was omitted from the analysis as this is a compliance-related action that farmers in the catchment are required to do. Figure 5 shows there appears to be a subsequent relationship between the cost per kg of nitrogen mitigated and the existing implementation of applicable water quality actions in the catchment. Minimum tillage has also been adopted extensively by arable farmers (79%).

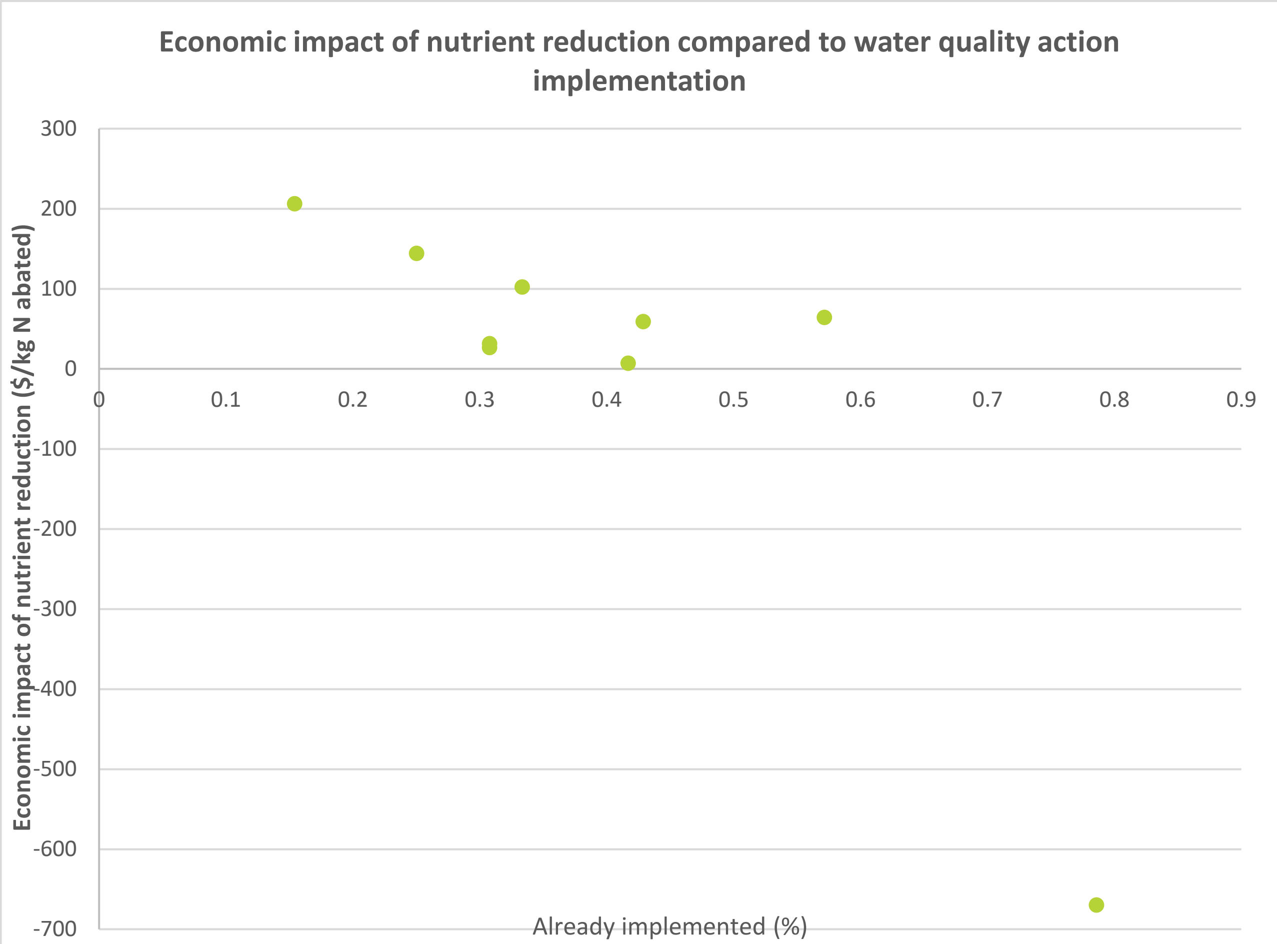

Figure 5: Economic impact of nutrient reduction compared to water quality action implementation based on farmers surveyed in the Tukituki catchment

Land use change

Perceived drivers and willingness to land use change

Farmers provided insights into the drivers of land use change and partial land use change, with the largest contributor to decision making being land use suitability. Farmers reported that they would be willing to adopt or extend alternative land uses to their primary land use, but only if the land use suitability was appropriate. Farmers were questioned on a scale of 1-7 their potential willingness or interest to adopt or expand different land uses within their existing farming operation at some stage in the future. Where participants provided a value of 3 or less (1 being extremely unwilling and 7 being extremely willing) participants were asked to provide the main reasons for these rankings and these were categorised based on response. Table 1 below shows the average score and related ranking that sheep and beef breeding and finishing farmers indicated their preferences were toward alternative land uses.

Table 1: Sheep and beef breeding and finishing farmers willingness to change to alternative land uses

Land use change to	Average score	Ranking
Indigenous forest	4.58	1
Exotic forest	4.12	2
Drystock - finishing (incl. velveting)	3.44	3
Horticulture – field	2.73	4
Horticulture - orchard	2.65	5
Mixed arable	2.65	5
Arable	2.17	6
Viticulture	2.00	7
Dairy - dryland	1.35	8
Dairy – irrigated	1.31	9

Sheep and beef breeding and finishing farmers in the Tukituki catchment scored indigenous forest the highest, indicating the most willingness to undertake some form of land use change to this land use. The next likely land use that farmers indicated was exotic forest with dairy dryland and irrigated being ranked the lowest.

Across the catchment, it was apparent that many farmers perceived that the major drivers of land use change over the next 20 years would be economic returns, regulations, as well as market dynamics (Figure 6). Changes in consumer preference, and global market trends were also likely to influence land use change in the catchment in future. Interestingly, climate change and environmental degradation were not identified as significant drivers of land use change, but rather their associated regulatory functions to reduce the environmental impact of agricultural practices.

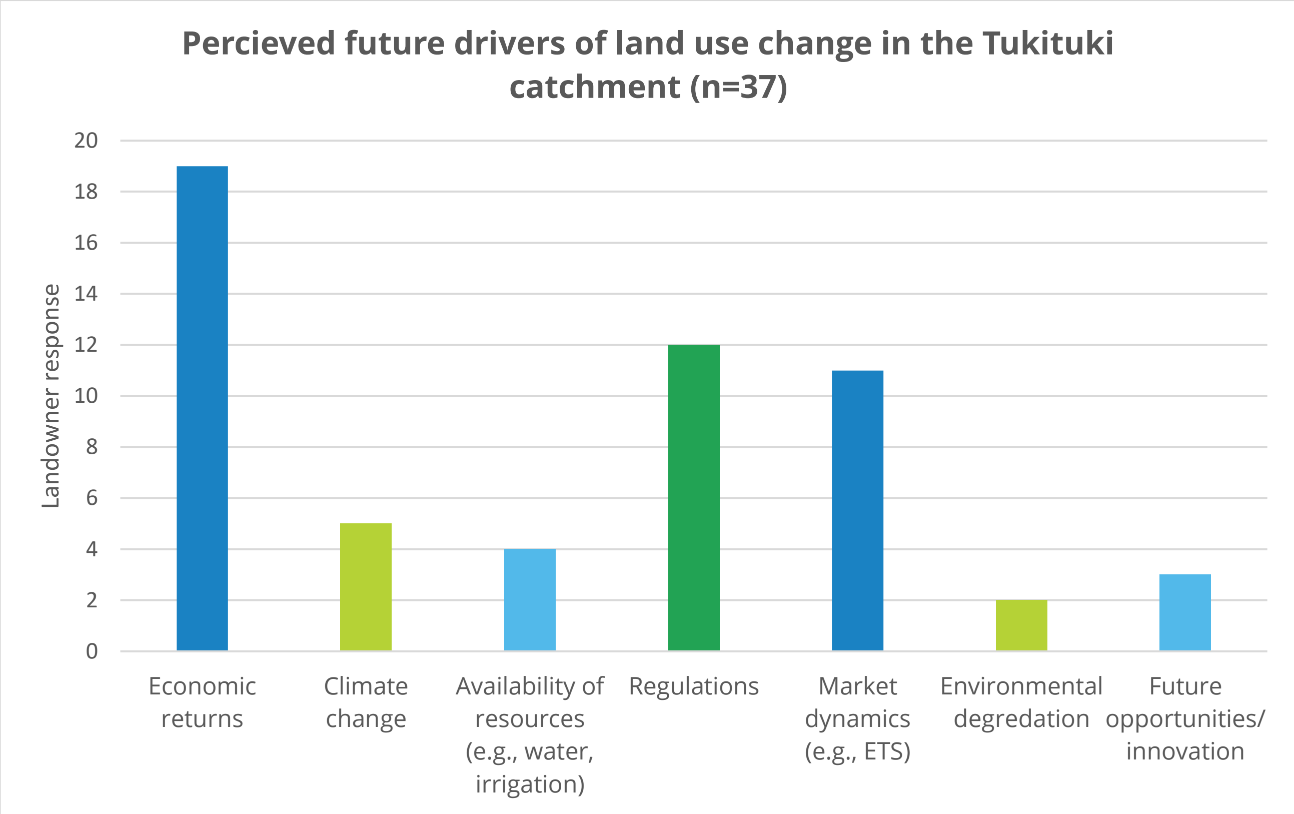

Figure 6: Perceived future drivers of land use change in the Tukituki catchment

Perceived future barriers to land use change

Participants provided insights into their willingness to change land use to a range of alternatives from horticulture to arable or native forestry. When questioned about the biggest barriers to partial land use change are, a three-pronged reasoning was evident; compliance (32% respondents), water availability (28% respondents) and cost (23% respondents) were identified as the foremost barriers. Although farmers who participated exhibited a generally favourable attitude towards transitioning land uses, they underscored challenges related to the cost of establishment, regulatory compliance and environmental planning, compounded by limited access to water resources which constrained their capacity to change to some forms of alternative land use.

"[We are] unwilling to change land use or adopt new water quality mitigation measures until there is more certainty from regional council and central government around regulation."

"There is not enough water, need more allocation to move into arable horticulture, Ruataniwha dam would have to go ahead before we see land use change on the lower country. Profit driven for what we can actually afford to do going forward, but there are constraints on why we can't go down the line of intensification into those arable/horticulture land uses."

Decision-makers should consider the barriers that farmers have identified for partial land use change. Greater insight into these barriers will support policy development and resource allocation in future to promote improved water quality across the catchment.

How the data is being used?

The research being conducted will contribute toward a better understanding of how farmers consider mitigations on farm as well as land use change. The farmer interview and survey data is also being used to inform the abatements curves developed for each typology in the Tukituki catchment. An optimization model utilising these abatement curves will subsequently be run for the catchment to understand the potential land management and land use change requirements to achieve water quality outcomes with the maximum profit possible. The current mix of land uses and practices will be compared to the model predictions. Case studies with 5-6 farmers in the Tukituki catchment will then be undertaken to interrogate the specific results for their farm and investigate whether there is a viable business case for the proposed management practice and land use change to occur. The optimisation model findings and consequent research paper will be publically available in the near future from the Our Land and Water National Science Challenge website.

Conclusions

Farmer interviews and survey results indicate that farmers and growers in the Tukituki have demonstrated considerable commitment to enhancing water quality, with significant endeavours in riparian planting and waterway fencing. They are generally open to change regarding ongoing mitigations and land use change, however there are some barriers that farmers indicated require a viable solution before some water quality actions are adopted. The myriad of factors influencing farmer decision-making became evident, notably the balance of environmental benefit and personal preference as primary motivators for implementing water quality measures. Water availability and economic considerations were identified as important drivers or enablers of land use change, which given the potential need for land use change in the Tukituki catchment over the next two decades highlights the need to factor these into policy direction.

"[We] need a large-scale approach where everyone chips in to an overall pattern. In a community if there is plenty of talking about things, we could all benefit and possibly this would be an issue of the past. For example, if one neighbour did one thing and another did something else and they were totally different and didn't complement each other."

There is also a need to focus on a joined-up approach to water quality actions across the catchment. Farmers are practical and are more likely to adopt a water quality action that has been tried and tested. Consideration should be given to the percieved barriers to implementation for farmers as this will help inform water quality mitigation selection, adoption and policy development.